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A Vote for Unity

THE American Society of Civil Engineers will move its headquarters to the Engineering Societies Building; all the great national engineering societies will soon be under one roof. This is the significant announcement made this week at the annual convention of the American Society of Civil Engineers. By a vote of 2500 to 390 the members expressed their desire to move. When all the circumstances are taken into consideration—the sacrifice of its independent home and the turning of the two to one adverse majority of twelve years ago into a six to one favorable vote now—it is apparent that some very deep feeling stirred the members. True it is that some conditions have changed; the joint housing is no longer an experiment; the disparity in the relative standing of the societies has disappeared; and the financial strength of the Thirty-ninth Street organization is undoubted. But these changed conditions alone could not have brought such a reversal of feeling among the members of the American Society of Civil Engineers. Some deeper motive was stirring and that motive was the desire for professional unity. The profession, generally, feels that on the big questions which affect the welfare of the engineer or that bear on civic problems of an engineering character all engineers must act together. There must not be civil and electrical and mechanical and mining engineers, but just engineers. And this unity of action, those who voted favorably believe, will be furthered by physical proximity. The separate societies will continue separate. Their identity will not be impaired, but where joint action is needed, there will be joint action. The vote just counted is a clear direction by the civil engineers to the officers of the society to bear well their part whenever co-operation will properly serve the ends of the profession and of the public. The future is rich in promises of great results from the momentous step that has been taken.

The Subsurface Hydrant

IN his report on city planning and its relation to waterworks design, presented recently at the convention of the American Waterworks Association in New York City, E. P. Goodrich gave the results of a questionnaire on the subject of underground water hydrants. Reduced to its simplest terms the case of the subsurface hydrant may be stated thus: It is regarded with distrust by those who have not used it and is in high favor with those who have. This summary of opinion is highly significant and it prompts the question, "Is there not a wider field of usefulness for the hydrant located underground?" Its chief disadvantage, as compared with the post hydrant, is that it is difficult to locate during winter, when the ground is covered with snow and ice. This objection, however, would not apply under conditions which exist in many of the Pacific Coast and Southern cities. As Allen Hazen pointed out in discussing the report, there is a field for study here by American manufacturers. No United States firm, he said, is manufacturing a subsurface hydrant at the present time.

Pay for Guardsmen

IN announcing its decision to continue the payment of regular salaries to its employees who are now members of the National Guard or Naval Reserve and who have been called into the service of the United States, the McGraw Publishing Company, Inc., is merely embodying in concrete form one feature of the policy of national defense which has been advocated so strongly and so frequently in the columns of the Engineering Record. The ruling, which takes effect this week, applies not only to the Engineering Record's editorial and business staffs, but to all of the papers issued by the McGraw Publishing Company—*Electrical World, Electric Railway Journal, Metallurgical and Chemical Engineering*, and the new paper, *Electrical Merchandising*, which will make its initial appearance next week. Members of this organization, affected by this order, will, insofar as possible, be retained on the payroll and returned to the positions they now occupy when the need for their military services has ceased. The company has preached the military obligations of citizenship. It is now prepared to practise them by placing no restrictions upon members of its staff who wish to serve their country.

State and Federal Control

EVIDENCE of the growing realization of the folly of our present dual system of regulating interstate railroads is shown in the recent declarations of the platforms of two of the political parties. One of these declares as follows: "The entire transportation system of the country has become essentially national. We therefore favor such action by legislation—or, if necessary, through an amendment to the Constitution of the United States—as will result in placing it under exclusive federal control." Apparently the time is approaching when the wasteful necessity for the railroads of meeting the various requirements of state legislatures and tribunals, the discrimination forced by certain states, the square collisions between state and national authority, will end, and one public power will have the sole right to define good and bad, safe and dangerous, commendable and criminal railroad practice. Some of the politicians of the Middle West and elsewhere can be expected to fight hard for their football, but there is much encouragement in the declaration just quoted.

Compulsory Arbitration or a Strike?

AS WAS to be expected, little came of the recent conference in New York between the railroad managers and the representatives of the four brotherhoods. The latter refused to consider any line of wage revision that might reduce the present compensation of any trainman—in fact, adopted such an uncompromising attitude that there was slight chance for the conference to accomplish anything. Now the matter is in the hands of the employees, who are expected to decide by a vote whether or not there is to be a general strike of conductors, trainmen, enginemen and firemen—such a strike as the country never saw. It is time for the public to act. It ought not to be possible for any group of men, even so large a group as the membership of the four brotherhoods, to paralyze industry and force the railroads to pay $100,000,000 additional in wages, absolutely irrespective of whether they can earn it. Congress should act and compel the brotherhoods to submit the whole question, as the railroads have offered to do, to arbitration either by the Interstate Commerce Commission or under the Newlands Act, the former being preferable. Steps to make such arbitration automatic in the future could follow. The thing to be done now is to avert a strike—not by the usual method of surrender by the railroads, but by a fair trial of the case.

Federal Department of Public Works

MR. HERSCHEL'S presidential address before the American Society of Civil Engineers this week, printed in part on page 9 of this issue, makes a strong and convincing appeal for the formation of a federal department of public works. The countries of Continental Europe have demonstrated the wisdom of such a department. Their engineers, in consequence, occupy a very important place in governmental affairs. Despite all the arguments that can be advanced in favor of such a department and the commissioning of engineers, as army officers are commissioned, no results can be expected until strong pressure is brought to bear on Congress. When the engineers of the country can present a united front on the

question, 30,000 strong in the national body, backed up by all the strength of local societies from coast to coast, which are in a position to impress their views individually on their congressmen and senators, results can be expected; but not before. Without a doubt the standing of the profession as a whole would be enhanced in this country if all the engineering work of the government were placed under such a department. The question is a good one for the consideration of the joint conference committee of the national societies.

The Work of the 22d Engineers at Camp Whitman

ENGINEERS who have been attending the many military lecture courses held in the principal cities throughout the country this winter have an opportunity of learning, from the leading article in this week's issue, how the theories which they have been studying have been carried out in actual practice. When President Wilson sounded his call for the mobilization of all National Guard forces the 22d Corps of Engineers of New York was rushed to Camp Whitman to prepare the 825-acre state-owned tract for the incoming troops of the division. A reading of Mr. Tomlin's article will indicate that the work preparatory to the assemblage of a large military force is, essentially, an engineering job.

There is, first of all, the transportation problem, involving, in the case of the little railway station at Green Haven, N. Y., the construction of extra sidings and unloading platforms. At the camp proper the big problem was the water supply. The alternatives were a ground water supply from deep wells or a surface water supply from Fishkill Creek, the latter involving a long pipe line and the installation of a chlorine-sterilization plant. Another big task was the mapping of the camp area so that space might be definitely assigned to the arriving regiments and information collected to guide the plan of tactical operations on a large scale. For this work the regular military sketching board or plane-table proved invaluable, and one of the novelties of the work was the use of thin sheets of celluloid, instead of drawing paper, in order that operations might be carried on during the heaviest rain without ruining the work. These and similar problems of an engineering nature demanded immediate solution before the camp could be declared ready to receive additional troops.

Never before, it is believed, has a civil engineering journal sent a staff correspondent to report the activities of military forces. The Engineering Record believes, however, that during the past year there has arisen among technical men a demand for information along military engineering lines. Acting upon this assumption this journal is able to present to its readers, at first hand, the news, from the engineering point of view, of the greatest mobilization of state forces in the history of the country.

Oregon Water Law Upheld by Supreme Court

OREGON'S water law, which has done so much to settle economically and finally water titles in that state, has been upheld by the United States Supreme Court. While being of the greatest moment to Oregon, the decree has only slightly less importance to the entire arid West. Particularly will engineers be interested in the decision. Not only does it directly affect works with which they are intimately connected, but confirms procedure by boards composed of or entirely dependent on engineers.

The Oregon water law, passed in 1909 and amended in 1913, was described by the state engineer of Oregon, John H. Lewis, in the Engineering Record, July 15, 1911, page 69. It provides a comprehensive scheme for securing an economical, orderly and equitable distribution of the waters among those entitled to their use, incidentally prescribing a mode of determining the relative rights of the various claimants to the waters of each stream, and in large measure commits the administration of the streams to the state water board and officers acting under its supervision. When one or more users of water from any stream make the request, the board, if it finds that conditions justify it, is required to set in motion a proceeding looking to an ascertainment and adjudication of *all* rights to the waters of that stream. Every material step in the proceeding is attended with notice and an opportunity to be heard. Each claimant is required to present a sworn statement of his claim to the board. Its nature, inception, extent and all the particulars upon which it is based must be given. These statements are open to public inspection, so that every claimant may determine whether there is reason for him to oppose or contest the claims of others. The state engineer, or a qualified assistant, measures the flow of the stream, the carrying capacity of the several ditches taking water therefrom, and the land irrigated or susceptible of irrigation from each ditch, and also takes such other observations as may be essential to a proper understanding of the claims involved. A report of all this is made in writing. A claimant desiring to contest the claim of another must present the grounds for his contest to the division superintendent and obtain a hearing before that officer, at which the parties may present whatever evidence they have and may secure the attendance of witnesses by compulsory process. After the evidence in the contest is taken, it and the sworn statement of the several claimants, with the report of the engineer's measurements and observations, are laid before the board. A finding of facts is made, an order entered embodying the findings and provisionally determining the relative rights of the several claimants, and the evidence and copy of the order transmitted to the circuit court of the county wherein the stream or some part of it lies. Exceptions to the board's findings and order may be presented to the court and the court then proceeds in accordance with the practice prevailing in suits in equity. The court may order the taking of further evidence by the board or may re-examine the whole matter itself, all parties in interest being fully heard. The court then enters a decree as the law and evidence may require, whether it be an affirmance or a modification of the board's order. Appeal may be taken to the supreme court of the state. When the rights are finally adjudicated each claimant receives from the board a certificate setting forth the priority, extent and purpose of his right, and, if it be for irrigation purposes, a description of the land to which it is appurtenant.

The law was attacked in the case just decided principally on points of legal practice, though it was also contended that the law is in contravention of the fourteenth amendment of the federal constitution. The case was that of the Pacific Live Stock Company vs. Lewis et al.

The purely technical grounds are of very little interest to engineers. In his contention that the law is repugnant to the fourteenth amendment of the constitution the plaintiff claimed that it contravened his right because it required a claimant, at his own expense, to assert and prove his claim before the board and to pay an extortionate fee for having it considered—all under penalty of forfeiting his claim if he refuses—notwithstanding that the board acts only administratively and its finding and order are not conclusive. The plaintiff also maintained that repugnance existed because the board accepted sworn statements of claimants taken ex parte, without affording opportunity to ascertain their true value by cross-examination or otherwise, and finally because the board's finding and order must be followed and given effect in the distribution of the water pending the action of the circuit court upon them.

On all of these points the Supreme Court disagrees with the plaintiff. The court holds that the fee of 15 cents per acre for the first 100 acres, 5 cents for the next 900 acres and 1 cent per acre for any excess over 1000 acres is not extortionate and unreasonable. It quotes with approval an opinion of the Supreme Court of Oregon saying: "That these services are beneficial to the claimant and necessary to the preservation of his rights in the stream and the protection and assurance of his title goes without saying." Regarding the ex-parte testimony accepted without cross-examination or other ascertainment of its worth, Judge Van Deventer points out that the records at every stage in the proceedings are open to public inspection and that the entire matter is reviewable by the court, all parties in interest being heard. On the distribution of waters in conformity with the board's order, pending the adjudication by the court, the Supreme Court holds that there are many precedents in congressional and state legislation for this procedure.

On every point, therefore, on which the law was attacked the Supreme Court has ruled against the plaintiff. Those respon-

sible for framing the Oregon statute have every reason to be satisfied with the results of the contest. While there may be other points on which the measure may be attacked, it is hardly likely that any promising arguments were omitted in the present issue. The statute has been of immeasurable value to Oregon, and close approximations to it in other arid states have given excellent satisfaction. Engineers have long contended that litigation would be saved were the technical advisers allowed to reach a determination as to the engineering facts. The demonstration of the effectiveness of the procedure has been conclusive in Oregon, and it is a satisfaction to know that the statute under which the procedure is carried on has now been confirmed.

Standard Units for Municipal Work

MAYORS and other officials of cities in New York State, assembled in annual conference early last month, will serve the interests of their taxpayers, as well as the engineering profession at large, by ordering the adoption of the standard units for comparing municipal work recommended in an address by A. Prescott Folwell, chairman of the committee on standard forms of the American Society of Municipal Improvements. Some of the absurdities occasioned by the present lack of uniformity in methods of reporting costs of work were well illustrated by cases cited from the pavement field.

In spite of the fact that sheet asphalt construction is pretty well standardized, one city reported a cost as low as $1.25 per square yard, while another showed an expense of $3.53 for the same type of construction. In one case the cost represents actual paving, while in the other are included, in addition to the pavement proper, such items as grading, setting new curbs, laying drains and resetting manhole heads. Of course, without detailed explanation, such figures are absolutely worthless as a basis for comparison.

Mr. Folwell's committee is endeavoring to make the term "cost of pavement" mean just one thing—the wearing surface down to the base, if any. It does include the cushion or binder course. The unit recommended is the square yard, accompanied by a statement giving the thickness of pavement. Other items of expense, the committee maintains, should be classified under their proper headings—such as base, excavation, embankment, curb, gutter, sidewalk and sidewalk base. It should not be necessary to urge upon engineers the desirability of uniform practice in this matter. Technically trained men, however, might advocate such standardization without making the force of their argument felt, but, coming from a mayor or other high city official, orders for preparing contracts and reporting costs on the basis of the recommendations of the American Society of Municipal Improvements would go into effect immediately and would have a far-reaching influence.

If the American Society of Municipal Improvements would confine its activities to constructive work of this sort, instead of making its meetings hotbeds of commercial discussion, it would reach a higher place in the minds of engineers.

Strength of Large-Size Columns

ALTHOUGH the slenderness ratios of the eighteen large columns tested in the 10,000,000-lb. testing machine at Pittsburgh are so low that these half-size models of heavy bridge chords must be classed as short struts, so that no conclusions regarding variation of column strength with slenderness are possible, there are two definite indications of importance noted in the results. As reported in the abstract of a report of these tests made to the director of the U. S. Bureau of Standards, printed on page 19 of this issue, the tests show that the strength of large built-up columns of low slenderness ratio is about equal to the yield point of the component steel, practically regardless of the composition of the material. This fact is unusually well demonstrated by the tests, in which five different alloy steels were used. For all twelve specimens which failed as a whole the ultimate strength lay between the minimum and maximum values for the yield points of the steel.

The second important fact, demonstrated by the local buckling failures of all the models of chords for the Memphis bridge, is the necessity for careful detailing of jaws and lacing. The value of the slenderness ratio for any short, separate, unsupported segment of a column should never exceed that of the column as a whole. Computation will show that for each of the four models which failed near the pin ends, the slenderness ratios of the jaw plates (based upon rectangular sections, neglecting small projecting angle legs) exceed that of the column as a whole, the excess being particularly marked for the carbon-steel models. Such unsupported jaws should be designed by an empirical "jaw thickness" formula which, though perhaps requiring excess material at the jaws, should insure column failure as a whole. It is good economy to add extra weight to details at such vital points.

One other less striking result of these tests is the influence of form of cross-section upon strength. By using thinner metal and greater distribution from the center of gravity, it was found that for all six comparison tests made on the Metropolis bridge chord models the strength in every case except one was somewhat increased.

These tests confirm the laws of strength for short struts and once more, as in the case of the Quebec bridge failure and subsequent tests, impressively emphasize the fact that ample end details and stiff unsupported elements between adequately laced points are of the utmost importance if the full column strength is to be developed. They furnish definite data to the designers and manufacturers of large bridges concerning the action under load and the relative strength of heavy built-up columns of various alloy steels. Nickel steel and Mayari steel show approximately equal ultimate strength, consistently exceeding the values for silicon, chrome and high-carbon steels.

Engineers and the New Nationalism

NEVER before in American engineering history has there been so widespread an interest as now in the relation which the engineer should bear to the community. National as well as local societies are seeing the obligation and the opportunity. What is more, they are discharging the one and seizing the other as never before. But not merely as independent bodies are they making themselves felt. The strength of co-operation is appreciated. On all sides are heard pleas for the unity of the profession in order that its influence and power may be increased. The overwhelming vote, commented on elsewhere in these columns, in favor of moving the headquarters of the American Society of Civil Engineers to Thirty-ninth Street is most striking evidence of this desire for professional unity.

While, therefore, the engineer is appreciating as never before his relations to the public good, it is doubtful whether he has grasped the significance of his position and opportunities as clearly as they are set forth in this issue by Miss Frances A. Kellor. In the article on the "Engineer and the New Nationalism," on page 12, she pictures the engineer as holding the pivotal position in the solution of the human problems—the greatest, she contends, in industry to-day. Her thorough familiarity with conditions among the working classes —with the relation which industry bears to these conditions and with the reaction, in turn, which these conditions and their results have on industry—gives her words an undisputed authority. Moreover, none can read her argument without admitting the truth of her conclusions.

Her thesis is that to develop a stable, competent labor force—to the end that America may be able to maintain her industrial supremacy—the incoming foreign labor and that already here must be Americanized as speedily as possible. "We can do this," she says, "by reducing uncertain elements in labor, by providing good conditions within the plant and outside, by having a common language, a common citizenship and one standard of living. We can do it by giving each workman a citizenship stake in America, a home stake in the town and an industrial stake in the plant. This is Americanization by industry, serving both the needs of industry and of citizenship." Manifestly the engineer with his supervision of municipal conditions—the laying out of towns, the provision of sanitary measures, etc.—has control of the material factors which affect and aid to effect this Americanization. That is just Miss Kellor's contention, and she pleads for a full recognition by the engineering profession of its responsibility and of its great opportunity.

A careful reading of Miss Kellor's article is urged upon every reader of the Engineering Record.

THE TENTS OF THE 22D CORPS OF ENGINEERS WERE THE FIRST ONES PITCHED AT CAMP WHITMAN

With the 22d Corps of Engineers at Camp Whitman

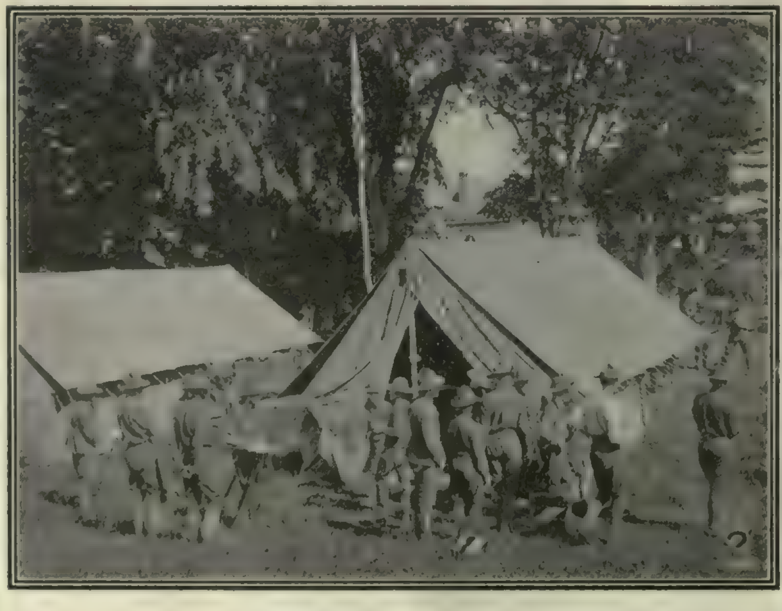
In Preparing for the Mobilization of the Entire National Guard of New York State Last Week the Engineers' Duties Included the Installation of a Water Supply, a Survey of the Camp Site, Mapping a 64-Square Mile Area for Tactical Operations and Constructing Aids to Transportation and Sanitary Works

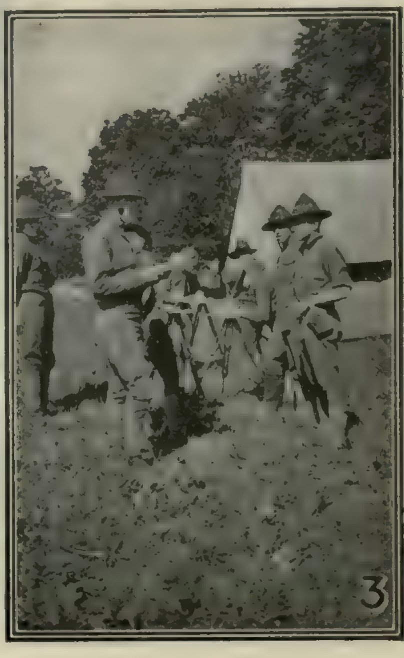
By ROBERT K. TOMLIN, JR.
Managing Editor of The Engineering Record

Photos by the Author

UPON an 825-acre tract of rolling farmland up in Dutchess County, New York, a mile or more back from the little railroad station at Green Haven, a great tented city sprouted, mushroomlike, last week, almost before the echoes of President Wilson's orders for the mobilization of the nation's militia forces had died away. This was the answer of New York's 22d Corps of Engineers to the call for a camp to accommodate a full division of the National Guard. With transit, level, military plane-table and map-making equipment, car loads of pipe and lumber, well-drilling rigs, pumps and excavating tools, the state's military engineering forces, under the command of Lieut.-Col. Eugene Willett Van Court Lucas, West Point graduate and member of the American Society of Civil Engineers, have performed the miracle of preparing the huge tract covered by Camp Whitman at Beekman, N. Y., for the influx of 18,000 men, a number which will be considerably increased when the units of the division are recruited to war strength. The intention last week was to mobilize all of the state's militia forces at Camp Whitman, but recent changes in orders indicate that some of the units provided for at the camp will proceed from their armories direct to the Mexican border.

Early last week Camp Whitman was little more than a painted signpost at the edge of a hay field along the Pawling-Fishkill road. To-day it is a vast checkerboard of conical tents and company streets, laid out with the precision of a township survey and furrowed by trenches carrying water-supply pipe lines from tanks on a hill commanding the vast camp area. Sanitary conveniences have been installed and crematories built for the destruction of kitchen wastes. Every day since the command was ordered out survey parties have sallied forth, shortly after sunrise, to map a 64-square mile area which Major-Gen. John F. O'Ryan, commander-in-chief of New York State's forces, has designated for extended field maneuvers of the troops which are concentrating at Camp Whitman. The mapping of this extensive tract was well along toward completion at the end of last week. To the observer of activities at Camp Whitman since President Wilson's call to arms was sounded, one thing stands out clearly—





1—MAKING ROAD SKETCH WITH ARMY PLANE-TABLE
2—SURVEY PARTIES AWAITING ASSIGNMENTS AT RECONNAISANCE TENT
3—READY FOR THE FIELD

the 22d Engineers have been the very backbone of the state-wide mobilization scheme.

A feature which should be noted at the outset is that the 22d Corps of Engineers was called upon to perform its task three weeks ahead of schedule time. It had been the intention to have a camp site ready for a portion of the State militia forces early in July, and a small detachment of the corps had been ordered to Camp Whitman in May to start preliminary work. But no contract of the size which actually developed when the general mobilization orders went out was ever anticipated. What has been accomplished in camp layout, topographical survey work, water supply, waste disposal and improvement of transportation facilities is a great tribute to the efficiency of Colonel Lucas and his men. Company D, commanded by Capt. Ernest F. Robinson, well known to New York engineers through his lecture on military preparedness,[1] delivered recently before the American Society of Civil Engineers, and Company B, in charge of Capt. H. C. Woodward, were the first to arrive upon the scene on June 13. They were reinforced on the following day by the remaining six companies of the command, bringing the strength of the command to 715 officers and men.

WATER THE CRUCIAL PROBLEM

Without doubt the water supply was the most urgent problem which Colonel Lucas and his men were called upon to solve. Beekman, where Camp Whitman is located, is the epitome of the "one-horse town." It boasts about 100 inhabitants and a four-train-a-day railroad service. There is no public water supply. Wells at the widely scattered farmhouses are the only sources of drinking water. The situation at Camp Whitman, therefore, presented complexities not encountered at the federal mobilization camp in San Antonio, Texas, where, according to a statement made to me recently by Robert J. Harding, general manager of the local water company, it was possible to tap the city mains and conduct water to the encampment by lateral lines of pipe.

At Camp Whitman there was no existing local supply which could be adapted to camp needs. A new one had to be created. The alternatives were to sink wells or to pipe a supply from Fishkill Creek, which crosses the State-owned camp tract north of division headquarters. Preference was given by the engineer officers to the ground-water supply. It must be remembered that the area, when fully occupied, will contain at least 18,000 men at the outset, and to this number thousands more will be added when the division is recruited up to war strength. With this number concentrated within a comparatively small area on a watershed it was realized that there would always be a menace of pollution were a surface water supply, such as Fishkill Creek, chosen. The decision in favor of deep wells, therefore, was made, and rush orders were sent out to a couple of drilling contractors at Poughkeepsie, 18 miles away, to ship rigs and working crews to the site at once. The first man to arrive on the job was George M. Lyon, a well-drilling contractor of twenty years' experience, including work on the Catskill aqueduct for New York City's additional water supply. He was assigned to a low-lying area west of the center of the camp, and started work with a cable rig, chopping bit and sand bucket. Water was struck June 21 at a depth of 13 ft. at a point located between two rock outcrops, in what is known as the Hopewell basin. The first flow, however, was classified merely as surface water, and the drilling was continued in order to get into a water-bearing stratum of gravel and sand. Three wells had been put down at this site last week. At another location, northeast of the camp center, a second group of three wells was sunk, and with the yield from these it was hoped to have a supply sufficient for the needs of the incoming troops. On June 20 Fairbanks-Morse gasoline-driven engines and pumps were on the ground ready to be hooked up to the wells just as soon as they had reached a depth and gave promise of a flow satisfactory to the engineer officers.

The basis upon which the calculations were made for the necessary water supply was a consumption of about 25 gal. per capita per day, including water needed by animals. It was estimated that with the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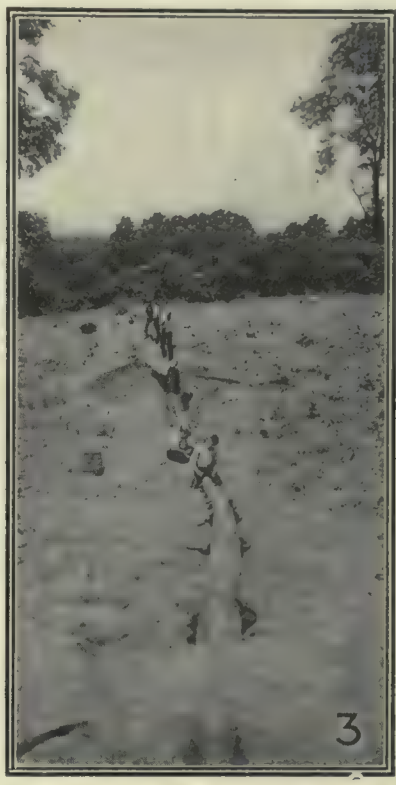
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The Camp Water Supply

1—LOADING PIPE LENGTHS AT GREEN HAVEN STATION. 2—THE FIRST ATTEMPT TO SECURE A WATER SUPPLY WAS BY MEANS OF WELL-DRILLING RIGS. THE ALTERNATIVE PLAN CONTEMPLATED A SURFACE SUPPLY FROM FISHKILL CREEK. 3—LAYING 6-INCH PIPE LINE TO ELEVATED TANKS FROM WHICH DISTRIBUTION WILL BE MADE. 4—THIS WELL, FROM WHICH ALL CAMP WATER WAS FIRST DRAWN, WAS THE SUBJECT OF A SANITARY SURVEY. 5—DETAIL OF ENGINEERS UNLOADING FIRST CARLOAD OF WATER-SUPPLY PIPE

camp fully occupied 500,000 gal. of water a day would be sufficient.

May Utilize Fishkill Creek and Sterilize Water with Chlorine

In the event of the wells failing to produce the necessary amount of water, the plan last week was to run a pipe line to Fishkill Creek and pump the water to camp. If this scheme is adopted all the surface water, before it reaches the men, will be passed through a sterilizing plant using liquid chlorine. Pending the final solution of the water problem last week, troops which were expected at the mobilization camp were held in their armories at New York City and elsewhere.

The distribution of the water supply will be from a pair of 50,000-gal. elevated wooden tanks, supported on concrete foundations at the summit of a hill commanding the camp site. The plans call for a main girdling the camp area, with connections to each of the units of the division. Because of its ease in laying over rough ground, and the fact that it requires no lead calking, Universal cast-iron pipe was selected for the main arteries of the water supply system of Camp Whitman. The first of four carloads of pipe and fittings left the Central Foundry Company's shops the day after the contract was placed by Colonel Sternberger of the Quartermaster's Department. The pipe-laying work is being done entirely by militia forces. In the 69th Infantry a number of steamfitters and mechanics were discovered, and these men, working with the engineer troops, are laying the pipe lengths in plowed furrows, which are to be backfilled. The line leading uphill to the elevated tanks is 6 in. in diameter, the circuit main around camp 4 in., and the lateral lines 2 in., with ½-in. bib cocks at company streets.

There will be a pipe line with a tap at the head of every company street, where the kitchen is located. This means 14 taps to an infantry regiment, one for each of the twelve companies, one for the officers and one for the machine-gun detachment. Each regiment also will be provided with a bathhouse containing 14 shower heads. It is expected to deliver water under a head of about 60 ft. The complete supply will involve the laying of about 60,000 ft. of pipe ranging in size from 6 to ½-in.

The camp water-supply problem has been in the hands of Capt. Ernest F. Robinson and Lieut. J. E. Baker, reporting to Major William S. Conrow. Lieutenant Baker in civil life is employed on the engineering staff of Westinghouse Church Kerr & Company, of New York City. This firm has placed the resources of its purchasing and other departments at the disposal of the water-supply engineers at Camp Whitman, and as a result supplies needed in a hurry can be telephoned for and delivered promptly on the work. This co-operation, it is stated, has been of invaluable assistance in expediting the work. At Camp Whitman Lieut. M. H. Gray has been in charge of the receipt and disbursement of supplies for the 22d Engineers.

Sanitary Survey Made

One incident in connection with the water supply demonstrates the ability of the 22d Corps of Engineers to cope with special problems. Last week the troops were obtaining all their drinking water from a well at the Owsley homestead, just across the street from division headquarters. Colonel Lucas wished to be absolutely sure that this source was safe, and he sent out a call to his company commanders for a man who could make a sanitary survey. Captain Robinson, of Company D, recommended for this work Private Nabstedt, an engineer who has had considerable experience in water supply and sewage work. He was detailed to make a thorough examination of the site, and in a four-page technical report, accompanied by a map drawn to scale, he indicated all possible sources of pollution at the well, and made recommendations for their prevention. Samples of the water were carefully taken and shipped to New York for analysis. Private Nabstedt recommended that the area in the vicinity of the well be disinfected, that the water be drawn, by means of a short length of pipe and a three-way valve, at a point some distance from the pump—so as to reduce the possibility of débris falling into the water—

Aids to Transportation

1—SIDING TO QUARTERMASTER'S SUPPLY TENTS. 2—COMBAT WAGON LOADED WITH TOOLS AND EXPLOSIVES. 3—RAILWAY CREW CUTTING DOWN HILL FOR NEW TRACK NEAR CAMP. 4—PLATFORM AND RAMP BUILT BY A DETAIL OF ENGINEERS. 5—HOW THE NEW PLATFORM SIMPLIFIED THE REMOVAL OF WAGONS FROM FLAT CARS

and that a guard be stationed at the well to inforce the sanitary regulations prescribed. Colonel Lucus promptly issued orders based on these recommendations. Thus work which, in civil practice, would call for the services of a consulting engineer, was done by a member from the ranks of the 22d Engineers.

That the water supply has been the crux of the mobilization problem is apparent from what Colonel Lucus told me last week. "We have six wells down," he said, "but are having some trouble with fine sand. Our well points and screens have been delivered and they will be placed just as soon as we are satisfied that we have reached a plentiful supply of pure water. It is not possible to predict exactly when the wells will be connected with the pumps, but we expect to be delivering a flow into the pipe lines within a few days.

"It must be remembered that in this work we have been jumped three weeks ahead of schedule, which called for the completion of the camp site July 9. With the arrival of the 69th Regiment we will be able to secure a number of steamfitters and mechanics to help on the work of laying the pipe lines. Our present water supply is sufficient for the troops now in camp—the 22d Corps of Engineers and the 69th Regiment. No more regiments will be ordered to Camp Whitman until the adequacy of the water supply is assured. Our two wooden water tanks, each of 50,000 gal. capacity, are reported to be at the railroad station at Beacon.

"Lack of transportation facilities has been one of our biggest handicaps, although within a day or so we will have available ten motor trucks and a number of draft horses."

Vying in importance with the water supply is the work of castramentation, or the laying out of the camp site and the assignment of definite ground areas to the troops of the division. This work was finished last week under the direction of Lieutenant Stockwell of Company F. The fields surrounding the camp were teeming with survey parties operating transit and stadia and plane-table. The job for which the survey parties are responsible is the assignment and marking of camp locations for the following organizations of the division: Headquarters Division, 22d Corps of Engineers, Signal Corps, Armored Motor Car Battery, Adjutant General and Pay Department, 1st and 2d Field Hospitals, 1st, 2d, 3d and 4th Ambulance Companies, 1st Cavalry, Squadron A, 1st and 2d Field Artillery. Then there are the following infantry units, nine of which will be chosen for the division: First Brigade Headquarters, and 7th, 71st, 12th and 69th Regiments; Second Brigade Headquarters and 23d, 14th and 47th Regiments; Third Brigade Headquarters and 1st, 2d and 10th Regiments; Fourth Brigade Headquarters and 3d, 65th and 74th Regiments. Then, too, provision has been made for the Quar-

LIEUT. J. E. BAKER, DETAILED TO WATER-SUPPLY WORK

LIEUT.-COL. EUGENE WILLETT VAN COURT LUCAS, COMMANDING THE 22D CORPS OF ENGINEERS AND CHIEF ENGINEER OF THE NEW YORK STATE MILITIA DIVISION

Upon him rested the responsibility of getting Camp Whitman ready as a mobilization site for the entire National Guard of New York State.

MAJOR W. S. CONROW, IN CHARGE OF CAMP WATERWORKS

CAPT. ERNEST F. ROBINSON, WHO SUPERVISED CAMP LAYOUT AND WATERWORKS INSTALLATION

COLONEL LUCAS READS THE ORDERS OF THE DAY TO THE COMMISSIONED OFFICERS OF THE COMPANIES OF HIS COMMAND ASSEMBLED AT DIVISION HEADQUARTERS TENT LAST WEEK

CAPT. H. C. WOODWARD, EXPLOSIVES EXPERT AND BUILDER OF AIDS TO TRANSPORTATION

Sanitation at Camp Whitman

1—COOK TENT HAS SIDE WALLS OF WIRE SCREENS. 2—CLOTHING AND BEDDING ARE AIRED EVERY MORNING. 3—CONSTRUCTION OF A MODEL CREMATORY FOR DESTRUCTION OF KITCHEN WASTES — STONES HEATED BY FIRE BUILT ON THEM EVAPORATE ALL LIQUIDS

termaster's Department, storage tents, corrals, wagon trains and commissary. Information about the topographical features of the tract is collected by the field parties, assembled upon a large map, and space then is assigned to each regiment or other unit. The field men have been instructed to mark with particular care all low spots, wooded areas unsuitable for tent pitching, stone walls and fences, and fields under cultivation. The main map of the camp site is on a scale of 200 ft. to the inch, with a 10-ft. contour interval.

There is a standard arrangement of the units in an infantry regiment which is followed just as closely as the configuration of the terrain will permit. The ideal encampment plan is shown in the accompanying sketch. It will be noted that a regiment of infantry occupies an area of 900 ft. long and 700 ft. wide.

With the topographical data available on the main map, areas are assigned to each regiment, and men with transit and stakes are sent out to mark the four corners of the plot and the head and rear of all company streets. At these locations long stakes are driven into the ground and are used by the company commanders for aligning the tents of their men. Provision is made along each company street for 18 squad tents, and in addition to the twelve companies of each infantry regiment there are lines of tents for the headquarters company and sanitary detachment, and for the supply and machine-gun company. The engineer troops also mark the location of the company officers' quarters and the line for the field officers' tents.

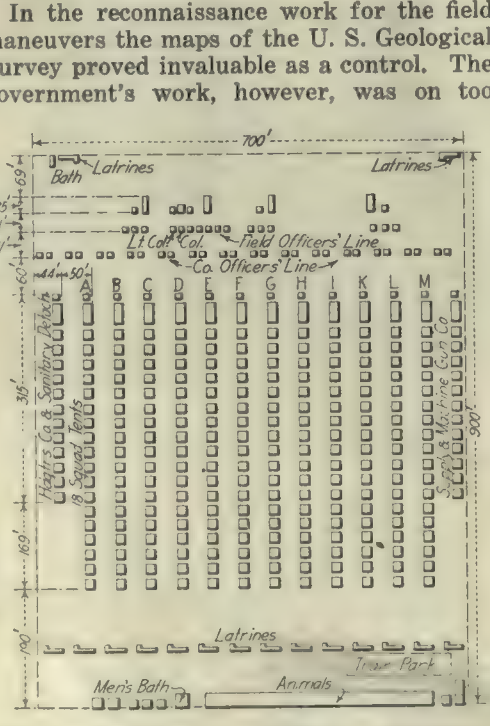
When word was received last week that the 69th Regiment had left New York June 21, a survey squad was sent out to designate the space for its encampment, and the last stake was driven, during a driving rainstorm, just as the head of the column appeared along the road from the Green Haven Station.

Map for Tactical Operations

Differentiated from the precise survey of the camp site is the task of mapping an area of 64 square miles in the vicinity of Beekman for tactical operations, practice marches and maneuvers in extended order. If time permits, it is the intention of the State military authorities to give the men thorough practice in the field, and it was essential, therefore, to know in detail the locations of all roads, cultivated fields, hills, farmhouses, fences, ponds, etc., in order that problems in attack and defense could be intelligently planned. To secure this information Lieut. H. L. Mellen of Company D, an engineer graduate of Columbia University, has had about 20 or 30 sketching-board parties in the field, and it was expected to have all data ready for the final map last Saturday.

The sketching outfits used are of the regular army type, comprising a wooden board about 14 in. square, mounted upon a tripod with adjustable legs. Sights are taken along a ruler lying flat on the board, and all distances are paced. Speed, of course, is one of the essential requirements, and no chaining or taping is in evidence at Camp Whitman. The work which has been done with the sketching-board is spoken of as road mapping, and is plotted on a scale of 3 in. to a mile. Such features as fields, houses, stone walls, cultivated areas, woods, streams, etc., are marked upon the map. The work is done by running traverses along the road and then the fragmentary information from each party is turned in to Lieutenant Mellen at the reconnaissance tent, where it is co-ordinated and reduced, by tracing, to one large map. A surprising accuracy, considering the approximate methods employed, is reported for the closures of the traverses. It has not been uncommon for the survey parties to number 150 men. The best day's progress for one party on the road-sketching work has been made by Corporal O'Brien and Private Southard of Company C, who covered a distance of 14 miles.

In the reconnaissance work for the field maneuvers the maps of the U. S. Geological Survey proved invaluable as a control. The government's work, however, was on too small a scale for military use, but it served to indicate the general topographical features of the country and was employed in order to assign work, in specified sections, to the survey parties. In the first road maps which have been turned in, no attempt was made to get detailed topography. The prime object of these sheets was to show the road locations, fields, houses, etc. Later, if time is available, the topography will be filled in.



IDEAL ARRANGEMENT OF UNITS IN A REGIMENT OF INFANTRY

Plane-Tables Operated in Rain

When it began to rain on the afternoon of June 21 I decided to visit the reconnaissance tent, thinking that the stormy weather would drive the men under canvas and afford plenty of time for an interview about their work. I was surprised, therefore, on raising the flap of the reconnaissance tent to see one lone draftsman.

"What sort of maps are these men going to bring in after the paper has been rained on for two or three hours?" I asked.

"Rain doesn't make any difference in this work," he replied. "We are not using paper at all on our sketching-board, but specially prepared thin sheets of celluloid with a roughened surface on which rain has practically no effect. In fact, we tested the sheets by submerging them in a pan of water and making a sketch in pencil. There was no smudging. This sample of subaqueous draftsmanship convinced us that we had nothing to fear from the weather while our plane-table work was in progress."

Complete Drafting Room

Located just in back of Colonel Lucus' quarters, the "reconnaissance tent" is one of the camp features, from the engineering point of view. All the accessories of an up-to-date designing and drafting room are in evidence. The equipment includes two large drafting tables and two small tables, with T-squares, triangles, drafting instruments, tracing cloth and other equipment needed in map making. The tent is equipped with an acetylene light so that work may be done at night. The field equipment included a standard transit, a light mountain transit, a dumpy level, a plane-table and a score or more of military sketching-boards. The tent proper is continued by means of a canvas fly, under which are a long wooden table and seats for the use of computators.

Unloading Platform Built

The first engineering work I encountered upon arrival at Green Haven last week was a wooden bulkhead and earth platform and ramp which a detail, commanded by Captain

Woodward, had just completed to facilitate the unloading of supplies from cars. The structure consisted of a heavy timber bulkhead wall along the tracks, built to the height of the floor of a flat car. An earthfill had been placed back of the wall, which was anchored to deadmen. Up to the time the engineer troops landed the Green Haven Railroad Station was totally unequipped to handle any large volume of freight.

Another important aid to the handling of supplies from the railroad cars was begun June 21, when two sidings were built from the tracks of the Central New England Railway into a field containing the storage tents of the Quartermaster's Department. The pictures show this work under way with forces recruited by the railroad company.

The wagon road between the Green Haven Station and Camp Whitman was in urgent need of repair to sustain the heavy motortruck traffic and team haulage which will follow the complete occupation of the camp by the remaining troops of the division. Last week it had not been called upon to sustain any real heavy traffic, but during Wednesday's rain it was a mire of mud in many places. The engineer troops were planning to rebuild this important stretch of roadway just as soon as the camp layout and the water supply had been completed.

Urges Creation of National Public Works Bureau

Clemens Herschel Deplores Vesting of Control of Government Engineering Programs in Short-Lived Commissions

PREFACING his address with a reference to the great loss sustained by the American Society of Civil Engineers in the death of its president, Dr. Elmer L. Corthell, Clemens Herschel, who as ranking member of the society delivered the presidential address at the forty-eighth annual convention in Pittsburgh this week, urged the creation of a national department of public works. The states, he thought, should have similar departments, and in support of his view he pictured the ineffectiveness of "the commission habit in state government." Mr. Herschel also commended the decision of the society, as announced at the convention, to join the other national engineering societies at the Thirty-ninth Street Building in New York City. He thinks this is but a beginning, the end of which cannot be foretold.

Mr. Herschel said in part:

"We have had of late in the technical press and in the proceedings of engineering societies, ample evidence that the advancement of the profession of the civil engineer is a cause that still has the earnest attention of the large body of thoughtful working engineers of the country. The spirit of unrest has been abroad among them, and however much content with one's individual lot may be ethically or religiously proper, and bringing blessings in its train, yet is unrest in behalf of one's class, and an altruistic, lawful striving to better the lot of that class, a commendable, and perhaps the only effective means of achieving that end, as experience has amply shown. Engineers feel that they occupy a prominent place in the creation of the world's material welfare, and want a recognition of this fact —a recognition that a share in the world's honors is due them, in the minds and actions of their fellow-men. Especially is their unrest and a striving for increased public recognition justifiable and prominent among engineers, when the creation of state or public works is under consideration.

CONTROL OF PUBLIC WORKS

"Public works have been deemed the glory of long-established, or developed, states, since the dawn of history. To attempt to do without them, or to rely solely upon private enterprise to procure them, is a mere delusion; or notion; impracticable; and yet we have a national government and, generally speaking, forty-eight state governments, that make no permanent provision for their construction and upkeep, in their organic law.

"The expenditure of 4 per cent of the annual United States budget on public works is made the football of politics, and great is the cry of victory when this expenditure has been reduced to 3½ per cent.; but no word is heard about the other 96 or 96½ per cent of expenditure of the same budget; because public works are not recognized in the constitutions of the United States and of the states, to the extent of providing a department of the government, and permanent officers of the government, to construct and care for them. A large part of the lack of recognition of the civil engineer as a member of an honorable profession, and of his merits, is, in my belief, traceable to this very state of affairs.

"From time to time, the technical press contains discussions as to the anomalous position held by 'junior engineers,' and 'assistant engineers' in the service of the United States, on public works, in charge of the Corps of Engineers, U. S. Army; the former of whom can never rise above their basic position, and the best of whom consequently leave that kind of a service as quickly as circumstances will permit. These discussions are carried on in all sorts of tempers, and, to make my own temper clear in the matter, let me express the belief, founded on long personal observation and friendships, that there does not exist an abler, a finer body of men than this same Corps of Engineers, U. S. A. . . . The trouble is not there. It is because the whole system of carrying on the civil engineering works of the United States is an emergency makeshift; born of a denial of the propriety of the nation to build *any* civil engineering works, and of the necessity of building them, when their construction could no longer be avoided, by makeshift methods.

"Says Laurence Sterne, in his 'Sentimental Journey': 'They order this matter better in France.' And not only in France, but in every country of the globe, except in Great Britain and in the United States, the copyist of Great Britain, which the United States has been for so long and in so many directions. The first named, all have a ministry of public works, and, carrying on the business of this department, a corps of commissioned civil engineers. To that must the United States, and every state in the union, come, sooner or later. Commissions of laymen to rule in these matters, appointed as an emergency measure, are an anomaly in these days of a striving for efficiency.

HOW THE COMMISSION HABIT OPERATES

"Let me illustrate how the commission habit in state government operates, as philosophically viewed from a distance, in recent years. A certain state conceived the idea that it would be well to develop its principal seaport by works of the civil engineer. So a commission of laymen was immediately created to cause this to be done. The newspapers were replete for months as to who should be the chairman of this commission. There was a good salary attached. Not a word as to the civil engineer capable of designing the necessary works, and of wisely superintending the expenditure of millions of dollars in the future. Not one word.

"At length the die is cast, and the favorite of the 'plum-tree' enters upon a course of after-dinner speeches. After months of this sort of thing, and when the novelty of the situation has worn off, not much has been heard in the daily press as to the work to be done. An engineer has indeed been somehow appointed, and certain work planned and done. Then the former after-dinner speaker resigns, or is crowded out—it is immaterial which—changes of political government affect and debase the at-no-time illustrious commission and engineering corps, and the last end of that commission is worse than its inception—it is itself swallowed up and abolished in a reshuffling of the commissions of the state generally; and all this in the space of barely five years with the simultaneous hazard of millions of money to be expended, at once and in maintenance and repairs, or reconstruction in the future in a football game of politics.

COMMISSIONED CIVIL ENGINEERS NEEDED

"Is it not true, does one not see, in contemplating such bits of contemporaneous history, that especially in a republic are commissioned civil engineers needed for the proper carrying on of the public works of the state? The reason the average congressman, even the executive, respects the army engineer, as he does, is because the former knows that the services of the latter in and to the government will go on, when he himself will not unlikely have been wholly forgotten. He would equally respect the commissioned civil engineer.

"To illustrate again: Where else than in the United States would it have been possible for a dreamer of patriotic visions, in the service of the government, to have seen those visions come true under his able guidance in the space of some fifteen years, and at an expenditure of scores of millions of dollars; creating empires of arable land, where before was the desert; and after the threat of political removal by one brief layman incumbent of the chair at the head of his bureau, finally be made to succumb, without any justification that the public ever heard of, by another such brief incumbent, to the already manifested harm of the service, and of its future?

"No amateur ruling the immediate present, of an important government work and agency, should have such subversive powers of harm for their future. No matter even that he act from motives which to him at the moment seem wholly good. He may be mistaken. Certain it is that a system that enables a mere passing temporarily exalted incumbent of an office thus radically to disorganize, out of his own mere motion, a work of national usefulness and importance, is not for the good of the body politic.

A BEGINNING OF UNITED ACTION

"But the advancement of the profession of the civil engineer can be viewed from many another angle. We have, for in-

stance, the work of combining the efforts of the various branches of the engineering profession, in matters of their common interest. According to section 2 of article II of our constitution, there are no engineers, except civil and military engineers, the original class distinction. But so various are to-day the occasions when it is necessary to apply 'the art of directing the great sources of power in Nature for the use and convenience of man,' that it long ago became impracticable to have all engineers in the United States enrolled in one American Society of Civil Engineers. Instead, we have the four prominent national engineering societies, and many amply useful, though less prominent, such engineering societies. And yet the number of their aggregate membership is small, compared with the population which they serve; a prominent reason why their expressed desires are too often but as a 'voice crying in the wilderness.'

"To remedy this condition which confronts us, many have labored, in season, and out of season, to bring about joint action of the engineers of the United States in matters of a common interest. This society has said that it believes in it, and as a step in that direction, as facilitating that sort of work, as a landmark and a beacon light to the public that engineers are at their posts of duty and should be recognized and reckoned with, we have said that the building of the four founder engineering societies on Thirty-ninth Street in the city of New York shall represent to the public, the home of a power in the land. The step we have taken and which has been voted in the affirmative, 2,500 for, 390 against, is of course but a beginning. It has been worked for in a duly humble spirit, and on the principle of doing one thing at a time, but the beneficent end of that work no man can see. 'Be of good comfort,' Master Ridley Latimer cried at the crackling of the flames, 'play the man! We shall this day light such a candle, by God's grace, as I trust shall never be put out.' Not only not put out, but increasing through the years, in effulgence, glory to the profession, and in usefulness."

What Is an Engineer?

Prof. C. R. Mann Reports That Canvass of Second Vote Raises Technique and Knowledge of Fundamentals to 25 Per Cent

TECHNICAL ABILITY, 25 per cent; human attributes, 75 per cent—these are the new ratings of the qualifications for success for engineers just given out by Prof. C. R. Mann of the Carnegie Foundation for the Advancement of Teaching. The figures are based on the votes received from the engineers asked to confirm or refute the percentages indicated by an earlier vote of a smaller number of engineers and announced last January at the annual meeting of the American Society of Civil Engineers. (See the Engineering Record of Jan. 22, page 125.) The new percentages were derived from 5441 votes. Professor Mann thinks the figures correspond to a rather definite ideal in the professional mind, one that can safely be made use of in testing and planning the work of the schools.

It will be recalled that in the ballot postcard sent out some months ago there were six groups of qualities, which were headed character, judgment, efficiency, understanding of men, knowledge of fundamentals and technique, and that the voter was requested to prefix numbers to the groups to show his estimate of their relative importance. Professor Mann's report states that differences in years of practice were found to make little difference in the vote. The votes placed the six groups in the order in which they appeared on the post-card, which is that of the table published in the Engineering Record. The report gives an extended table showing the percentage of the voters that placed each group above or below each other one. Representing the groups by their initial letters, C was held almost unanimously to outrank all of the others, the percentages so voting ranging from 85 per cent for C:J to 98 per cent for C:T. Similarly J was thought to outrank E, V and K by a slightly smaller percentage; a still smaller percentage placed E above U and K, and a bare majority favored U over K, while less than 15 per cent ranked T above any of the other groups.

Calculation of Ratings

The most probable values of the relative importance of these groups of qualities, states the report, were computed from these percentage votes by the method described in chapter 8 of Thorndike's "Theory of Mental and Social Measurements." These values are given in the first column of figures in the accompanying table. The last two columns give the values based on the first circular, and published in the Engineering Record of Jan. 22.

Revised and Original Ratings

	Revised		Original	
Character	24.0		41.0	
Judgment	19.5		17.5	
Efficiency	16.5		14.5	
Understanding of men	15.0		14.0	
		75		87
Knowledge of fundamentals	15.0		7.0	
Technique	10.0		6.0	
		25		13
		100		100

"When applying this definition to the schools," concludes the report, "it is desirable not to forget several perfectly obvious facts. In the first place, all the qualities mentioned are essential to genuine success, and conscious effort should be made to develop all of them as far as is possible. Second, character, initiative, common sense and qualities of this sort cannot be taught explicity like multiplication tables and rules of grammar. Third, education is a continuous process of growth, and therefore the conscious development of the qualities of the first four groups cannot to advantage be arrested for four years, even for the sake of a mastery of knowledge and technique. Fourth, the man whose character, judgment, efficiency and understanding of men have developed most during his college years has the best show after graduation, since these qualities constitute 75 per cent of his equipment. Fifth, the fact that character is rated at 24 per cent does not mean that an engineer can succeed with a 24 per cent character. It does mean that even a perfect character is but 24 per cent of the engineer's total equipment.

"With these facts in mind, it is evident that instruction in mathematics or machine design which aims only at a mastery of fundamental principles and technique cannot be nearly as efficient as instruction which, while paying due regard to technique and the mastery of principles, yet develops integrity, initiative, resourcefulness and common sense."

Supreme Court Confirms the Right to Levee Stream

Holds That Riparian Owner May Protect His Lands Even Though Such Protection Causes Damage to Other Owners

THAT the state levee boards and the Mississippi River Commission have the right to levee the Mississippi even though there be accidental damage to some owners of adjoining lands was the decision of the U. S. Supreme Court in an opinion (Cubbins vs. Mississippi River Commission et al.) handed down June 5, 1916. A certain Cubbins prayed for injunction perpetually prohibiting the levee boards from further building any levees, or strengthening and maintaining those now built. His grounds were that his lands had been subject to overflow and had thus been irreparably damaged; such damage, he contended, being a taking without compensation in violation of due process of law under the federal constitution, no offer having been made him for the lands damaged or proceedings taken to expropriate them.

Chief Justice White, who wrote the opinion—which was concurred in unanimously—set forth the main point at issue as follows:

"Its solution involves deciding whether the complainant as an owner of land fronting on the river had a right to complain of the building of levees along the banks of the river for the purpose of containing the water in times of flood within the river and preventing it from spreading out from the river into and over the alluvial valley through which the river flows to its destination in the gulf, even although it resulted that the effect of thus keeping the water within the river was by increasing its volume to so raise its level as to cause it to overflow the complainant's land."

Two Possible Views

The court stated that the question could be viewed from two angles—first, with reference to the rights of the land owners and the power of the state to deal with the subject; and second, with reference to the power of the United States under the constitutional provisions giving it control of improvements for navigation. The court found under the first heading ample authority to dispose of the issue, and the strength that might lie in its second method of approach was not requisitioned.

Reviewing briefly the Roman law of riparian rights, and the Code Napoleon, the court pointed out that while the free flow of water in rivers was secured from undue interruption and the respective riparian proprietors were protected from undue interference or burden created by obstructions to the flow or by deflections in the course, a limitation to the rule was also universally recognized by which individuals in case of accidental or extraordinary floods were entitled to erect such works as would protect them from the consequences of the flood, and that no other riparian owner was entitled to complain of such action upon the ground of injury inflicted thereby, because all, as a result of the accidental or extraordinary condition, were entitled to the enjoyment of the common right to construct works for their own protection. The court cites in support of its position numerous comments on the Code Napoleon and decisions of American tribunals to the same effect.

Special Plant Layout Expedites Construction of Brooklyn-Brighton Viaduct

Economy in Erection Increased by the Use of Adjustable Steel Arch Centering—Gantry Crane Places Heavy Sandstone Railing

ALTHOUGH handicapped by the necessity for constructing the Brooklyn-Brighton viaduct, Cleveland, in two sections, one half being first completed to allow traffic on the old viaduct to be diverted thereto, and the second half constructed after removal of the old, interfering structure, rapid erection progress was made through the use of a well-designed plant layout. Adjustable steel arch centering was found to be economical, the centers being constructed for one half the width and rolled laterally under the other half after the first was concreted. Owing to the large capacity of the mixing plant, due to efficient handling of materials, it is stated by the contractors that the whole bridge could have been completed in the time it actually required to build one half. The design of this bridge was described in the Engineering Record of June 24, page 832.

USE OF ADJUSTABLE ARCH CENTERS

One of the most economical features of the erection methods, which at the same time contributed largely to the rapidity of the concreting of the arched ribs, was the use of steel centering. As shown in one of the photographs, these three-hinged-arch steel centers were erected as braced units in two pairs of two each for the pair of ribs in one half of the roadway width. To the top chords were bolted 3 x 12-in. timber spiking pieces to take the 3-in. lagging, and the rectangular box for each rib was built in place. Centers for five arched spans were used, these being applied successively in the longer spans.

By using parts of these large centers and adding temporary members at the haunches, the centers were made for all remaining spans, except the three spans at each end. Timber centers were used for the three short spans at both the south and the north end, the centers for the two ribs being left in place until the first half of the viaduct was completed, and then rolled into position under the second half.

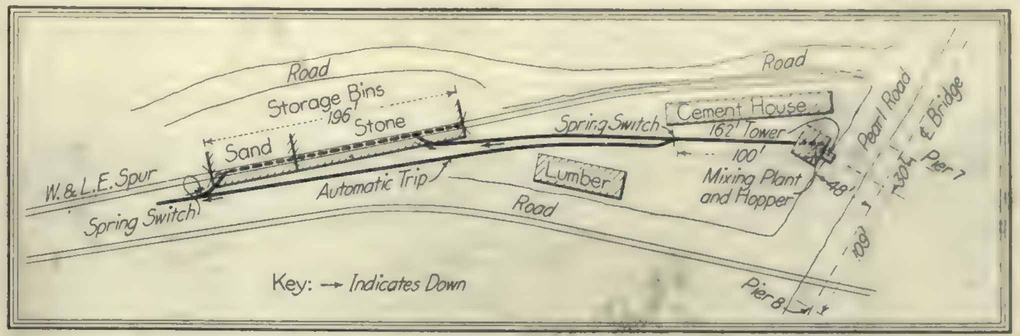
As the arch centers were not designed to carry more excess unbalanced weight of concrete than the weight of one panel, the spouting was arranged to insure alternate pouring on each side of the crown of the arch. The concrete was guided down the outside of the top lagging for the rib forms until it reached a hole cut just above the level to be filled. In this way the pouring was controlled and danger from excessive unbalanced weight avoided.

All the steel arch centers were supported on the reinforced-concrete coping at the springing line of the piers. They were rolled from the west to the east half in some cases. No centering supports were carried to the ground.

The concreting of this long viaduct was accomplished by using two mixing plants and chuting from towers at these plants, using relay towers. They were located on railroad sidings, one on the Baltimore & Ohio Railroad and the other on the Wheeling & Lake Erie Railroad. The former fed one relay tower north and one south of the plant tower, while the latter fed one relay tower north of the plant tower. One of these plants, with its material storage yards, is shown in an accompanying photograph, and the scheme adopted for the rapid handling of materials is indicated in the drawing.

The aggregates were delivered in hopper-bottom cars run on the trestle shown and deposited in the material bin, while the cement was stored in a house located on the material spur and adjacent to the mixing plant. The material tracks were laid underneath these bins and $1\frac{1}{2}$-yd. dump cars hauled by cables in two-car trains were loaded with the aggregates and hauled over the middle of the 70-yd. hopper above the mixer. A partition across the middle of this hopper separated the sand and stone supply, and the cars were dumped either to right or left, according to the material carried. The hoist then permitted the train to return by gravitation. The cable was automatically released at the bottom of the incline and the train was switched under the bins again and loaded.

The cement was wheeled to the mixer platform, at the level of the top of the charging hopper, by ordinary baggage trucks. The top of this charging hopper was below the material hopper or bin. The materials could thus be proportioned as desired when charging, the quantities of sand and stone being noted by the levels in the separate hoppers. A mix of 1:3:6 was used for the piers and abutments, 1:$2\frac{1}{2}$:5 for the retaining walls and 1:2:4 for the arch ribs, posts and floor system.

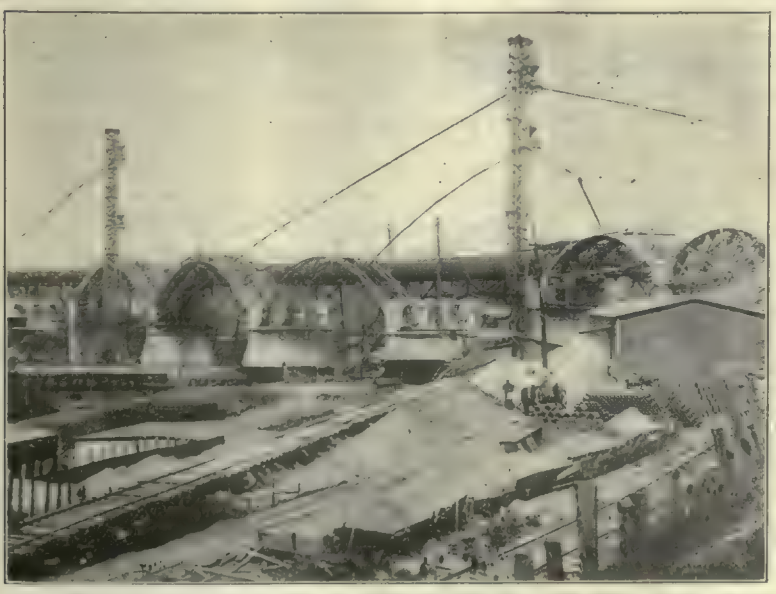


PLAN OF NORTH CONCRETE PLANT SHOWS HOW MATERIALS WERE HANDLED

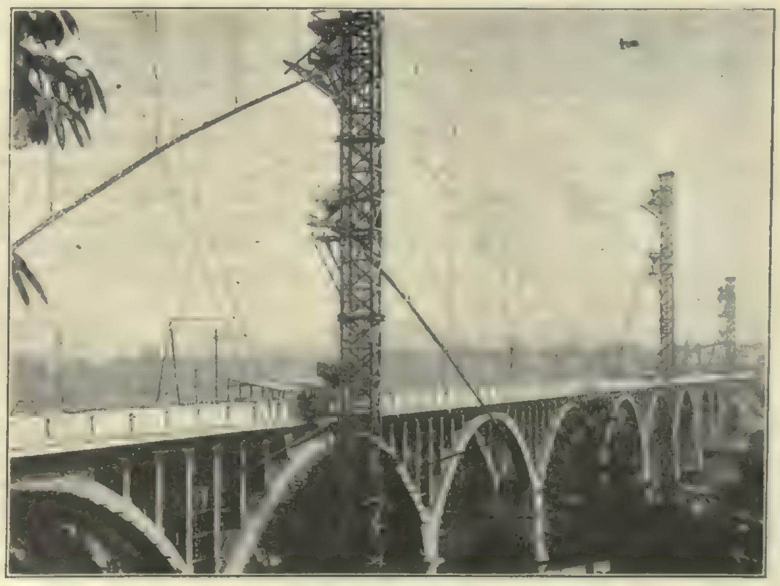
RAPID CONSTRUCTION PROGRESS

An especially good record for one mixer of 539 cu. yd. in one 9-hr. day was made on the work, but the average was about 50 yd. per hour while running. Owing to the small sections being concreted, it was rarely possible to continue running for a whole day; in one week, however, 2500 cu. yd. were placed.

While the work really began in September, 1914, only about 4000 cu. yd. were placed that year in footings and piers, so that the main structure has been erected since March 8, 1915, the date of starting



FIRST HALF OF ARCHES UNDER CONSTRUCTION—HIGH TOWERS AND LONG CHUTES DELIVER CONCRETE



FIRST HALF COMPLETED—SIDEWALK SHELTER AT TOWERS FOR PROTECTION WHILE POURING OTHER HALF

for the 1915 season. One half of the roadway for the whole length was complete July 21. It was then necessary to wait until the paving was finished and traffic transferred from the old viaduct to the completed half before the second half could be started. This caused the loss of over one month, until Aug. 25, and between Aug. 25 and Nov. 5 the second half was finished. The contractors state that they could have completed the whole bridge in practically the same time it took to build one half.

SURFACE FINISH—RAILING

All the exposed surfaces showing in the elevation of the bridge were rubbed by a wooden float in water as soon as the forms could be stripped. This was done within 24 hours in all cases where no loads were carried by the concrete. All the piers were rubbed in the same way up to the level of the springing lines of the arch ribs.

The solid paneled sandstone railing shown in one of the photographs is exceptionally heavy, containing nearly 5 cu. ft. per linear foot. It was handled by a gantry crane running on a temporary track on the roadway. The posts were first set in place over anchor rods, then the panels erected between them by doweling the various sections together.

The viaduct was built by Cuyahoga County, Ohio, after the design made under the direct supervision of A. W. Zesiger, bridge engineer, with W. A. Stinchcomb, county engineer. W. H. Baker was resident engineer for the county. The construction was carried out by the Bates & Rogers Construction Company, of Chicago, with C. S. Smith as resident superintendent.

FLOOR REINFORCEMENT FOR SECOND HALF PROJECTING FROM COMPLETED HALF
Old steel viaduct on right to be removed before second half is begun.

Concrete Paving Statistics

Statistics compiled by the Portland Cement Association show, by states, the number of square yards of concrete road, street and alley pavements in the United States which have been contracted for between Jan. 1 and June 1. The figures are: Roads, 6,066,204 sq. yd.; streets, 4,136,327 sq. yd.; alleys, 44,933 sq. yd.—a total of 10,247,465 sq. yd.

Engineers and the New Nationalism

The Great Industrial Problems To-day Are Human, Not Mechanical—Engineer's Position Puts Solution in His Hands

By FRANCES A. KELLOR
Assistant to Chairman, Immigration Committee, Chamber of Commerce of the U. S. A.

IN the selection of 30,000 engineers to take an inventory of industries, to serve as the basis for mobilization, the Naval Consulting Board is revealing the engineer as the future big civic factor in individual plants and as the foremost agent in the nationalization of business. This inventory will not only give the government information, it will give the engineer training and a vision of industrial organization and responsibility which he has but dimly realized as he struggled with world-wide problems in his corner of the plant.

When the industry was content with a "welfare" department or secretary for the benefit of its men, the social worker, the reformer, the misfit in regular departments, the outside agent, was placed in charge. The Safety-First movement, combined with first-aid work, spelled the doom of the irresponsible outside agent, and placed the engineer in the saddle. With the growth of functional management and scientific management, the engineer has become even more important. And now comes the call of the nation for the development of industrial resources and the conserving of materials. Already there are signs that this is but the beginning of national service for the engineer.

THE GREAT PROBLEMS

The great problems before industry today are not mechanical, but human—the conservation of men and the regularizing of industry, which will stabilize the labor supply. America is short of men. Many immigrants have returned to the home country; many others will go at the close of the war. Canada and South America are competing for immigrants. Canada is even now invading America to fill her vacant farms. We may be sure of one thing, industry cannot obtain workers after the war upon the same terms as before. Human beings have become more precious, and those in the trenches that return to hard labor will be less easily adjusted to peace conditions. The reserves in America to supply the existing demand are women. Many thousands of them have already been drawn into industry for the first time without adequate provisions for housing and protection being made for them—the usual wasteful American way. The other reserve is the negroes of the South, who are already being brought North to work on farms.

ADJUSTMENT NECESSARY

This again requires industrial and social adjustment, to which we have given but little thought. It is obvious to the industrial leader who is thinking about this problem that he must take steps to keep his men in the plant, to keep them in condition and contented with conditions. Immigrants have been given jobs in America, but little or no job stakes or home stakes. Many of them will not stay in America for high wages and short hours alone. They constitute the thousands of "birds of passage" that go back and forth between seasons in times of peace—with their labor power idle and their American wages to be spent elsewhere. It is not enough to keep men in condition and at work most of the time. The average labor turnover in America is about 200 per cent in the industries upon which America must primarily depend in time of war. In other words, for every 100 kept at work 300 are employed. This is sheer waste of men due to lack of combination in the regularizing of industry and employment of men.

In the past we have relied upon the economist and the professor to tell us about unemployment, irregularity of work, vocational education and similar industrial questions. The laboratory for study has been the employment agency and the lodging house, and the remedy—a law. In the future it will be the engineer who studies the problem in the plant, and the remedy will be the adoption of measures within industry itself which will make laws as unnecessary as they are useless to deal with such questions.

PROPOSED SOLUTION OF LABOR PROBLEM

America has to-day no system for distributing labor. We are trying to get it by establishing a Federal Bureau of Employment. It will succeed just in proportion as business uses it. We have for years witnessed "back-to-the-land movements," colonization schemes, land booms. They will succeed permanently only when industry establishes itself and furnishes jobs, and when agriculture organizes and obtains a system of rural credits enabling men to stay on the land until it becomes productive. We are building our distribution system without plans or specifications—a base here and a girder there, over which only an aeroplane could take us. When the engineer grapples with the problem of distribution he will give us a structure on which

men can and will travel to work best suited to their needs.

There is no better illustration of the engineer's coming usefulness than in housing. We have long considered this a civic and welfare matter, but not as an industrial item, powerful in its influence to stabilize or disorganize the labor market. It is true that on a welfare basis corporations and employers can do and have done much in the way of providing "model housing" for a certain percentage of their men. But to provide adequate housing in a new community, or in a rapidly expanded old community, not only for a percentage of the higher-grade workmen, but for all the workmen in the plant, is plainly outside the welfare field.

This is true for two reasons. One of these is that workmen normally wish to have their own houses, arranging for renting or buying them on an independent basis. The second reason is that the houses that are built for several thousands of workmen are in the aggregate the making of a community, and it is in the nature of American character and institutions that the standards of that community should be controlled by the individuals that make it up. The standards they evolve may be better or worse than those that would be evolved for them by a kindly employer, but that the standards will belong to the men themselves—if the community is a creative and growing community and not merely an industrial camp—is proved by the whole industrial tradition of America.

The Engineer the Real Town Planner

But even while this is true it is also true that the employer or the corporation which is responsible for the creation or expansion of a given town sets its housing and its community standards in the very beginning. Naturally, the employer's influence controls many of the things that are to determine the possibilities of the town. He may own or control the land around the factory, perhaps to the extent of half the town. He is probably a determining factor in transit facilities, water power, etc. Above all, he is the one man in the place who is in a position to map out the town with a view to both its industrial and its civic future.

Whether or not he has any aspirations to the office, he is the "town planner" by every implication of his position. His consulting engineer and the engineers that actually control the physical conditions in and around the plant are the real makers of the city or town that is to be. In a housing competition recently instituted, the chairman of the education committee of the special housing committee in charge of the contest is an engineer, and at least one-half of the committee are engineers. The conclusion of the whole matter is this: The engineer is the only man who can, in an expert way, translate the industrial-welfare movement into a sound industrial and community movement.

The model sanitary and housing conditions and much of the educational work on the aqueduct—the source of New York City's water supply—were in charge of engineers. We cannot import into a big construction project a committee of social workers or of social housing experts. Everything that is done in the way of housing the men and establishing standards in a community must be done with direct reference at every point to the actual project in hand. Only the engineer has his hand on every one of the considerations that must come into any plans that are made for housing or community existence.

Engineers and the Public Need

One of the most interesting aspects of the national-defense movement has been the way in which it has stirred various specialized groups in American life to see their work with reference to other groups and from a national perspective. The medical profession shows now, through its journals and through the utterances of various of its representatives, a distinct sense of its potential value as a profession in a national-reserve plan. Chemists, wireless operators, automobile manufacturers, etc., show the same realization. They show also a desire to put the realization into practical effect, and to be guided by it in such matters as making methods uniform, standardizing means of production, etc.—all with a view to efficiency from the point of view of the national need.

The enthusiasm with which engineers have taken up their work with the industrial preparedness committee of the Naval Consulting Board, and the evidence from the sub-committees in the different states of the business-like way in which the work is being carried out, testify to a keen interest on the part of the engineering profession as a whole in a piece of work whose significance to the profession is entirely new. *One of the great results which the work of the industrial preparedness committee will produce in the different states will be a body of engineers distinctly aroused to the economic and industrial needs of the country, as locally represented.* The information that these men will obtain, and the attitude which they undoubtedly will develop, will be a tremendous potential asset to the country. It should be used when the work of the industrial preparedness committee is done. In short, we want the engineers as a permanent economic and social reserve corps in a work that has long been needing their attention.

Americanization

In the movement toward Americanization through industry, for instance, which is now sweeping the country, it is the engineer who must lead the way. Americanization is a practical matter. It is partly a matter of education, it is true, but in the industrial communities of the country the facilities for the education of immigrants are at this moment very largely determined *by the actual physical provision* in the way of schoolhouses and schoolrooms, the location of workmen's houses with reference to the schoolhouse or some other meeting place, etc. So far as housing standards, water provision, etc., go, the movement is entirely in the engineer's hands in the first instance, and there are not very many aspects of it in which he does not bear some part.

When the Safety-First movement became a campaign in need of organizing and standardizing, it was an engineer that shouldered the burden. We are now facing the vital need of conserving our labor supply, stabilizing the labor market and regularizing industry. The need to maintain our present output and to enable America to hold markets after the war is the need of a practical industrial conservation policy—a thing we have never had. Much of our trade energy must be given over to developing industries which have been created or fostered in this country by the war, and which must be retained if we are to maintain industrial independence.

One Standard of Living

We must, therefore, conserve our present supply and plan to keep every resident in America. We can do this by reducing the uncertain element in labor by providing good conditions within the plant and outside, by having a common language, a common citizenship, and one standard of living in America. We can do it by giving each workman a citizenship stake in America—a home stake in the town and an industrial stake in the plant. This is Americanization by industry, serving both the need of industry and of citizenship. It is the engineer who goes first and helps build the plant. At the same time a beautiful, orderly, well-equipped plant is built and a new town started, equally good town planning must be done, and good housing, sanitation, transportation, etc., be provided—at the start. Men must be cared for *from the beginning.*

The Americanization pioneer in the new town is the engineer, and more and more there will fall to the young native-born engineer the task of preserving American traditions and standards and teaching them to strangers. Are our engineering courses that fit these young men taking into account the new responsibilities, and are they doing their share to fit the men for this national service? It would be well for the engineering profession to take stock of these new responsibilities and to see how well the engineering colleges and courses are designed to meet America's test of fitness.

Jealousy of State-Supported Schools Criticised

A. Lawrence Lowell Contrasts Harvard-Technology Co-operation with Rivalry of State Institutions

SPEAKING at the dedication of the new buildings of the Massachusetts Institute of Technology, June 14, President A. Lawrence Lowell of Harvard criticised the rivalry of State institutions drawing their funds from the one public treasury, and contrasted that rivalry with the co-operative plan worked out between Harvard and the Massachusetts Institute of Technology. He expanded also on the enduring nature of educational institutions, citing the histories of some of the world's great universities.

He spoke in part as follows:

Duty of Public Service

"Of late years there has been an enlargement in our ideas of the duty of public service. Institutions of learning are not ends in themselves, but means to a greater end—that of the education and professional training of young men to fit them for their manifold work in the world. This is no less true of institutions endowed by private generosity than of those that are supported and managed by the state. Both are in equal degree public servants; both should have the same aims, duties and responsibilities. It is in this spirit that the Massachusetts Institute of Technology and Harvard University have agreed to co-operate in engineering and mining education, in order by so doing to render together a greater service to the public, in such form as the court may

decide that we have a right to do it. By this spirit we have shown that we are more quick in our sense of public duty than some State institutions which, although paid from the same public treasury, maintain a needless rivalry at the public expense; while the general approval of our graduates shows that in their sojourn here they have been impressed with a larger sense of public service than those alumni of state institutions who have thwarted such a fruitful policy.

Most Enduring Human Creation

"The reward of public service is the opportunity for still greater service; and to the institution of learning that has used well and faithfully one talent, men will intrust the more. This has been our experience here in the past, and it will be so in the future. Men die and pass away, but these institutions remain, and our work here is not for ourselves but for them—the most lasting of all things. Forms of government change. Monarchies are replaced by republics, and these in turn decay. The boundaries of nations are removed; races melt away to re-form on different lines. But the University of Bologna has outlived all the small Italian republics—all the convulsions and transformations through which the country has passed—and stands erect to-day. The University of Paris has seen the expansion of the small monarchy over the whole territory of France, and has outlived it, and outlived many changes in the government.

"England has had a less checkered career, but one that has been less unshaken than that of Oxford or of Cambridge. From ten years after the settlement of Boston, throughout the times of the colony, the Revolution and the history of the United States, Harvard University has grown stronger and stronger on the banks of the Charles; and the Institute of Technology has existed for only one of the many half centuries to which we look forward with confidence. The most enduring human creation known to modern history is the institution of higher learning. It endures because it renders a public service with which the world cannot dispense."

NOT THE FULL HEIGHT OF THE FILL—ANOTHER TRESTLE ON TOP IS TO BE BURIED

185-Foot Fill of Bessemer & Lake Erie Railroad Reaches Beginning of Last Stage

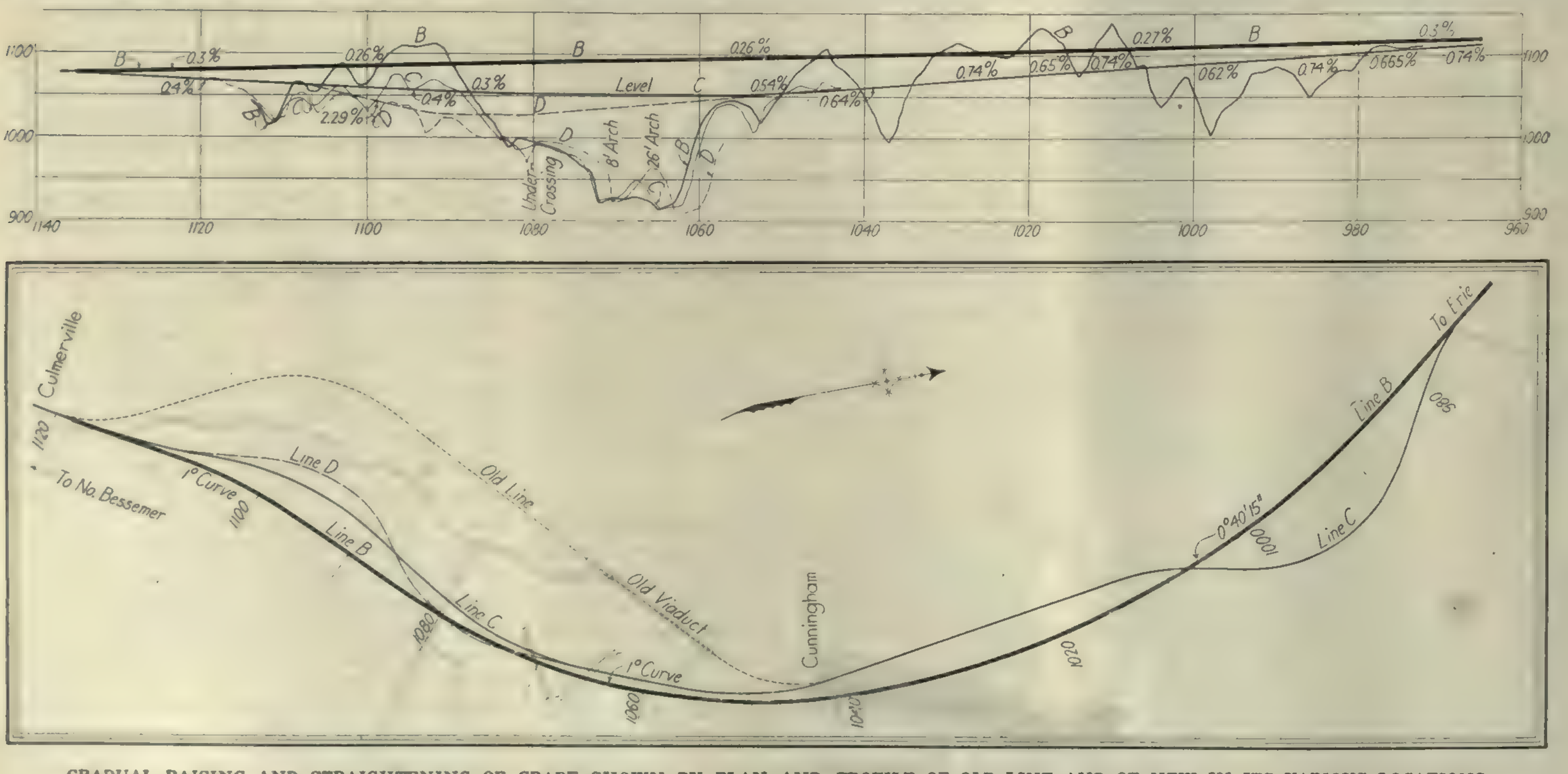
Contents of 88,000 Railroad Cars Have Already Been Consumed in 4,500,000-Yard Embankment, and Trestle for Final 50-Foot Lift Is in Place

A FILL that will reach a maximum height of 185 ft. and a bottom width of 600 ft., one that has been consuming an average of two train loads of steel-mill refuse per day for the last three years (enough cars to reach more than half way from New York to Chicago) and will still require 1,000,000 cu. yd. for completion—this is the present outstanding feature of the grade-reduction program that the Bessemer & Lake Erie Railroad has been carrying out on its line for many years. The fill is located near Culmerville, Pa., about 25 miles from Pittsburgh. Sweeping around well up the sides of a range of hills on a 2-mile curve, 1 deg. in part and 40 min. in part, the new line, besides taking up a sag and replacing a large part of a 0.75 per cent grade with a 0.3 grade, breaks away from the old line, eliminating several curves and shortening the line considerably.

It also eliminates a steel viaduct 1545 ft. long and 155 ft. high, and this structure is now being removed and transplanted as a dumping trestle at the site of the Allegheny River bridge of the same railroad, where another large fill is to be made. Three trestles have been buried in the fill at Culmerville, known as the Bull Creek fill, which now rises to a maximum height of 135 ft. and carries the two main tracks. A fourth trestle alongside the main tracks and rising 50 ft. above them marks the ultimate top of the fill. Up to March 1 the contents of 88,446 cars had been placed in the embankment. Probably 25,000 more will be required. The entire fill is being made by company forces, at a cost of about 20 cents per yard.

Disposing of Steel-Mill Refuse

The Bessemer & Lake Erie Railroad, which is controlled by the U. S. Steel Corporation and extends from Erie and Conneaut Harbor on Lake Erie to a connection with the Union Railroad near Pittsburgh,



GRADUAL RAISING AND STRAIGHTENING OF GRADE SHOWN BY PLAN AND PROFILE OF OLD LINE AND OF NEW IN ITS VARIOUS LOCATIONS

Line *D*, temporary construction; line *C*, present location; line *B*, final location.

AN EARLY STAGE OF THE WORK—ULTIMATE FILL WILL BE 50 FEET HIGHER THAN OLD VIADUCT ON LEFT

A GOOD PART OF THE MATERIAL HAS TO BE SHOVELED FROM THE CARS—NOTE LENGTH OF 8-FOOT CULVERT

is used primarily for handling ore from Lake Erie to the Pittsburgh steel mills and for handling coal and steel in the opposite direction. As this traffic is heavy the line is double-tracked, and much money has been spent in the last fifteen years to reduce the grades and curvature. The considerations affecting grade revisions are entirely different from those of the average railroad. When the steel mills are in full operation the railroad is called upon to dispose of several train loads daily of slag and other steel-mill refuse. Consequently, when a grade reduction is contemplated the profile sought is not one that will balance cut and fill, but one in which the excavation will be minimized and the embankment held within reasonable but liberal bounds. In the Bull Creek fill the total excavation will hardly exceed 100,000 cu. yd., as compared with 4,500,000 cu. yd. of embankment.

LINES B, C AND D

In the accompanying plan are shown three lines, *B*, *C* and *D*, together with the original line. Line *B* is the ultimate alignment. Line *C* is that followed by the main tracks at present. Line *D* is that of an earlier temporary construction location. An examination of the accompanying profile will explain these lines. The deepest part of the fill is in the vicinity of Sta. 1065. At about Sta. 1055 the ground line comes up to the present profile, although the ultimate profile will still be on a 50-ft. fill. A nose projects westward across the lines about Sta. 1095; and while the high profile rises well over the top of this, it was necessary to swing the lower lines out around it to avoid excessive excavation. Another line, line *A*, was contemplated which would have made no swing around this nose, but would have carried the Culmerville tangent north to tangency with the long curve at about Sta. 1070. This was abandoned, however, because it made the cut excessive.

The line *C*, joining the old line at Cunningham, although only a temporary line, has a better alignment and virtually the same profile as the original line. Except where it swings out at Sta. 1095 to avoid the cut, it falls entirely on the large embankment, and therefore did not require any considerable amount of extra grading. Cunningham is at the foot of a 4-mile northbound ascent on what is now the ruling grade, 0.75 per cent. By giving the new fill another lift, beginning the ascent at the tunnel just south of Culmerville and running up on a 0.3 per cent grade, compensated, the new profile finally intercepts the old nearly half way up the 4-mile ascent, and thereby greatly reduces the problem of bringing the rest of this grade down to 0.3 per cent. At the same time the new line, from Cunningham to the point of crossing with the old, is on higher ground, so that the long sweeping curve at once improves the alignment and reduces the yardage.

WORK BEGUN IN 1912

Work on this improvement was begun in September, 1912. The line *D* was built on a 3 per cent grade from the old line to the south end of the low-level trestles. This trestle had a maximum height of 70 ft. The form of construction is shown in some of the photographs. Longleaf yellow pine was used for the longer timbers and maple or native wood for the shorter lengths. When this trestle had been filled, which was about April, 1913, a second one was built on the same level parallel to and some distance from the first. This had been filled by November, 1913, and during the winter the space between trestles was filled and the tracks were jacked up about 10 ft.

In the spring of 1914 a new trestle 45 ft. high was placed on top of the first lift, on the line *C*. This trestle was all filled, and since then spreading has been done from it, and the entire embankment has been given an additional lift of some 10 ft. The main tracks have been located on the line *C* and have been in service since May 31, 1915. The embankment at this height is of ample width, so that the trestle for the final lift could be built on the line *B* without interference with regular operation on the line *C*. This last trestle is practically completed, and dumping from it has begun.

TYPICAL 70-FOOT TRESTLE — LONGER TIMBERS LONGLEAF YELLOW PINE, SHORTER ONES MAPLE OR NATIVE WOOD

The removal of the viaduct on the old line, which, as previously stated, was 1545 ft. long and 135 ft. high, has been nearly completed. This viaduct is to be re-erected 9 miles south alongside the north viaduct approach of the bridge over the Allegheny River, which is being reconstructed as a double-track bridge. (See the Engineering Record of June 3, page 744.) The viaduct in its new location will be used simply as a dumping trestle, to avoid interference with traffic on the main line. The viaduct will be completely buried in the fill.

CULVERTS 700 FEET LONG

In connection with the Bull Creek work several long culverts were necessary, two of them being under the deepest part of the fill. Bull Creek passes under the fill through a 26-ft. arch 716 ft. long, while another creek occupies an 8-ft. arch 678 ft. long. There is another 26-ft. arch 311 ft. long carrying a highway, and in connection with the grading of this highway over a deep fill it was necessary to build a 6-ft. waterway arch 174 ft. long under the highway. A conception of the length of these culverts is given by the view showing cars being unloaded from a trestle.

The progress of this work has been governed largely by the supply of material from the steel mills. The work, it has been noticed, was started more than three years ago. During this time an average of nearly 100 cars has been unloaded in the embankment each working day. Up to March 1, as previously stated, 88,446 cars, averaging probably 35 cu. yd. each, have been unloaded in the embankment. Last February 1685 cars were so unloaded. From now on, as a good profile and alignment on the new embankment have been obtained, and as other improvements, particularly that at the Allegheny River bridge, will demand a good part of the available refuse, progress will be slower.

The material making up the fill takes a slope of about $1\frac{1}{2}$:1, and there is little or no shrinkage. There has also been no trouble from slips, although earth and clay embankments in the vicinity have given much trouble. The upper-level trestles have held their line well.

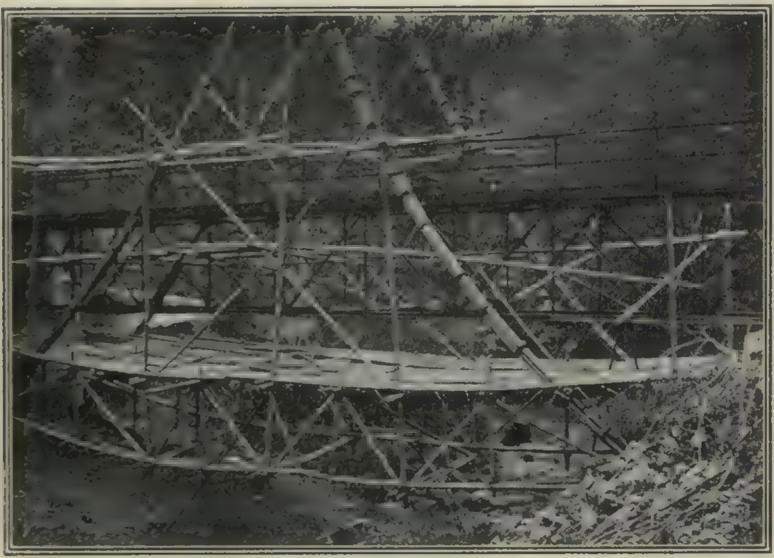
This grading and trestle work, like most

of the grade-reduction work and double-tracking carried out by the company in the last ten years, is being done entirely by company forces. Although it has been necessary to shovel a good part of the material, for the reason that the company gets the cars from the Union Railroad and has no control over the class of cars used, the entire grading work, which includes the trestles, but excludes the land and the culverts, has been done at a cost of about $6 per car, or less than 20 cents per cubic yard. The work is handled by the regular organization of the Bessemer & Lake Erie Railroad, of which H. T. Porter is chief engineer.

Falsework Lashed Together With Vines on Java Bridge

BY J. W. SWAREN

VINES were used to lash together the bamboo falsework for a steel frame bridge recently completed by a Chinese contractor in Java, using native labor. The material used for the falsework cost $16, and the labor of putting it in place $24. The ingenuity of the contractor in using vines, gathered from a jungle near the bridge site, to lash the falsework together was doubtless partly responsible for the low cost.



BAMBOO FALSEWORK UTILIZED IN CONSTRUCTING BRIDGE

The bridge was built in a single span of about 29 ft., with roadway about 10 ft. wide, to permit the transporting of tea machinery and Pelton water wheels into a new tea growing section.

Fewer People Use Brooklyn Bridge

More passengers use the Williamsburg Bridge in twenty-four hours than pass over any of the other three East River bridges in New York City, according to a count of the bridge department of that city. The daily travel in both directions over this bridge was 327,134. Travel over the Brooklyn Bridge, the next in importance, fell off 16 per cent from the year previous, the number crossing the bridge in 1915 being 243,617 in one day. Travel over the Manhattan Bridge more than doubled because of the opening of the Fourth Avenue subway, 111,314 persons using this bridge daily. The daily travel over the Queensboro bridge increased slightly to a total of 93,654 persons in twenty-four hours. The daily traffic increased by 47,144 passengers to 804,146 for all the bridges.

Engineers Allocate All Uses of Illinois River —Floods, Farming and Fisheries

Alvord and Burdick Define Flood Rates to Be Expected, Waterway Sufficiency and Interests Involved, and Recommend Raising Levees

ENGINEERS have for the first time made a comprehensive study of all the complex problems of the Illinois River relating to flood control, to the effect of the extensive reclamation of farm lands within the past ten years and to the rise and decline of the fish industry. In the 140-page report of John W. Alvord and Charles B. Burdick to the Rivers and Lakes Commission answers are given to these questions: (1) What future floods may be expected? (2) Can the present waterway care for them? (3) What interests are affected by past and probable future improvements, and how? (4) What plan will correct the deficient waterway and produce the maximum benefit to the local interests and to the public? The answers given are as follows:

1. Once in fifty years there may be expected a flood 35 per cent greater than that of 1904, when the rates reached 80,000 sec.-ft. at Peoria and 125,000 sec.-ft. at the mouth of the river. These rates are equivalent respectively to 5.94 and 4.48 sec.-ft. per square mile.

2. In the lower one-third of the river farm-land levees have reduced the width of the flood plane by about 80 per cent and have reduced the cross-section of the flowing stream in a great flood to about 25 per cent of the available cross-section of the 1904 flood. Although a large part of the flood flow has always passed by way of the channel, the velocity being comparatively slow upon the land, it is concluded that the farm-land levees are a menace to themselves in that they have restricted the flood-water channel to such an extent, and are so lacking in height, generally speaking, that they are likely to be overtopped in a great flood. As the protection afforded to different districts is quite variable, it is evident that the lowest levees will suffer first and will tend to protect the higher levees. If all the districts are to be protected, however, a greater available flood cross-section must be provided, which may be accomplished in several ways, or the flood rates must be reduced through storage.

3. The predominant interests in the river valley are agriculture and fishing. There are other important interests at Peoria and at a few of the other cities bordering the stream.

Since 1904 the construction of levees for the protection of the bottom lands has proceeded at a rapid rate. The total leveed lands are estimated at 171,725 acres. These lands have been protected from floods at an estimated cost of $30 per acre. The estimated full value of these lands is $112 per acre. Projected levee districts aggregate about 49,250 acres.

It is estimated that the leveed lands produce crops to the value of $3,000,000 per annum, and that when these districts are fully cultivated they will be capable of producing $5,000,000 per annum. With the projected districts completed and fully cultivated, together with a small acreage upon the higher ground, now successfully cropped without levees, the total yield from agriculture will be $6,500,000 per year. The fish crop was worth $860,000 in 1908, but is now about one-half of that. The annual catch upon the Illinois River had gradually increased from about 6,000,000 lb. in 1894 to 12,000,000 lb. in 1900 and 24,000,000 lb. in 1908. The great increase is probably largely accounted for by the rapid increase of the German carp, which first began to appear in the catch of the Illinois River at about the date of the earliest statistics above mentioned. All fish life was undoubtedly stimulated by the increased stages of water that have prevailed since 1900. The decline since 1908 is probably due to a number of causes, including the lesser flood stages prevailing in recent years and the large number of lakes (about 17,740 acres) excluded from the river through the construction of agricultural levees, shutting off the breeding and feeding grounds of fish and the places where the larger part of the seining has been done. About 36 per cent of the original lake acreage has been inclosed since 1908.

Agriculture is the predominant interest of the valley and now furnishes and will hereafter furnish a much greater addition to the wealth of the state than is produced or can probably be produced hereafter by the fisheries. As far as possible, however, both interests should be promoted in harmony.

RESERVOIRS AND FISH CULTURE

In Europe, where the flood problems and the fisheries have been studied for a longer time than in America, the suggestion has been made to promote the fisheries and reduce the floods upon the diked rivers by admitting water to certain of the leveed districts in rotation during each spring season and allowing the water to return to the stream during the low-water season. All this is done with the object of reducing the spring freshets, artificially providing overflowed land for the breeding and rearing of young fish and the periodical enrichment of the land by the sediments of the flood waters. An endeavor was made to demonstrate the practicability of such a scheme upon the Illinois River.

No great flood has occurred upon the river since the occupation of the valley by levees approaching the present scale of development, but it is estimated that if the 1904 flood should be repeated under the same conditions of water level in the Mississippi, a number of levees would be overtopped. If a flood 35 per cent greater in rate than the flood of 1904 should occur, and if such a flood should enter the Mississippi at the height of water prevailing in 1844, more than one-half of the levee districts would be flooded, and under the conditions of levee construction likely to

prevail in the future nearly all the levee districts would be flooded.

The exclusion of the flood waters from the bottom lands through the construction of levees has a tendency to increase the flood run-off rates of a stream. The net effect of all the levee districts so far constructed would probably increase the maximum flow rate only about 5 per cent, and when the bottoms are fully leveed about 10 per cent. This rather unexpected result is accounted for by the fact that in an excessive flood, such as the flood of 1904, the valley is practically filled with water several days before the apex of the flood, and the maximum flood rate occurs at a time when the gage height is nearly stationary for several days before and after the apex. A smaller stream or a more flashy stream would doubtless make a better utilization of the storage in its valley.

4. In general there are three ways to increase the available prism for the passage of flood waters. The width of the flood stream may be increased by setting the levees back a greater distance from the river bank, but this remedy is impracticable on account of the cost, except where new levees are to be built. The flood-water prism might also be increased by lowering the bed of the river, as in the construction of a deep waterway. In the opinion of the engineers dredging operations undertaken especially for this purpose would be too costly as compared with other remedies, and none of the projects for improved navigation would affect the flood-water levels any sufficient amount to be of material benefit.

HIGHER LEVEES RECOMMENDED

The available cross-section for flood waters can be most economically enlarged by increasing the height of the levees. The circumstances would seem to warrant the building of levees to a height about 3 ft. above a great flood, assuming it to enter the Mississippi River at about the height of the flood of 1904. The excess height of levees is recommended to provide for wave wash and in emergency as a small factor of safety, to prevent disaster in case of a greater flood. It is believed that in the protection of these farm lands the danger from loss of life is small and, therefore, that it is not wise to provide against a flood of extremely rare occurrence or to provide a factor of safety that would be justified in the protection of a city where great loss of life might result from the unexpected.

To comply with the above recommendation the higher levees at present would be increased from 2 to 3 ft. The lowest of the levees lie about 6 ft. below what is regarded as a desirable elevation. As nearly as can be estimated from rather incomplete data, the cost of bringing all the present levees up to the desirable plane would be about $2,532,000. The total expenditure, including this item and also the total cost of all future levee districts, is estimated at about $8,154,300. If all future levee districts should be so built that they might be utilized for storage of the apex flood waters, the necessary levee heights in the upper three-quarters of the river could be reduced from 2 to 3 ft., but this would still require that nearly all of the levee should be increased in height at a total estimated cost of $1,592,000. The total expenditure, including this item and also the total cost of all future levee districts, is estimated at $5,389,000.

Giving the storage proposition the benefit of all the doubts, including the practicability of manipulating the reservoirs during the flood and the benefit accrued to the fisheries, it is estimated that the largest financial return to the community will be effected through the utilization of the bottom lands for agriculture and increasing the height of the levees such an amount as is necessary to protect the lands. The predominance of the agricultural interest does not require that the fisheries of the Illinois River should be abandoned. It is believed, notwithstanding the present and future of the levee districts, that a scientific utilization of the remaining public waters, including the river and twenty or more meandered lakes, together with the best use of the remaining undiked bottoms and the spaces between the river banks and levee toes, will result in the maintenance of a valuable fishery.

MACHINE SPREAD SAND FOR SEAL COAT

PAVEMENT COMPLETE BUT FOR SHOULDERS

Pennsylvania Will Try Wider Freight-House Platforms

A platform 10 ft. wide instead of 8 ft. on the track side will be provided in a freight house which the Pennsylvania Railroad is about to build in the Pittsburgh district, according to G. W. Snyder, principal assistant engineer at Pittsburgh. The company has found that because with the 8-ft. platform, trucks cannot conveniently pass outside of the building, it is virtually necessary to reserve a trucking lane inside of the house. By adding 2 ft. to the width of the outside platform it is thought that this waste of space inside will be eliminated.

Bitulithic Pavement Laid Over Old Gravel Road

Construction Methods Explained and Costs Given for 5⅓-Mile Section Near Tacoma, Washington

By DAVID H. WHITE
County Engineer, Tacoma, Wash.

UTILIZING an old gravel road on alluvial soil as the sub-base, Pierce County, Washington, has laid a 5 1-3-mile section of bitulithic pavement on the road which begins at Alderton, about 15 miles southeast of Tacoma, and ends at Orting. The pavement has a 2-in. bitulithic top, is 16 ft. wide, contains 49,878 sq. yd. and is laid on a 5-in. 1:3:6 concrete base, with 6-in. concrete curbs. The base and curbs contain 52,979 sq. yd. The curbs are monolithic with the base; 3-ft. bank-run gravel shoulders make the total width of the roadway 23 ft.

The contract was let to the Washington Paving Company for $76,549 with a 5-yr. maintenance bond costing $500 extra, making the cost to the county $1.445 per square yard, divided as follows: Subgrade and extras, including curbs, 23.4 cents; concrete base, 60 cents; bitulithic top, 68.6 cents. The cost per mile was $14,391.61.

MATERIALS AND PLANT

Sand for the bitulithic top and sand and gravel for the concrete base were obtained from a pit, owned by the contractors, 0.6 mile from McMillan, where the bitulithic plant was stationed. It was 2.2 miles from one end of the pavement and 3.2 miles from the other, making the average haul for the aggregate for concrete 1.95 miles and the average haul for bitulithic mixture 1.35 miles. Crushed granite rock for use in the bitulithic top was furnished to the contractor at cost from the county-owned quarry at Kapowsin. The contractor paid freight on the crushed rock at 1 cent per ton per mile from Kapowsin to McMillan, a distance of 13 miles. Cement cost the contractor $2.30 per barrel delivered on the work, with a rebate of 40 cents per barrel for sacks.

In the construction of this work a one-car asphalt plant was used by dividing the sand bin into four compartments. The plant consisted of a rotary drum to heat the sand and rock, oil being used for fuel. Elevators lifted material into sizing screens over the bins. Bitulithic cement was heated in three kettles by coal and staves of barrels. The weighing machine had a scale of seven beams, weighing platform, buckets and mixing boxes. The crushed rock and sand were piled separately near the end of the rotary drum and a two-horse scraper was used to bring the rock and sand to the ele-

vators for delivery to the heating drum. It takes about 4 min. from the time the aggregate starts in the drum to reach the bin. The rock is heated to from 240 to 250 deg. Fahr. After leaving the drum the aggregate is lifted onto the screens, which separate it into four sizes, passing into the bins as follows: Bin 1, aggregate passing a No. 10 mesh; bin 2, passing ¼-in. screen and retained on No. 10; bin 3, passing ½-in. screen and retained on ¼-in.; bin 4, passing 1¼-in. screen and retained on ½-in.

The following proportions were generally used, though some little variation was made to fit different material: 315 lb. from bin 1, 90 lb. from bin 2, 140 lb. from bin 3, 440 lb. from bin 4, and 15 lb. of dust finer than 200 mesh. This makes 1000 lb. of aggregate, to which was added 88 lb. of bitulithic cement heated to a temperature of 250 deg. These materials were carefully weighed, passed into a twin pug mill and thoroughly mixed for about 1 min. and 40 sec. Then they were dumped into a wagon which stood underneath. The mixture was hauled by teams and dumped onto the street, shoveled over until it was about the thickness required, raked and spread as nearly smooth as possible. It was then thoroughly rolled with a 10-ton roller until no appreciable compression appeared.

After the rolling was finished a squeegee car spread the bitulithic cement, which was heated in kettles on the street. The top was thoroughly coated with the bitulithic cement, using approximately ¼ gal. per square yard, and then covered with hot screenings from bin 1, with a little excess sand put on by a sand-spreading machine, which applied approximately 25 lb. per square yard. The pavement was then thoroughly rolled with a 10-ton roller, which completed the process.

Force and Wages

The force required at the plant and wages paid were as follows:

1 superintendent furnished by the patentees, per month	$200.00
4 feeders, 3 using shovels and 1 a hoe, to feed the aggregate into the elevators, per day	2.50
1 foreman, per month	100.00
1 drum fireman, per day	2.50
1 boilerman, per day	2.50
1 hopperman, per day	2.50
1 mixerman, per day	2.50
1 team, per day	5.00
1 night watchman, per day	3.00

From three to thirteen teams, costing $5 per day, were used to haul the material to the pavement.

The street force was as follows:

	Per Day
1 foreman	$4.00
1 rollerman	3.50
1 man cleaning pavement	2.25
1 wagon dumper	2.50
1 tamper	2.50
5 shovelers	2.50
2 rakers	2.50
2 squeegeemen	2.50

Work was begun on the bitulithic top Oct. 21, 1915, and ended Feb. 28, 1916. The total number of actual working days was 48. Work was considerably delayed on account of bad weather and breakdowns in the plant. About 2307 cu. yd. of crushed rock and 1183 cu. yd. of sand were used in the top; 953 cu. yd. of this amount of sand was taken from the river bottom and the remainder from the gravel pit. Of bitulithic cement 508 tons were used, 50 of which were for the seal coat.

Adopts Low Jetties for Shore Protection

Jersey Central Replaces Destroyed Groins at Seabright, N. J., by Longer Ones with Outer Ends at Mean Low Water

LOW JETTIES or groins, with the tops of the outer ends at mean low water, and the shore ends rising only a foot above mean high water, are being built by the Central Railroad of New Jersey along its mile and a half of trackage on the Atlantic Ocean from Highland Beach to Seabright, N. J., to replace higher and shorter jetties which have been practically destroyed by the severe winter storms of a year and two years ago. Like the old jetties, the new ones, with the exception of a stone-filled pile jetty, are of timber piles and sheathing. They are 200 ft. long, however, instead of 75 ft. They are spaced about 300 ft. apart, and the plan calls for twenty-nine new ones and extensions or repairs to three old ones. Fifteen were constructed last year before the cold weather stopped the work.

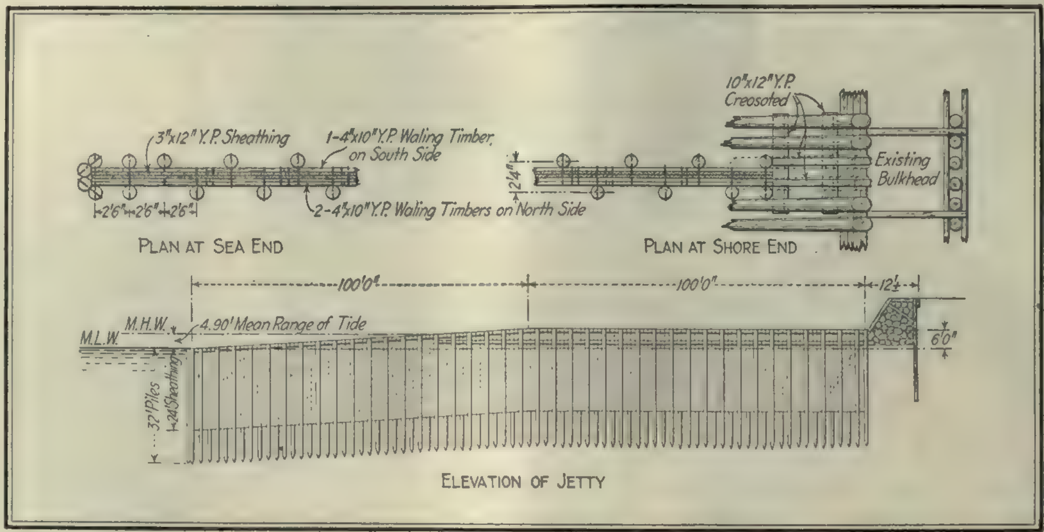
The Central Railroad of New Jersey is peculiarly exposed to the sea at this point on a coast noted for its severe storms. The Shrewsbury River, instead of finding its outlet in the ocean at Seabright, turns north and parallels the coast, emptying into the lower New York Bay at the base of Sandy Hook. This leaves a strip of beach not more than 600 ft. wide, and at points less than 300 ft., the strip culminating in Sandy Hook. The Central Railroad of New Jersey, skirting the south shore of the bay, crosses the Shrewsbury River at its mouth and swings down on this narrow strip of sand, occupying the ocean front for a distance of about 9000 ft.

Jetties Supplement Bulkhead

The double-track railroad is protected primarily by a bulkhead built in 1895, and consisting of rock fill held in place by piles as indicated in one of the drawings. As a further protection, jetties had been built at intervals of approximately 300 ft. in the attempt to build up a beach and afford a permanent protection in front of the bulkhead. These jetties were 75 ft. long and rose entirely above high tide. Violent storms and high seas in December, 1913, and January, 1914 (see the news section of the Engineering Record of Jan. 10, 1914, page 13), and again in January, 1915, destroyed practically all of these jetties. The waves broke over the bulkhead and threw the tracks in some cases off the right-of-way, putting the line out of commission for the time being. While the bulkhead held and prevented any serious washout, the condition suggested the possibility of the pounding waves washing the entire strip into the river.

High Jetties Fail to Hold Beach

It has been observed that when a wave struck the high jetty it broke and dropped its burden of sand on the near side, and that this sand was likely to be washed out by the next wave, so that the jetties were not dependable as beach builders. It was believed that with the jetties built to conform as nearly as practicable to the natural contour of the beach and be low enough for the waves to carry most of their sand burden over the top, this sand would remain and build up, and would in turn protect the jetty itself. It was noted, also, that low jetties would afford much less surface for the destructive action of waves, and much less leverage. Hence it was decided to give them a trial, and, while they have not as yet been subjected to such violent wave action as destroyed the old ones, they have withstood some very high seas.



DETAILS OF LOW JERSEY CENTRAL JETTY THAT HAS PROVED EFFECTIVE

The drawings show the main dimensions and elevations of the jetties. The construction itself is ordinary, except, perhaps, that half of the piles are driven butt down. Last year fifteen of the twenty-nine were built, and it is expected that the remainder will be built next year.

Quick Work by the Teredo

With those first built the timber of the outer 50 ft. was creosoted, but that of the inner 50 ft. was not. While there had been some evidences of the teredo in these waters, the borer had not caused any considerable amount of trouble. The uncreosoted sheathing of the new jetties, however, seemed to show a surprising vulnerability to blows from floating debris, and an examination revealed the fact that some of this sheathing had been practically honeycombed by the teredo in three months. Consequently in August, 1915, it was decided to creosote the entire 200 ft., and no further trouble has been experienced from the marine borer.

The work has been carried out under the direction of Jos. O. Osgood, chief engineer, and A. E. Owen, principal assistant engineer, of the Central Railroad of New Jersey.

Large Columns of Carbon and Alloy Steels Fail Near Yield Points of Material

Among Half-Size Models of Chords for Metropolis, Memphis and St. Louis Bridges Are Largest Columns Ever Tested—Maximum Load, 7,000,000 Pounds

By J. H. GRIFFITH and J. G. BRAGG
Pittsburgh Testing Laboratory, U. S. Bureau of Standards

TESTS made upon half-size models of the exceptionally large chord members for the Metropolis, Memphis and St. Louis bridges (some of which are larger columns than have ever before been tested), composed of high-carbon, nickel, Mayari, chrome and silicon steels, show remarkably consistent results for the ultimate strength or crippling load in relation to the yield point of the component material. The elastic limits averaged a trifle below one-half the ultimate strength. Of the eighteen columns tested, six failed by local buckling or by bending at the jaws, giving striking confirmation of the fact that care in detailing is essential in column design. In all cases the slenderness ratio was less than 45, so that these columns must be classed as short struts. No bending influence varying with l/r was observed.

The following is an abstract of the report made to the director of the U. S. Bureau of Standards covering an investigation upon the strength of large bridge columns. This investigation was conducted at the Pittsburgh Laboratory of the bureau, and the general results of the tests are published with the permission of the director.

The tests were made upon eighteen columns which were half-size models of heavy chord members in the long-span bridges under construction at St. Louis, Mo., Metropolis, Ill., and Memphis, Tenn. The specimens were constructed of nickel, Mayari, chrome, silicon and high-carbon steels, the chemical constituents of the particular steels of each member being given in Table 1.

The designs and construction of these columns conformed with the best modern bridge practice. They varied in length from 16 to 24½ ft., in cross-sectional area from 42 to 119 sq. in., and had slenderness ratios l/r varying from 15 to 44. The mechanical and structural data for the members are given in Table 2, to which Fig. 8 belongs.

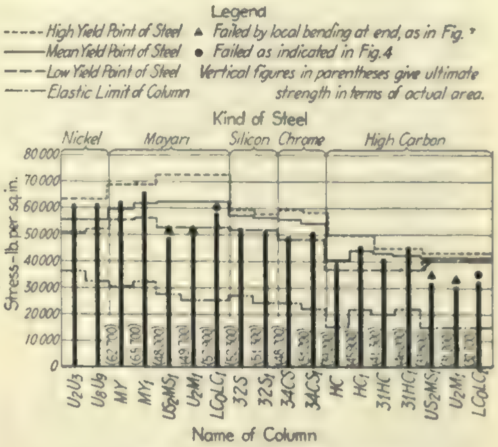


FIG. 2—RELATION BETWEEN STRENGTH OF COLUMN AND YIELD POINT OF STEEL

The purpose of the investigation was to determine the efficiency of the members as columns and the deportment of their respective details under a range of axial loads taken from an initial load of 1000 lbs. per square inch, up to the final loads at the failure of the columns.

METHODS OF EXPERIMENTATION

The columns were tested in a machine of 10,000,000 lb. capacity. Their laws of action as units were determined by an analysis of the results found from taking strain measurements with 80-in. extensometers clamped to the four corners of the specimens at their mid-points. Numerous measurements were taken also in 8 and 16-in. gage lengths on the columns, lattice bars, pin plates, diaphragms and other details. Supplementary tests were made on small specimens to obtain independent com-

FIG. 3—TYPICAL END FAILURE (U_2M_1, MAYARI)

FIG. 1—NEAR CRIPPLING LOAD (31HC, CARBON)

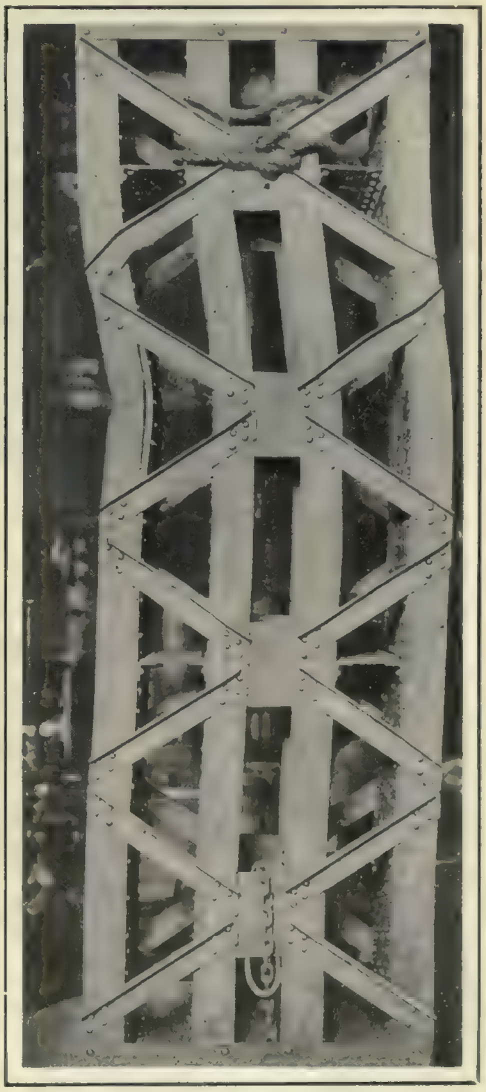


FIG. 4—LOCAL FAILURE (LC_0LC_1, CARBON)

parative data, and also for studying the effects of initial strain from fabrication. The maximum loads, elastic limits, deflections, moduli and other coefficients were found for comparative analysis. The more essential data usually desired by engineers, covering maximum loads at failure and their relations to the yield points of the component steels, are shown graphically in Fig. 8. The maximum loads given are based upon nominal areas. The exact areas were determined by weighing the specimens, and are recorded in Table 2.

FIG. 6—ST. LOUIS BRIDGE COLUMN MODELS FAILED BY BUCKLING
Upper specimen, U_2U_3; lower specimen, U_8U_9. Photographs Figs. 1, 5 and 6, through courtesy of American Bridge Company, G. F. Sparhawk, engineer.

RESULTS ARE CONSISTENT

It will be seen from Fig. 2 that twelve of the eighteen members failed as units. The average of the loads at failure was found to be practically identical with the mean yield point of the component steels, the mean deviation being only ½ per cent. The range of deviation from the mean yield points in absolute values for the individual specimens varied from 4 to 12 per cent. The curve for the failures is practically confined to a zone defined by the curves (Fig. 2) drawn for the high and low extremes of the yield points for the specimens.

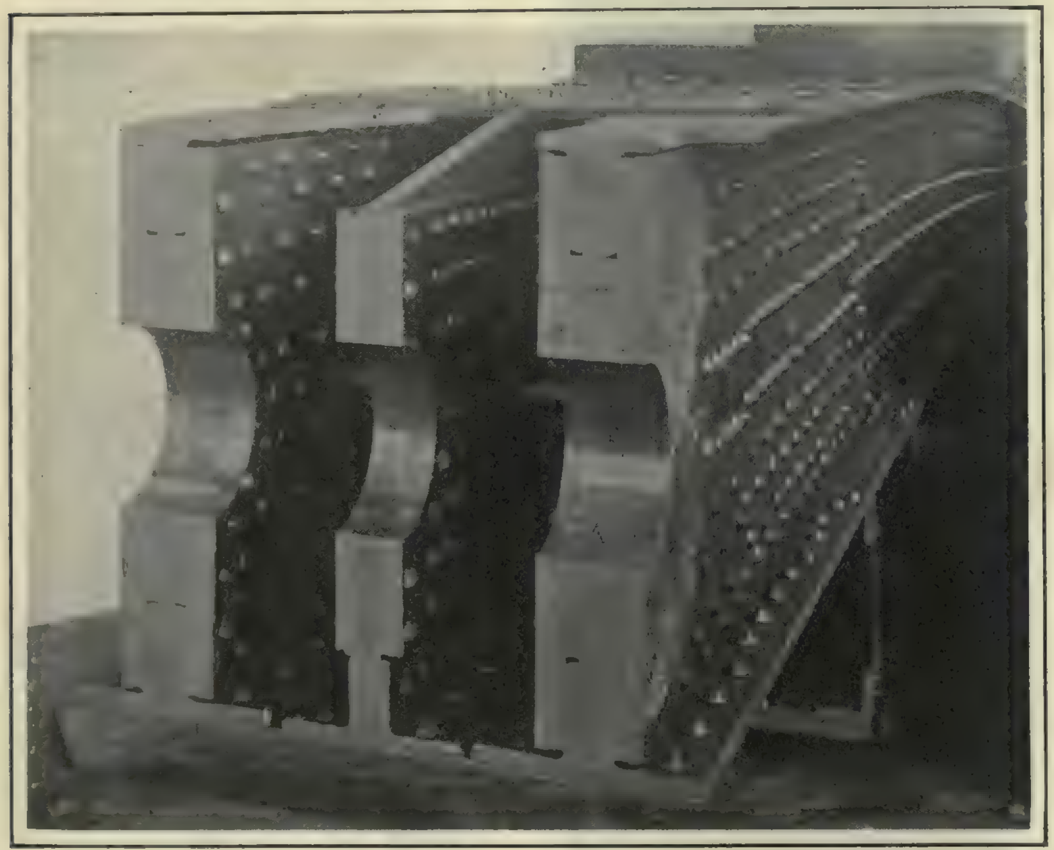


FIG. 5—CHARACTERISTIC DEFLECTION CURVE, METROPOLIS BRIDGE MODELS (34CS1, CHROME)
Transverse lattice angles prevented pantograph action of lacing.

Of the remaining six specimens, four (as indicated in Fig. 2) failed by bending locally at the ends before the full strengths of the columns were attained, owing to the fact that the forked ends required for the ingress of eyebars at the pin were too long in unsupported length to prevent flexure at the junction with the main shafts. The behavior shown in Fig. 3 is typical of this method of failure.

Two members failed in the plane of greatest theoretical strength through the ribs distorting in the body of the column, although one of these failures fell well within the zone of yield points already mentioned. The type of failure is indicated in Fig. 4. The influence of a column formula reduction factor was not discernible. When deflections first became visible they occurred in a short range of loads near the maximum loads observed and increased to 1 or 2 in. as the load progressed. No laws were found connecting the observed stresses with the deflections.

EFFECT OF DISTRIBUTION OF METAL

In the ten tests for the Metropolis bridge the lengths and cross-sectional areas were identical, but five of the specimens had additional flange angles turned outward and also somewhat thinner web material than the remainder (see Table 2 and Fig. 8). There were three times as many failures occurring above the respective mean yield points of the column steel of this set as there were in the case of the five columns which were thicker and more compactly built, but which had only one set of flange angles which were turned inward. It was inferred from this fact that there is an effective distance from the column axis for placing the steel, even in columns of small slenderness ratio, and that the influence of a cross-sectional form factor cannot be entirely ignored in constructing large bridge columns very compactly with respect to the metal of shafts and column details and without much reference to the radius of gyration of the section.

The average elastic limit of the columns failing as units occurred at a stress equal to about 48 per cent of the maximum load. The values given in Table 2 are conservative estimates from the stress-strain curves, as in Fig. 7. The mean modulus of elasticity for the fifteen columns was 29,600,000 ± 120,000, as found by least-square methods. The coefficient of lateral expansion of the steel was approximately that found for plain steel, the range being from 0.291 to 0.327 with a mean of 0.30.

STRESS DISTRIBUTION NOT UNIFORM

There was some apparent lack of integrity of action of the steel shapes in the members, causing variations in the uniformity of stress distribution over the column cross-sections. This was attributed to variations in the yield points and other properties of the component steels, a partial breaking down ultimately of the longitudinal frictions between shapes at a well advanced stage of loading, and the effects of internal initial strains induced by the driving of rivets. The influence of initial strain from riveting was given as a partial cause of the lowering of the elastic limit of the member, but the shortening due to "crimping" or internal buckling of the shapes as this increased with the load was also considered to be an essential factor. Supplementary tests upon independent riv-

TABLE 1—PROPERTIES OF STEEL IN COLUMNS

		CHEMICAL TESTS								PHYSICAL TESTS			
		ELEMENTS—PER CENT								YIELD POINT			Ultimate load
	Name of column	Ni	C	P	Mn	S	Si	Cr	Cu	Mean	High	Low	[illegible]
Municipal Bridge, St. Louis	$U_2 U_3$	3.51	0.29	0.014	0.59	0.031	....	....	....	55,500	63,100	50,500	93,300
	$U_8 U_9$	3.50	0.32	0.015	0.59	0.033	....	....	....	55,200	63,100	52,040	93,060
Metropolis Bridge	HC	....	0.36	0.012	0.43	0.030	....	....	....	40,700	50,000	37,590	76,660
	HCl	....	0.36	0.012	0.40	0.030	....	....	....	44,100	50,000	37,650	75,930
	MY	1.12	0.34	0.010	0.68	0.037	0.10	0.53	0.10	59,900	68,380	55,890	100,610
	MYl	1.12	0.34	0.010	0.68	0.037	0.10	0.53	0.10	62,100	68,380	56,080	101,170
	31HC	....	0.28	0.017	0.64	0.031	....	....	....	42,900	45,440	37,280	73,400
	31HCl	....	0.28	0.017	0.64	0.031	....	....	....	42,700	45,440	37,280	74,400
	32S	....	0.35	0.017	0.83	0.039	0.38	....	....	57,200	58,840	51,940	87,700
	32Sl	....	0.35	0.017	0.83	0.039	0.38	....	....	56,500	57,480	51,940	88,300
	34CS	....	0.31	0.017	0.49	0.028	0.13	0.66	....	55,800	59,290	48,260	82,700
	34CSl	....	0.31	0.017	0.49	0.028	0.13	0.66	....	54,200	58,010	48,260	83,600
Memphis Bridge	$US_2\ MS_1$ (Carbon)	....	0.23	0.012	0.49	0.027	....	....	....	41,740	43,700	40,250	65,420
	$US_2\ MS_1$ (Mayari)	1.58	0.33	0.016	0.64	0.027	....	0.37	....	62,430	72,160	52,000	99,800
	U_2M_1 (Carbon)	....	0.23	0.012	0.49	0.029	....	....	....	41,740	43,700	40,250	65,420
	U_2M_1 (Mayari)	1.58	0.33	0.016	0.64	0.027	....	0.37	....	62,830	72,160	52,000	99,800
	$LC_0\ LC_1$ (Carbon)	....	0.23	0.012	0.49	0.029	....	....	....	41,740	43,700	40,250	65,420
	$LC_0\ LC_1$ (Mayari)	1.58	0.33	0.016	0.64	0.027	....	0.37	....	62,430	72,160	52,000	99,800

TABLE 2—DIMENSIONS OF COLUMNS AND RESULTS OF TESTS

Name of Column	Steel	Manufacturer	Length* Ft.	Length* In.	Size of Pin, In.	Type and Section, See Fig. 8	Lacing	Diaphragms No. and Thickness	Area, in Sq. In. Nominal	Area, in Sq. In. Actual	Radius of Gyration, In. ⊥ to Pin	Radius of Gyration, In. ‖ to Pin	Slenderness Ratio l/r ⊥ to Pin	Slenderness Ratio l/r ‖ to Pin	Elastic Limit Lb. per Sq. In. of Nominal Area	Ultimate Strength Lb. per Sq. In. of Nominal Area
U_2U_3	Nickel	American Bridge Co.	15	8½	7½	A_1	2½-in. channels	3 and ¼ in.	88.8	......	7 55	8.57	25.0	33.6	36,000	61,700
U_8U_9	Nickel		24	0	....	A_2		3 and $\frac{5}{16}$ in.	110.3	......	7.78	8.97	37.0	32.1	32,000	61,400
HC	Carbon	Pennsylvania Steel Co.	24	4		B	4x¼ in. diagonal bars and transverse angles 4x3x$\frac{5}{16}$ in.	3 and ¼ in.	76.14	74.58	6.73	8.46	43.5	34.5	15,000	38,400
MY	Mayari								76 14	74 90					30,000	61,500
31HC	Carbon	American Bridge Co.							75.99	76 94					20,000	41,700
32S	Silicon								75.99	76 94					27,000	52,800
34CS	Chrome								75.99	76.94					24,000	49,200
HC1	Carbon	Pennsylvania Steel Co.	24	4	7	C	3x¼ in. diagonal bars and transverse angles 4x3x$\frac{5}{16}$ in.	3 and ¼ in.	76 46	75 35	7.60	8.05	38.5	36.4	22,000	45,300
MY1	Mayari								76.46	75 28					32,000	64.700
31HC1	Carbon	American Bridge Co.							76.27	77.17					22,000	46,500
32S1	Silicon								76.27	77.17					24,000	51,700
34CS1	Chrome								76.27	77.17					22,000	51,800
US_2MS_1	Carbon	Pennsylvania Steel Co.	15	10	7	D	3x¼ in. bars	4 and ¼ in.	55.17	55.97	6.61	9.05	28.7	21.0	15,000	34,300†
US_2MS_1	Mayari					E	Angles 3x1¾x¼ in.	None	42.47	41.66	6.87	9.78	27.7	19.4	27,000	47,200†
U_2M_1	Carbon		23	6	8½	F		6 and ¼ in.	96.01	95.77	7.80	9 25	36.1	30 5	15,000	31,000†
U_2M_1	Mayari					G		5 and ¼ in.	66.55	66.02	8.17	8 47	34.5	33 8	25,000	49,400†
LC_0LC_1	Carbon		15	6		H		4 and ¼ in.	119 00	118.18	6.74	12.14	27.6	15 3	15,000	32,400‡
LC_0LC_1	Mayari					I		4 and ¼ in.	75.12	76.47	6.87	11.59	27.1	16.0	25,000	59,100‡

*The length is given from center of pin at lower end to square upper end, except for U_8U_9, which was tested with square bearing at both ends without using lower pin.
†Failed by local bending at ends as in Fig. 3. ‡Failed locally as in Fig. 4.

eted sections were made to illustrate the effect of initial strains from riveting on plain columns and test pieces and showed the lowering tendency on the elastic limits.

Tests of the action of details—lattice bars, diaphragms and pin plates—were made to obtain their laws of action. In the ordinary diagonal lattice used on several of the columns (see Table 2) the mechanical action was shown to approximate that of a pantograph of bars placed upon the column ribs, the maximum strains being at the transverse diaphragms and the end battens, where freedom of movement of bars was most constricted. The ten columns of the Metropolis bridge had transverse angles between panels in addition to the diagonal members, and while the amount of strain was not materially reduced, a more uniform bending of the columns was obtained, with elimination of the sharp bends in the ribs. The favorable action was also shown in the fact that each of these ten members failed with the smooth deflection curves indicated in Figs. 1 and 5, while the remaining members possessed irregular fractures of various kinds, as shown in the other photographs.

All of the pin-plate observations indicated that there was some slight movement of one pin plate over the other (typical curves are shown in Fig. 7). The opinion was expressed that the chief cause of this slipping of the pin plates was due to the intensity of the stress just over the pin, which was shown to be considerably higher than the mean, and is difficult to lower in any form of pin-connected member. The distributions of stresses in the pin plates were analyzed and their laws determined approximately. Fig. 9 shows a typical pin end of one of the Memphis bridge models.

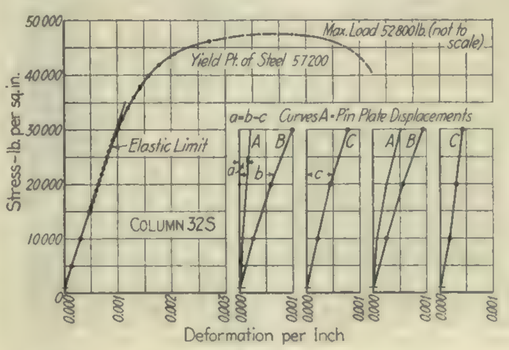


FIG. 7—TYPICAL STRESS-STRAIN CURVES

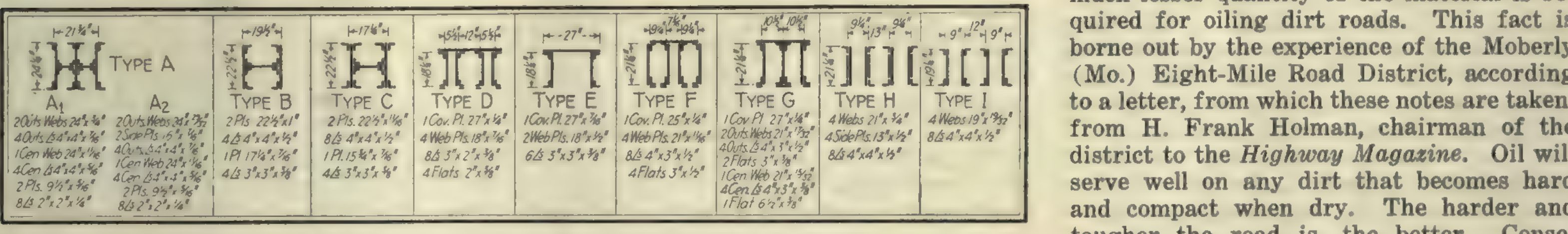


FIG. 8—TYPES AND MATERIAL IN MAIN SHAFTS OF TEST COLUMNS

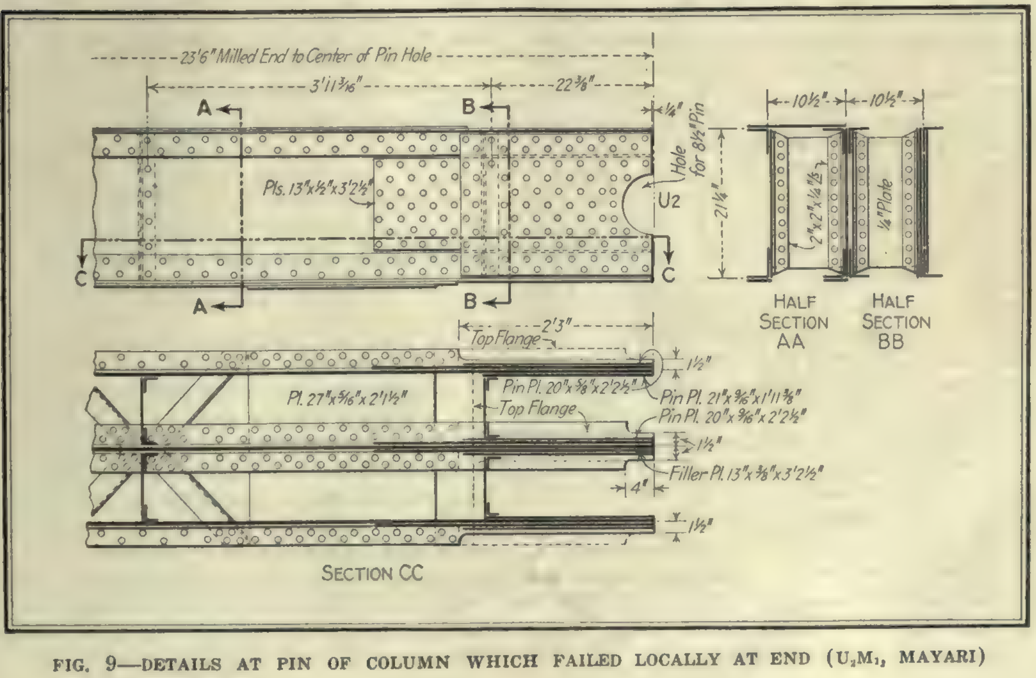


FIG. 9—DETAILS AT PIN OF COLUMN WHICH FAILED LOCALLY AT END (U_2M_1, MAYARI)

The complete data of tests and the laws deduced are contained in the larger report, but the discussion of these is too long to be included in this abstract of results.

Acknowledgments are made of the cooperation of H. C. Baird of Boller, Hodge & Baird, of New York, designers of the Municipal bridge; R. Modjeski and the late C. H. Cartlidge, of Chicago, who were the designers of the Memphis and Metropolis bridges respectively; of the various officers of the American Bridge Company and Pennsylvania Steel Company, particularly C. E. G. Larson, Thomas Earle and C. H. Mercer, and of Edward Godfrey, of the R. W. Hunt Company of Pittsburgh.

Removal of Dust Lessens Quantity of Oil Needed for Dirt Roads

When the oil is fairly free from dust a much lesser quantity of the material is required for oiling dirt roads. This fact is borne out by the experience of the Moberly (Mo.) Eight-Mile Road District, according to a letter, from which these notes are taken, from H. Frank Holman, chairman of the district to the *Highway Magazine*. Oil will serve well on any dirt that becomes hard and compact when dry. The harder and tougher the road is, the better. Consequently the importance of the road's being well graded and settled hard when the oil is applied is evident. To prepare for oil a grader is first run to remove as much dust or loose dirt as possible to the sides of the surface to be oiled, where it will serve as a dike to prevent the oil from running off. After the oiling is completed this material is graded back on to the road to absorb the surplus oil on the surface.

The road should be kept closed to traffic for at least a week after oiling, though this is seldom possible. Oiled roads will be ready for dragging from five days to a week earlier than other dirt roads after the snow has melted in the break-up season.

The district now uses 6666 2-3 gal. of oil per mile of road, from 10 to 12 ft. wide, as compared to 8000 gal. per mile in earlier work, it having been found that when the oil is fairly free from dust the smaller amount is as much as can be applied without running off, especially on parts oiled in former years. Gravity pressure wagons are used for the work. Oil is generally applied once every year.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Reinforced-Concrete Bridge Fails at Moscow, New York

SIR: The recent disastrous flood in the valley of the Genesee River, New York, aside from the total destruction of many bridges, damaged others to an extent demanding extreme measures and careful engineering ability to restore them to grade level without impairing their efficiency.

One of these is the reinforced-concrete structure shown in the accompanying photograph—a bridge at Moscow, N. Y., of 24-ft. span, 18-ft. clear roadway and about 8 ft. high. It was constructed in 1913 and cost about $1,100. The slab is 17 in. thick with reinforcement of twisted steel rods spaced 5 in. center to center. Reinforcing rods were also used in abutments and wing walls, which are 12 in. thick set on a concrete mat 3 ft. wide and 12 in. thick.

LOWER END OF SOUTH ABUTMENT SETTLED ALMOST 3 FEET BELOW NORMAL

Failure was due to the undermining of the south abutment, the creek bed being more than 3 ft. lower after the water receded. The slab and abutments are absolutely intact, but a longitudinal crack runs the entire length of both parapet walls just at the top of slab, and also across the top of the wing walls. The lowest end is almost 3 ft. below normal floor level.

If deemed feasible, it is proposed to raise the structure to its proper position and construct a new concrete footing.

GEORGE E. SCHAEFER,
Superintendent of Highways, Livingston County, New York.
Geneseo, N. Y.

Latin-American Opportunities

SIR: In regard to opportunities for engineers in Latin America generally, the question is as broad as the profession. There are or will be many opportunities here, for the simple reason that the countries are less developed, all the engineering work is to be done and some one will have to do it. But as to whether they are "good" opportunities, the answer depends on the man. Salaries are a little higher than at home, though far from the gilded recompenses which most youngsters think them, and, on an average, I should say the work is harder and the working hours are longer by a very large proportion. Discomfort and loneliness to a degree undreamed of at home are the rule rather than the exception. If the work is near a large city where conditions are less depressing, the salaries promptly approximate those at home. At present it is true that positions of comparative importance and responsibility are attained at an age which would mean a very minor job in the States, but it takes an exceptional man to do the work. This condition is due more to a shortage of competent men than to anything else.

In general, for the very reason that there is so much to be done in Latin America, "jobs" will every day be more numerous; there *are* exceptional opportunities for the exceptional man, but he must be even more exceptional than at home to win one of them. It is no place for the mediocre man, for the increased pay (since there will be no more probability of advancement than at home) will by no means offset the increased discomfort; and lastly, the man who comes must realize that every dollar of salary he will receive will cost him, in hours of work, in personal discomfort, in nervous and physical wear and tear, and, above all, in being out of touch with former friends and with conditions at home, quite as much as, and probably a good bit more than, the same dollar would have cost him at home.

Why, then, do we stay—those of us who *do* stay—year after year? Some of us because, having arrived before we found out what it meant, and stayed while we were finding out, have learned to our sorrow that the very qualities which make us worth our salt here are distinct hindrances to our work at home, because we have got so out of touch with men and work there that getting a job is a pretty serious proposition; and because, on account of all this, we *can* make a pretty good living here and would find it hard to do so at home. Some of us stay because we are, or think we are, the exceptional man to whom I have referred, and because we have, or hope to have, one of the exceptional places. Some of us stay because we belong to "the brotherhood of the itching foot" and prefer the more rapid change and uncertainty of Latin America to the well-ordered routine of more civilized countries. Many of us—the majority, I think, if we would admit it—stay because we enjoy the very definite and comparatively satisfactory positions we occupy here in the scheme of things—the sense of being distinctly *somebody* in the local cosmos—in a word, the preference for being a fairly large fish even in a small puddle to being one of the small ones in the ocean at home.

Please pardon my discursiveness. It is a matter on which I feel strongly, both because I personally *do* like Latin America, on the whole, and because I have seen so many young men come down with large hopes, entirely mistaken ideas of the life and the work, and then make failures which might have been avoided if they had had a better idea of what they were coming to.

L. M. HUNTINGTON,
Vice-President and General Manager Bramon Estates Company.
Rubio, Venezuela.

SIR: In Porto Rico the possibilities for American engineers are small, as the island is small and very thickly populated, and has been developed for a good many years. I have spent more than half of the last 27 years in Latin-American countries, and I suppose from time to time there are excellent possibilities for American engineers in Cuba and in Central American countries. I also believe that during the next generation there will be extremely good opportunities for American engineers in the various countries of South America. American engineers, however, need patience in getting into foreign countries, as it is necessary that they learn the language and customs of the people before they can become valuable.

C. L. CARPENTER,
Manager Central Aguirre Company.
Central Aguirre, Porto Rico.

SIR: We believe that there are opportunities for American engineers in all the sugar-producing countries. We are employing at the present time five civil engineers on the extension of our railroads and other work on this plantation alone, and we know from experience that other companies require civil-engineering assistants for the extension of their plants.

We think that there are very good opportunities for mechanical engineers, as the sugar factories usually pay quite high salaries for such engineers on account of the complicated machinery in use.

VAN ALEN HARRIS,
Manager Central Romana.
La Romana, Dominican Republic.

Data and Samples of Borings in New York City

SIR: During the last few years extensive underground investigations have been carried out in New York City to determine the character of the underlying rocks and the depth and nature of the earth cover. It is estimated that about $3,000,000 has been spent for investigations of this nature by the municipality, the railroad companies and other corporations in connection with subway, bridge, dock and aqueduct construction, foundations for buildings and similar work. Probably the most extensive work of this kind has been conducted by

the Board of Water Supply in determining the location of the city tunnel of the Catskill aqueduct and by the Rapid Transit Railroad and Public Service Commissions in connection with subway construction.

On Feb. 21, 1911, Dr. Charles P. Berkey, professor of geology of Columbia University, and John R. Healy delivered a joint paper before the Municipal Engineers of the City of New York on "The Geology of New York City and Its Relation to Engineering Problems." In the discussion which followed the presentation of this paper it was suggested that the society could perform a valuable service to the city by aiding in the collection and permanent preservation of all boring samples, properly labeled and cataloged. Acting on this suggestion, application was made to the Board of Estimate and Apportionment in 1913 by Alfred D. Flinn, president of the society, for an appropriation for the purpose of collecting, classifying and permanently preserving boring samples and records, and for the preparation of geological maps of the city of New York. An appropriation of $5,000 was granted with the understanding that the work should be performed under the direction of Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment. Dr. Berkey, who has acted as consulting geologist of the Board of Water Supply, was selected to supervise the work, and, aided by a corps of assistants, rapid progress is being made in collecting and classifying all available data.

Space has been assigned to the chief engineer of the Board of Estimate and Apportionment on the thirty-fourth floor of the Municipal Building. It is expected that this space will be available for use during the current year. Suitable cases for the proper storage of the borings are to be provided and an accurate system of indexing and recording them is being designed.

On April 26, 1916, James F. Sanborn, division engineer of the Board of Water Supply, read a paper before the Municipal Engineers Society on the "Preservation of Boring Records and Underground Data," which was published in the April issue of the society's *Journal*. This paper reviews briefly the geology of the city of New York and the purpose and various methods of making borings, and emphasizes the necessity of collecting and preserving these records in order that they may be made available for general use.

The municipal engineers' committee on the preservation of core borings, of which Mr. Sanborn is chairman, is assisting in the collection of all information that can be obtained on this subject.

Not only the records of borings, but also observations of earth and rock exposed in excavations, such as pits, cellars, tunnels and subways, are to be collected and made available for reference. In order to facilitate the collection of such data a set of rules and suggestions with reference to the proper methods to use in planning underground surveys are being formulated. A standard form whereby all such data can be systematically recorded has been prepared and will be made available for general use. As this work progresses and more and more data become available through additions to the collection, the city will in a few years be in possession of information which will be invaluable and to which any engineer, architect or contractor will be glad to turn.

The municipal engineers' committee and the city officials are desirous of enlisting the co-operation of all engineers, contractors and others whose work brings them in contact with subsurface conditions throughout the city, to the end that all data now available, as well as all additional information on this subject, may be collected by the city authorities and preserved for the general use of the public.

Additional data for this collection may be forwarded to Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, or to James F. Sanborn, division engineer, Board of Water Supply, either of whom will be glad to supply further information on the subject.

VERNON S. MOON,
Assistant Engineer, Bureau of Public Improvements, Board of Estimate and Apportionment.
New York City.

Investments for Engineers

SIR: We have been very much interested in reading your editorial comments on the letter from John Berg published in your issue of May 27, 1916. It is a surprising and yet astonishing fact that most professional men are singularly unfortunate when it comes to the investment of money. As you are perhaps aware, the latter function is purely a banker's business, and none but an investment banker is qualified to give dependable advice on such a tremendously vital question.

This fact has been long recognized in England, for example, and you will find that there are very few standard publications, even of a technical character, in that country which do not have departments treating with finance.

We believe that the Engineering Record would be justified in giving further attention to this vital point.

BOWMAN, COST & COMPANY,
St. Louis. Investment Bankers.

Trailers with Motor Trucks

SIR: The article in your issue of March 25, page 420, on "Trailers with Motor Trucks" might have passed by me with little comment but for your editorial on the subject. In your closing sentences you state that "The Engineering Record believes that this analysis has shown again what ought to be obvious to all who have stopped to think about the matter and compare highway transportation with rail transportation, that the trailer is a natural complement to the truck." To those who have studied the matter it is not in the least bit obvious, and the seemingly scientific analysis made by Mr. Pennington [G. R. Pennington of the Troy Wagon Works Company, whose investigations were the basis of the article in question] is to them as full of loose generalities as an uninformed salesman.

Mr. Pennington shows only that it is feasible to use trailers with motor trucks. He distinctly does not show it is economical. The title of his article is, therefore, wrong, and the article itself is so cleverly worded on this point that even you, sir, were misled. It does not follow that because a project is feasible it is also economical.

Mr. Pennington need not have wasted time making an investigation into road resistances of various surfaces. These are a matter of common knowledge among transportation engineers and are embodied, for example, in the Society of Automobile Engineers' Handbook. Some engineers have gone much farther and accumulated considerable data on the effect of wind resistance at low speeds on heavy road vehicles—for instance, Mr. Williamson's paper before the Institution of Automobile Engineers, England, this February.

His diagrams are not at all new, and have been known for perhaps ten years. The *Commercial Vehicle* of England published six or seven years ago a large wall diagram, giving not only the tractive effort, but also surplus effort on grades and against road resistances. Similar diagrams have been published in this country many times.

All these facts and the feasibility of hauling trailers with trucks have been known to transportation and motor-truck engineers for years. Why, then, are trailers not adopted more generally, and why do large contractors, who have tried them, look askance at them? Why are the trailer manufacturers separate from the truck manufacturers? Many automobile manufacturers make motor trucks, but I do not know of any truck manufacturer making trailers, though it would be the simplest thing in the world for him to do, as a four-wheel trailer is practically made up of two-truck front axles and a body.

There must be something behind all this, and there is.

England has magnificent roads and has been familiar with road transportation by tractor (steam) for twenty or thirty years. Trailers were, and are, more in evidence along her roads than they are here, but they are always behind specially designed tractors. England, the home of road transportation, has not adopted the trailer behind the motor truck, not even in this war, where she is transporting thousands of tons for great mileages, and where the conditions would seem ideal.

France, before the war, was coquetting with tractor-trailer trains, but the war sees her using thousands of motor trucks *in puris naturalibus*. A few hundred four-wheel trailers were bought over here for use with motor trucks, but these were found unsatisfactory, though I understand some trials are being made of special two-wheel trailers under better circumstances.

Germany developed a special type of military tractor, but for ordinary road purposes her motor trucks ran alone.

Our United States has known the motor truck in its present state of efficiency for some five years. During this time the trailer proposition has been constantly in evidence; indeed, every little while some new tractor makes its bow, but only in a comparatively few cases have they justified themselves.

One of the reasons why is "obvious to those who stop to think" from Mr. Pennington's table of road resistances. It takes five times the tractive effort to propel a truck on the level on poor macadam that it does on good asphalt. That is where some of the surplus power goes to, and who knows a city or road network that does not share the bad with the good, not to speak of grades?

No, sir, the problem is not comparable with railroad haulage, nor canal haulage, where level (or very nearly so) conditions hold and resistances never vary. It is a problem all in itself, where speed, flexibility of operation, ease of manipulation, rapidity

of acceleration and deceleration, and "maneuverability" are some of the factors.

A large contractor in Pittsburgh found trailers paid him slightly during the day, but caused him to lose heavily at night. His routes and roads were the same, but in the daytime the congested streets brought his average speed away down to 3 or 4 miles per hour. At night the open clear streets allowed him to run as fast as his truck would, the trailer was a hindrance to the speed, and he found very quickly an economical hindrance as well. Given wider, less congested thoroughfares and he never would have used the trailers.

The trailer, such as Mr. Pennington describes, is designed to absorb the surplus power the truck designer provides for the heavy road and the heavy grade. In brief, it is designed to absorb the factor of safety, and this is poor engineering, as we all know. There is a legitimate field for trailers, and that is as a complement to the specially designed tractor, not for the motor truck designed primarily and finally to carry a self-contained load.

JOHN YOUNGER,
Chief Engineer Truck Department, Pierce-Arrow Motor Car Company.
Buffalo.

[The foregoing letter was submitted to Mr. Pennington, who replied as follows.—EDITOR.]

SIR: The invitation you so kindly extend to me to answer in your columns Mr. Younger's letter on the trailer question, I gladly accept.

I want to get on record with Mr. Younger as being emphatically opposed to the indiscriminate usage of trailers with motor trucks. The company with whose product I am identified has been so careful and conservative in its trailer promotion that I feel sure Mr. Younger would heartily approve—but he doesn't take the time to investigate what we really claim and do prove.

For us to say that a trailer should be used with every motor truck would be ridiculous. But for Mr. Younger to say that a trailer can never be economically used with an ordinary motor truck would make him equally blind to demonstrated facts. Hundreds and hundreds of concerns didn't think a motor truck would pay under any conditions. They were finally forced to change their opinion by seeing and observing what was actually being accomplished by motor trucks at work. Theory would never convince them, but performance does.

This is not the place for a sales or advertising talk, but the same condition applies to motor-truck trailers. Many, many present users of trailers were just as strongly opposed to them as Mr. Younger could be. But demonstration in their service with a specially designed trailer led to the purchase of one. And the continuous economy of these initial installations has brought re-orders as well as new orders from others who have watched and learned, until the motor truck trailer has become an established factor in the motor-truck transportation field.

Thirty-nine different makes of trucks are operating successfully with trailers. When the modern, specially designed motor-truck trailer was put on the market, none of the truck engineers knew what their trucks could economically do with trailers. So a great many of them opposed it as rabidly as Mr. Younger now does. But that condition has changed and Mr. Younger is pretty nearly alone in saying that the trailer is never an economical proposition. The rest of the industry agrees that it is economical *under proper conditions*. That is all we want said, because we know that with that proviso there is still a tremendous field for real motor-truck trailers.

Taking up Mr. Younger's objections, point by point, he says that my article proves the feasibility of using trailers but does not prove their economy. I have at hand plenty of concrete instances proving the economy of trailers, but as these all relate to a particular make of trailer I do not feel at liberty to get specific in the editorial columns of Engineering Record.

Mr. Younger next states that the tables and charts appearing in the article were not new. Possibly not, but as far as the writer knew, however, no similar matter had been published before except such data as the S. A. E. road-resistance tables. But, whether new or not, the one thing we are interested in knowing is that these tables and charts are correct and may be relied on. The S. A. E. tables were, it is reported, obtained from tests made with steel-tired vehicles. The writer therefore made further tests to obtain the correct figures for rubber-tired trailers.

Mr. Younger asks why the truck manufacturers are not building trailers. If he will explain why these same truck manufacturers do not even build the frames, radiators, tires, worm gears and the other parts of their own machines, I may find the answer.

Again, he is very much mistaken in thinking that a real motor-truck trailer is so simple a manufacturing proposition. Possibly the reason he is so skeptical about trailer usage is because he has confined his investigations to makeshift trailers.

As Mr. Younger states, four-wheeled trailers are being used abroad in war service in spite of the fact that in such service economy is no consideration. There, where a truck may at any time be compelled to make a detour through the fields and where conditions are, therefore, the least favorable to the use of trailers, it is significant that hundreds of trailers are, nevertheless, used.

Mr. Younger mentions an instance in Pittsburgh where a contractor found trailers paid him "slightly" during the day but caused him to lose heavily during the night. I can do better than Mr. Younger; I can mention cases where trailers will not pay at all, and I can mention many other cases where motor trucks will not pay at all. As long, however, as there are plenty of places where trucks will pay and plenty of places where trailers will pay, we need not worry about the unfavorable cases.

But let us consider this particularly unfavorable trailer installation of the Pittsburgh contractor. How "slightly" the trailer paid may be judged from the fact that Mr. Younger's firm used a full page at one time to make public the economy of this very installation. As for the trailers causing a loss at night, that would be impossible, for at the very worst the contractor would simply not use them at night, allowing them to pay for themselves during the day. It is not necessary that a trailer should be kept constantly in use in order to pay for itself. Unlike the truck alone, the trailer will prosper on a half day's work.

That the trailers did not make this particular contractor any money during the night we must, of course, accept as a fact. Mr. Younger says the trailers held down the truck speed too much. Now we know from experience that 5-ton trucks of other makes will readily handle their own load and an equally loaded trailer over city streets at 9 or 10 miles an hour without undue effort, and we do not question that the trucks manufactured by Mr. Younger's firm would do at least as well. If this contractor, therefore, chose to operate at greater speeds than these his apparently increased economy must have been largely eaten up by increased depreciation, for high speed will knock a truck to pieces, while pulling a trailer will not.

Mr. Younger winds up by saying that it is poor engineering to absorb the factor of safety built into a truck. Unquestionably this is true. But it is likewise true that every piece of machinery operates most economically at or near the capacity for which it is designed. High-grade trucks such as Mr. Younger designs are built with ample power to take them up the steepest grades and over the worst roads ordinarily encountered. A truck, therefore, which is used only over improved roads, with moderate grades, is utilizing but a part of its power. The unused surplus, unless also utilized, represents waste.

The trailer is intended to be used with a motor truck when the conditions of road and grade are favorable, not otherwise. The trailer is to be used in those cases where the surplus power of the truck would not otherwise be utilized. As it takes five times the tractive force to propel a truck on poor macadam that it does on good asphalt, and ten times the same tractive force in the case of a sandy road, it is evident that a truck designed to operate satisfactorily on the sandy road will have an immense excess of tractive capacity when used only on asphalt, and will still have an excess when used even on poor macadam. To utilize in part this excess tractive capacity means increased efficiency. To do so by putting a larger load on the truck is to absorb the factor of safety of that truck. To put this extra load on a trailer behind, however, which will carry its own load, is an entirely different matter, and does not involve excessive strains on the truck.

G. R. PENNINGTON & COMPANY,
Troy, Ohio. By G. R. Pennington.

How Can Brick Aqueduct Best Be Cleaned?

SIR: We are seeking information concerning some system for cleaning the inside of a brick water-supply conduit about 5 ft. 6 in. by 6 ft. in cross-section and 4½ miles long. The substance to be removed consists of silt mixed with slimy vegetable matter, which is easily removed by a brush.

If possible, we would like to obtain some apparatus whereby a set of revolving brushes mounted on a small self-propelled car can be run through the conduit, and thus do away with the use of the large crew of men necessary for hand cleaning. If you know of any place where such a scheme has been applied we would appreciate it if you would either let us know the name and address of the organization or refer this inquiry to them.

ROSCOE L. SMITH,
Principal Assistant Engineer, Bureau of Water.
St. Paul, Minn.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Swinging Leads on Derrick Boat Rigged for Rapid Driving

By GEORGE W. McALPIN
Junior Engineer, Ohio River Dam 35, New Richmond, Ohio

AS MANY as 52 piles with an average penetration of 18 ft. have been driven by the rig shown in the photograph, the feature of which is the runway sliding on a capped row of piles previously driven and on a timber suspended in front of the derrick boat, on which the swinging leads stood during driving, secured from slipping by steel points at the lower ends of the leads.

FIFTY-TWO PILES WERE DRIVEN IN 8 HOURS WITH SWINGING LEADS RIGGED ON RUNWAY

This rig was used in driving the foundation for the navigable pass at dam 35 on the Ohio River, the concrete section of which is protected on the downstream side by a long line of timber cribs filled with stone and on the upstream side by a row of sheet piling. The cribs were sunk first, the excavation for them naturally taking in enough dirt from the site of the pile and concrete section of the foundation to allow floating a derrick boat along the upstream side of the cribs after the cofferdam had been closed and pumped down below the cut-off elevation of the piles.

The concrete foundation for the pass is 35 ft. wide. The swinging leads were 44 ft. long, and a Vulcan No. 2 steam hammer operated at a speed of 70 blows to the minute was used in them. A row of piling was placed directly across the foundation, starting from the crib. A 6 x 8-in. cap, 30 ft. long, was then placed across the top of these piles and drifted to two of them. As the piles could be driven accurately to grade, the cap rested evenly on all. A 10 x 12-in. timber, 32 ft. long, was suspended from the timber heads on the forward deck of the derrick boat, over the front of the boat. The top of this timber was at the same elevation as the cap. The 30-ft. runway was made of two 10 x 12-in. timbers held 15 in. apart by cleats. The leads, swung from the end of the boom, were set on the runway over the place for the first pile and steadied by three guys, each tightened by a set of falls.

The piling was brought alongside the boat rafted, one man attending to this and seeing that piles were always ready when needed. While one was being driven the pile line was made fast to another so that no time would be lost. As each pile was driven the leads were lifted just enough to clear and quickly set in position for a new pile. When a row the length of the runways had been finished, the runways were slid sidewise on the cap and the timber in front of the derrick boat slid to position for the next row. This was continued until seven rows of piling across the foundation had been driven, when it was necessary to move the derrick boat back again. Thirty-five piles could be driven in this way from one position of the derrick boat.

Each driving crew consisted of a foreman and five men. The foreman and one man set the piles and leads, one man brought piling as needed and the other three men attended to the guys, steam line and hammer. An engineer and fireman operated the derrick boat, which supplied steam for the hammer as well as water pressure for a jet. The 2-in. jet, however, was not used much in driving, but was handy when it became necessary to pull a damaged pile or work a pile back into line. A lighting plant was installed on the derrick boat, and three shifts were worked.

The piling had an average penetration of 26 ft., and an average of 24 were driven to each 8-hour shift. The work is being done for the United States Government by the National Contract Company. L. H. Prell, assistant engineer, is in charge for the government.

Tension in Cableway Easily Found

THE PROPER size of track rope for a given cableway is that which will have a factor of safety of four when the maximum load to be handled produces a deflection at the center equal to one-twentieth the span, according to engineers of the manufacturers of Hercules wire rope. The deflection is measured below a straight line between the points where the track cable passes over the towers. One anchorage should be arranged with a set of falls, so that the track cable can be let out or taken up with seasonal temperature variations to maintain this deflection and tension.

An approximate rule, which gives close results for loads in the center with the deflection equal to one-twentieth of the span, gives the tension in the track rope as five times the load plus two and one-half times the weight of the suspended rope.

Accounting for the Contractor: The Balance Sheet

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Co., Scranton, Pa.

NOTHING SERVES so quickly to show the changing conditions in an enterprise as a monthly balance sheet. From it may be seen at a glance, provided the books are properly kept and the balance sheet compiled with due regard to a proper classification of accounts, just what the firm has, what is due it, what it owes, and whether a healthy improvement is taking place from month to month in the ratio of its assets to its liabilities.

The first step is to make a trial balance. Assuming that the books have been kept somewhat as outlined in the preceding articles of this series, the trial balance would have the form shown herewith. The convenient alphabetical arrangement is facilitated by the use of a loose-leaf or card ledger. After a correct trial balance has been taken, a balance sheet in the form illustrated, which shows the exact condition of the business, is easily prepared.

HOW TO TRACE TWO KINDS OF ERRORS

If the totals of the two columns on the trial balance sheet agree it is fair to assume that the ledger is correct. Suppose, how-

Arnold Brown & Co., Trial Balance, Mar. 1, 1916

	Dr.	Cr.
Anderson & Co.	150.50	
Barrett & Carter	200.00	
Arnold Brown (investment)		5000.00
Bridge No. 4		150.00
" " " Reserve	121.00	
Calvin & Co.		109.50
Cash (in bank)	8400.50	
" (petty)	7.50	
Corfu		4019.20
" Reserve	340.14	
Davis Mfg. Co.	141.50	
Chas. Dunn (investment)		1000.00
Edward Francis "		1000.00
E. F. Fraser		8.00
G. H. Ingersoll		20.00
Jones, Kipp & Lane		14.05
Leeds		2051.00
Leeds Reserve	201.66	
North Hill Arch	410.20	
" " " Reserve	150.00	
Plant	8000.00	
Reserve for Depreciation		800.00
R. Sanders, Agent	25.00	
Surplus		4566.00
State Road	560.00	
" " Reserve	250.20	
Unclaimed Wages		250.45
Thos. White, Agent	30.00	
	18988.20	18988.20

Arnold Brown & Co., Balance Sheet, Mar. 1, 1916

Resources

Cash:		
In bank	$8400.50	
Petty cash	7.50	$8408.00
Reserves (Retained percentages):		
Bridge No. 4	121.00	
Corfu	340.14	
Leeds	201.66	
North Hill Arch	150.00	
State Road	250.20	1063.00
Plant (Equipment)		8000.00
Accounts Receivable:		
Anderson & Co.	150.50	
Barrett & Carter	200.00	
Davis Mfg. Co.	141.50	492.00
Agents' Balances:		
R. Sanders	25.00	
Thomas White	30.00	55.00
		18018.00

Liabilities

Investment:			
Arnold Brown		$5000.00	
Chas. Dunn (Spcl. partner)		1000.00	
Edwd. Francis " "		1000.00	$7000.00
Reserve for Depreciation			800.00
Unclaimed Wages			250.45
Accounts Payable:			
Calvin & Co.		109.50	
E. F Fraser		8.00	
G. H. Ingersoll		20.00	
Jones, Kipp & Lane		14.05	151.55
Loss & Gain	Loss	Gain	
Leeds		2051.00	
Corfu		4019.20	
Bridge No. 4		150.00	
North Hill Arch	410.20		
State Road	560.00		
	970.20	6220.20	
		970.20	
Undivided profits, net.			5250.00
Surplus (from 1915)			4566.00
			18018.00

ever, that in the balance sheet shown a mistake had occurred in entering the balance of Jones, Kipp & Lane by transposing the figures to read $41.05. The total in the credit column of the trial balance would then have exceeded the total of the debit column by $27, the sum of whose digits is nine. Whenever the totals in the two columns differ, if the sum of the digits in the amount representing the differences is nine, or a number divisible by nine, it is a reasonably certain indication that there has been a transposition of figures either in the trial balance or in the ledger entries.

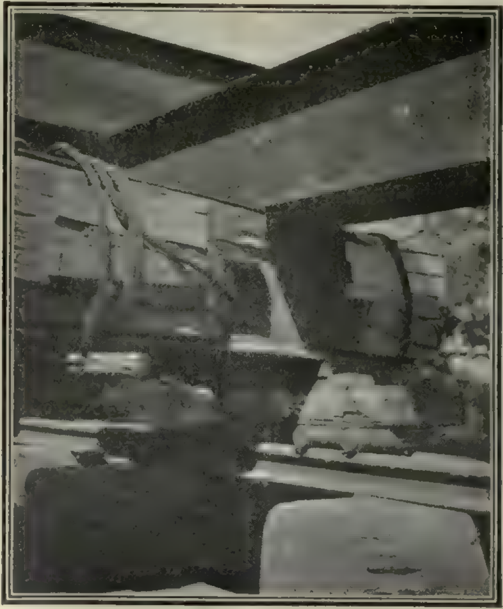
Another test often used by bookkeepers when the trial balance sheet fails to check is to divide the difference between the debit and credit columns by two. If the difference is so divisible, it indicates that a mistake has probably been made by entering an account on the wrong side either of the trial balance or of the ledger.

1450-Ton Apartment House Moved 80 Feet on High Cribbing

A brick apartment weighing 1450 tons has been moved two lots downhill from 950 Anderson Avenue, New York City, and lowered 12 ft. to a new foundation, rather than underpinning it in constructing the west portal of the tunnel section of the Eighth Avenue-162d Street connection of the Interborough Rapid Transit extensions, the portal being directly in the rear of the old location of the building. A new two-story store building and station will be constructed on the site after the tunnel is completed.

As the five-story apartment, 88 ft. deep with a front of $40\frac{1}{2}$ ft., is entirely of brick and wood, with no steel frame, it was needled on each side of each vertical row of door and window openings. Under the side walls two sets of beams, the lower parallel to and the upper through the walls, were placed. On top of the upper row was set a third row carrying the front and back walls. A center wall was carried by the second row of beams. The top beams were grouted to a bearing all around and the building raised with shoring jacks spaced 5 ft. apart till the steel-shod roller bearings, $2\frac{1}{4}$-in. cast-iron rollers and rail tracks could be set. The building was then lowered and the basement walls torn down.

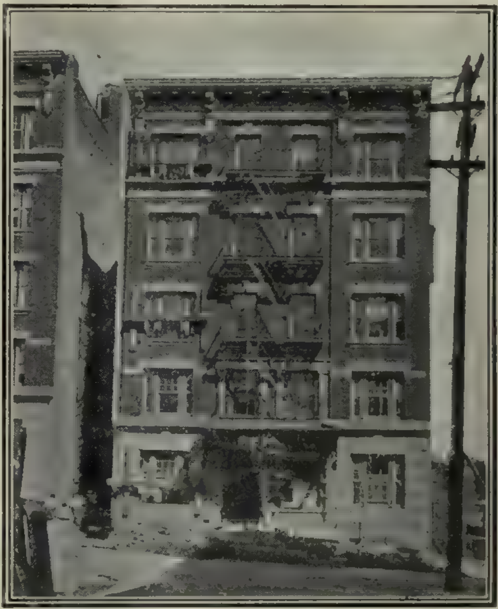
This part of the work was finished between April 19 and June 1, on which date the building was shoved 12 ft. south, sidewise, by seven shoring jacks braced against the apartment adjoining on the north. As the new site is downhill from the old, heavy cribbing had to be built for the tracks. This could not all be done in advance without interfering with the work of building the new foundations. The move was com-



DETAIL OF ROLLER NEST AFTER 10 FEET OF TRAVEL

pleted on June 26, having been delayed by bad weather and the building is now being lowered to place.

This section of the Eighth Avenue-162d Street connection is being constructed by the Battery Engineering Corporation under



THIS BUILDING WAS MOVED 80 FEET

the direction of the Interborough Rapid Transit Company, of which George H. Pegram is chief engineer, F. W. Gardner principal assistant engineer and O. C. Whitman resident engineer. The apartment is being moved under a separate contract with Charles Money. The moving operations were sublet to the Rudd-Nilson Company.

NEEDLING AND RAILS ON SOUTH SIDE OF BUILDING AT LEFT—RIGHT, MOVE BEING MADE ON TALL CRIBBING, NEW FOUNDATION IN FOREGROUND

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Civil Engineers Meet in Pittsburgh This Week

Annual Convention, as Usual, Is Almost Exclusively a Social Affair—Committee Activities Discussed—Attendance 600

A program of varied interest marked the convention of the American Society of Civil Engineers at Pittsburgh this week. According to custom, there were but two business sessions, at one of which Clemens Herschel, who succeeded to the presidency on the death of Dr. Corthell, delivered the presidential address. Extracts from the address, the chief theme of which was the advisability of carrying on the planning, construction and administration of public works by public-works departments managed by engineers, will be found elsewhere in this issue. The social activities included an inspection tour by boat of government locks and dams; alternative inspection trips, according to the tastes and interests of the delegates, to thirteen different industrial plants; a cross-country automobile tour; a dinner and a ball.

Business Meetings

The first of the business meetings was given over to addresses of welcome, an address by John A. Brashear, past-president of the American Society of Mechanical Engineers, and the presidential address. Dr. Brashear, introduced as the foremost citizen of Pennsylvania, a distinction conferred on him by vote of representatives of the state last year, spoke in his usual happy way on the relation of science and engineering. With anecdote and reminiscence he illustrated his contention that pure science and applied science must ever go hand in hand. The line of demarcation between them, if ever there was one, has disappeared. He suggested closer relations between the engineering societies and those devoted to pure science.

At the second business meeting, on Tuesday afternoon, the vote on the proposal to move the headquarters of the society to the Engineering Societies Building was announced. It is given elsewhere in these columns.

J. Vipond Davies, director of the society and chairman of the board's committee on special committees, laid before the meeting the difficulties which the board of direction was having in securing from the special committees reports as to what they were doing. He cited as particularly flagrant the failure of the committee on concrete and reinforced concrete even to acknowledge the receipt of letters, much less to give the information requested. He, therefore, moved that this committee be discharged. An extended discussion on the work of the committee ensued. Prof. A. N. Talbot detailed what the committee has been doing since last October, and Mr. Davies replied that if this information had been forthcoming from the chairman or the secretary of the committee there would have been no reason for his motion. Various substitute motions and amendments were proposed, but eventually the entire matter was laid on the table.

The matter of time and place of the next convention was referred to the board of direction with power to act. The secretary explained that a committee of the board is now working on a plan to route the convention to each of the thirteen districts, so that this matter would then be settled for years in advance.

Resolutions, striking for their sincerity and depth of feeling, were adopted on the death of Dr. Corthell. Past-presidents Swain, McDonald and Ockerson composed the resolutions committee.

Alfred Noble Memorial

Onward Bates, past-president and chairman of the committee on the Noble memorial, reported that Congress had granted a site for the monument, which is to be symbolic in character, on New York Avenue, in Washington, D. C., opposite the new Interior Department Building now under construction. The sculptor commissioned to prepare preliminary designs was to report to the committee at Pittsburgh this week. As soon as consistent with the character of such an assignment the committee expects to report a design to the profession and open subscription books.

About six hundred members and guests had registered at the close of the first day of the convention.

Civil Engineers Vote to Move Society's Headquarters

Result of Letter Ballot of Membership Shows Overwhelming Majority in Favor of Removal to Thirty-ninth Street

The American Society of Civil Engineers will move its headquarters from its present building on Fifty-seventh Street, New York City, to the Engineering Societies Building. That is the result of the ballot of the membership which closed June 15 and was announced at the Pittsburgh convention of the society on Tuesday of this week. The vote was 6 to 1 in favor of the removal of headquarters. In all 2963 ballots were counted. Of these 2500 voted favorably on the question whether the society should move and 390 in the negative.

The ballot not only asked for a vote on this question, but also on the detail plan favored. Plan A calls for the addition of two and a half stories to the present building of the Engineering Societies, the American Society of Civil Engineers to pay for the addition up to a cost of $250,000; 1096 ballots favored this plan and 248 were opposed. Plan B provided for keeping the Engineering Societies Building as it is to-day, the civil engineers paying into the treasury of the United Engineering Society the sum of $240,000; 194 members favored this plan and 695 were against it. The votes on plans A and B, therefore, reinforce each other.

On the final question, whether the matter should be left to the board of direction, the vote was 1795 affirmative and 524 negative.

Reorganization Plan of Western Pacific Is Approved

In a lengthy decision handed down June 23 the Railroad Commission of California approved the reorganization plan of the Western Pacific Railway which provides for the sale of all its property to the new Western Pacific Railroad Company, the issue of $75,000,000 of stock and $20,000,000 of bonds by the latter corporation, and the mortgaging of the property to secure an authorized bond issue of $50,000,000. The order hinges upon the Western Pacific Railroad Company's being the successful bidder for the property of the Western Pacific Railway Company in the foreclosure proceedings and sale. The decision commends the plan as one having a fair chance to succeed. The articles of incorporation of the new company confer power specifically to purchase or build about 350 miles of branch lines.

Clemens Herschel Presides at Civil Engineers' Meeting

A Short Biography of the Eminent Hydraulic Engineer Who Succeeded to the Presidency on the Death of Dr. Corthell

Clemens Herschel, who succeeded Dr. E. L. Corthell as president of the American Society of Civil Engineers and presided at this week's annual convention of that association in Pittsburgh, is best known for his work in the field of hydraulics. His experiments in 1887 led to the invention of the Venturi meter and the derivation of the well-known formulæ for calculating the flow through large pipes.

The principle upon which the Venturi meter is founded was first announced in 1797 in the published researches of J. B. Venturi, an Italian philosopher. He had observed that fluids discharging through an expanding nozzle exert a sucking action at the smaller diameter which diminishes as the diameter increases toward the outlet. It is apparent that he considered this phenomenon scientifically interesting but without practical value. Following Venturi, other engineers made occasional use of the peculiar property for various purposes.

Presiding Officer at Civil Engineers' Convention

CLEMENS HERSCHEL

In 1887 Clemens Herschel conducted a series of the tests was to determine whether a defsizes of tubes composed of two conical portions joined at their small ends, thus forming a contraction near the middle. The purpose of the tests was to determine whether a definite relation existed between the difference in pressure at the inlet and contracted section and the rate of flow. Such remarkably uniform results were obtained that he patented the device, giving it the name of Venturi meter.

Mr. Herschel was awarded the Elliott Cres-

son gold medal by the Franklin Institute for his invention, as described in the February, 1899, issue of the proceedings of that society. He was also presented with the Rowland prize by the American Society of Civil Engineers.

Mr. Herschel was born in Davenport, Iowa, in 1842. After graduating from Harvard University in 1860 he spent three years studying in France and Germany, being graduated from the Carlsruhe Polytechnic School in 1863. Upon his return to Boston in 1864 he took up the practice of consulting engineering, devoting most of his time to bridge work. In 1872 he was appointed superintendent of streets of West Roxbury, Mass.

In 1879 he entered the field of hydraulic engineering, in which he was destined to win world-wide recognition. As hydraulic engineer for the Holyoke (Mass.) Water Power Company he practically rebuilt the dam across the Connecticut River at that point and conducted many hydraulic experiments on a large scale, which resulted in the development of the Venturi meter as just outlined.

He became engineer and superintendent for the East Jersey Water Company in 1889 and undertook the construction of the works for that company. In two and one-half years he had completed the 80,000,000-gal.-a-day plant which supplies water to a group of New Jersey's cities and towns. He left the East Jersey Water Company in 1900.

Mr. Herschel was one of the three railroad commissioners of Massachusetts from 1881 to 1883. Since 1884 he has been consulting engineer on many of the largest power developments at Niagara Falls. Since its inception he has been hydraulic engineer for the Cataract Construction Company, whose works at Niagara Falls utilize about 100,000 hp. He has also acted as consulting engineer for the Niagara Falls Power Company and the Canadian Niagara Falls Power Company.

Author of Several Books

Aside from his experimental hydraulic investigations Clemens Herschel has contributed to technical literature. His volume on "Continuous Revolving Draw Bridges" was published in 1875. His most noteworthy work is "The Two Books on the Water Supply of the City of Rome, of Sextus Julius Frontinus," which contains the only photographic reproduction of the sole manuscript of Frontinus' "De Aquis" and the first translation into English ever made. It is said that this quarto book represents twenty years' collection of material for its publication.

The fineness of character and breadth of view of Mr. Herschel are exemplified by the self-effacement with which he coupled his own invention—the Venturi meter—with the name of that long-forgotten engineer who, but for this generous act, would have remained in oblivion.

Mr. Herschel is past-president of the Boston Society of Civil Engineers and a member of the Institution of Civil Engineers of Great Britain, in addition to holding a membership in many social organizations.

Engineers Want Unused Water Powers Developed

A letter dated June 28 from the Joint Conference Committee of National Engineering Societies, representing about 30,000 engineers, to the President of the United States reads as follows:

"The Joint Conference Committee of National Engineering Societies believes that the development of the country's undeveloped water power will increase national prosperity; that private enterprise should be encouraged and stimulated to expedite such development; that unnecessary legal burdens should be removed and existing doubts as to the safety of investment eliminated. It commends to the support of engineers all efforts to secure the fullest publicity as to the underlying facts regarding this subject."

A. A. Stevenson President of Testing Society

Has Been Connected with Standard Steel Works Company Since 1888—Prominent in Steel Business and Society's Activities

Archibald Alston Stevenson, vice-president of the Standard Steel Works Company since 1908, was elected president of the American Society for Testing Materials at the June 27 meeting at Atlantic City. He succeeds A. W. Gibbs. Mr. Stevenson is the first president of the society selected from the producing interests.

Mr. Stevenson was born in Allegheny City, Pa., in 1862. He was graduated from high school at Rock Island, Ill., in 1878, after which he spent a year as rodman on a government survey of the Mississippi River. He then studied at the University of Illinois for two years. He again took up active work in 1880 in the drafting room of the Southwark Foundry & Machine Company, Philadelphia. After three and one-half years with that company he was put in charge of the drafting room.

First President of American Society for Testing Materials to Be Selected from Producing Interests

ARCHIBALD ALSTON STEVENSON

He left the employ of the Southwark company after four and one-half years' service to go to the Cambria Iron Company, where he was employed for two and one-half years, part of which time he spent in the chief engineer's office and the remainder as foreman of the forge and axle plant. He entered the employ of the Standard Steel Works Company in 1888 as engineer. He rose to the position of superintendent in 1903 and in July, 1908, was made vice-president of the company.

Mr. Stevenson was vice-president of the Association of American Steel Manufacturers from 1908 to 1911 and president from 1911 to 1914. He is a member of the American Society of Mechanical Engineers, American Institute of Mining Engineers, International Association for Testing Materials and the Engineers' Club of Philadelphia.

Dams Break at Kalamazoo

A heavy rainstorm June 24 at Kalamazoo, Mich., caused heavy floods which wrecked the dams at the Bryant and Monarch paper mills. Twenty-six blocks in Kalamazoo's residence district were flooded. No lives were lost.

Testing Society Meets at Atlantic City This Week

In spite of the conflict of dates with the convention of the American Society of Civil Engineers at Pittsburgh, the registration of 375 for the first day of the nineteenth annual meeting of the American Society for Testing Materials at Atlantic City, June 27-30, exceeded that of last year by 140. At the business meeting on Tuesday morning the annual report of the executive committee was received and ordered printed without change. The reports of the committee on standing committees, the committee on wrought iron and the committee on papers and publications were also presented.

The following officers for the ensuing year were elected: President, A. A. Stevenson, vice-president of the Standard Steel Works Company of Philadelphia; vice-president, S. S. Voorhees, engineer-chemist, U. S. Bureau of Standards, Washington, D. C.; members of the executive committee (to serve two years), W. H. Bassett, chemist, American Brass Company, Waterbury, Conn.; John Brunner, assistant inspecting engineer, Illinois Steel Company, Chicago; G. W. Thompson, chemist, National Lead Company, Brooklyn, and F. E. Turneaure, dean of the College of Engineering, University of Wisconsin. This is the first time that a representative of the producing interests has been elected president of the society. A sketch of Mr. Stevenson's career is given elsewhere in this issue and an editorial on the significance of his election was published in the Engineering Record of May 6, page 597.

New Public Health Association Formed in Illinois

As an outgrowth of the public-health session of the Better Community Conference held recently at the University of Illinois, a new society—the Illinois Association for Public Health and Welfare—has been launched to organize the 400 health officers in Illinois, the sanitary engineers and all persons and firms in the State who are interested in public health and welfare.

The officers of the association are as follows: Honorary president, Dr. Robinson; president, Dr. G. T. Palmer; vice-presidents, W. J. Allen, Dr. A. C. Clarke and Dr. Ruediger; secretary-treasurer, Paul Hansen, chief engineer, State Board of Health, Springfield.

New England Waterworks Convention Sept. 13 to 15

This year's convention of the New England Waterworks Association will be held Sept. 13 to 15 in the city hall at Portland, Me. Arrangements are under way for transportation of the delegates by rail or boat. Excursions to points of interest near Portland have also been planned.

Gov. Oakley C. Curtis of Maine and possibly Admiral Peary will address the meeting at its opening. The exhibit, in charge of W. F. Woodburn, will be held in the auditorium of the city hall.

Jersey Supreme Court Sustains Grade-Crossing Law

The Fielder grade-crossing law of 1913, which authorizes the New Jersey Board of Public Utility Commissioners to order the elimination of grade crossings within the state at the railroad's sole expense, was declared constitutional by the state Supreme Court in a decision rendered June 23. The order at issue was that directing the Erie Railroad to eliminate fifteen grade crossings in Paterson at an estimated cost of approximately $3,000,000. H. A. Taylor, general attorney of the Erie, states that the matter will be carried to the Court of Errors and Appeals.

$2,085,000 to Be Spent on Hetch Hetchy Project

Time and Cost Estimates and a Construction Schedule Are Announced by Chief Engineer O'Shaughnessy

The project which is to bring 400,000,000 gal. of water per day to San Francisco from the Hetch Hetchy Valley, 181 miles away, is now well started. The site of the dam is to be unwatered late this fall and work will be begun simultaneously on several parts of the project, giving particular attention to those points where progress will be restricted the most. An estimate of yearly costs and a tentative outline of the construction program have just been prepared by M. M. O'Shaughnessy, from which the following has been taken.

During 1916 the principal activities will be building the construction railroad for which the contract has already been awarded; completing the diversion tunnel and diversion dam; preparing foundations for the main dam; laying out a temporary power plant to supply electric current for the construction operations at the dam site; continuing the aqueduct tunnel from Early Intake toward South Fork; making diamond-drill borings along the tunnels and continuing the minor incidental work.

$120,000 for Temporary Power Plant

Power for construction use will be developed about 12 miles from the dam site, where water can be diverted from Cherry River and led through a canal to a point near Early Intake, where the temporary plant will be built. A high tension transmission line will connect this plant with the dam site and another line, 20 miles in length, will follow along the aqueduct line as far as Moccasin Creek, with a substation at each portal, shaft and adit of the tunnel aqueduct. The canal will have a capacity of 200 cu. ft. per second and will be a permanent structure, remaining in service to make Cherry Creek tributary to the tunnel aqueduct.

The construction work outlined for this year is estimated to total $2,085,000, apportioned as follows: Hetch Hetchy railroad, $1,650,000; Hetch Hetchy reservoir, $160,000; temporary power plant, $120,000; Early Intake tunnel, $50,000; San Joaquin Valley pipe line, $5,000; Coast Range tunnel, $10,000; lands and rights, $25,000; general engineering and legal expenses, $65,000. The total cost of the project is given at $44,147,000, of which $2,267,000 has already been expended and the remainder is to be distributed among the next eight years with a maximum of $8,900,000 in 1921.

Engineers Have Opportunity to Receive Military Training

A depot battalion is organizing at the 71st Regiment armory, New York City, to hold the fort for that regiment of the National Guard while it is on border duty. Lieut.-Col. E. B. Bruch, commander, and First Lieut. Burton G. Wager, adjutant, unofficially announced that any engineers desiring to receive military training, including those who have been under instruction of 71st Regiment officers, will be welcomed to this detachment.

St. Louis Engineers Organizing an Engineers' Battalion

Following a call by John A. Laird engineers of St. Louis met June 23 at the Engineers' Club of St. Louis for the purpose of organizing an engineers' battalion for service in the Mexican campaign. The adjutant general of Missouri has given his assurance that every inducement will be given for such an organization. About 30 members enrolled that evening. It is expected that this number will be considerably increased as the movement is carried forward.

California Engineers' Battalion Forming for Mexican Service

An engineer battalion of three companies, with a full complement of 519 officers and men, is being organized in California for duty on the Mexican border. The battalion is officered by members of the California engineer corps and the organization and recruiting are under the direction of Major J. W. Swaren, of the Pelton Water Wheel Company. On June 23, after only a few days of activity, about 75 per cent of the requisite number of men had been recruited, and the number of candidates was rapidly increasing. Only men who have had some training which will enable them to serve effectively on an engineer corps are accepted.

Photo Courtesy Chicago Daily Journal.

Illinois Engineers Company Leads Way to Mobilization Camp

COMPANY A, Corps of Engineers, led the Chicago military procession to the mobilization camp at Springfield, June 21. Four passenger cars, two flat and two box cars loaded with equipment and supplies left on the Chicago & Alton Railroad at 7 a. m. June 21. Motor trucks furnished by the city transported the impedimenta, consisting of complete equipment for reconnaissance, bridge-building and demolition, from the armory to the railroad yards. Due to a cloudburst, the first work at the camp was that of drainage trenching. Capt. H. B. Sauerman, who organized Company A, is now engaged in developing two additional companies provided for under the new law which goes into effect July 1. He will also receive recruits for Company A, which needs about seventy-five men to bring it up to war strength.

Railroad Appoints Representatives to Assist in Mobilization

The New York, New Haven & Hartford Railroad has appointed four representatives to co-operate with the government in mobilizing of troops and handling supplies. L. DeB. Lovett, resident engineer, has been assigned to duty at the Framingham (Mass.) camp.

Caisson Bursts in Boston Tunnel

Four men were killed June 24 when a caisson used in the construction of a section of the South Boston tunnel at L and Summer Streets was wrecked by an explosion. A leak in the 80-ft. air shaft is said to have been the cause of the accident.

Extra Indexes Available

To meet the desires of those who like to bind their indexes to the Engineering Record separately, and still have each volume indexed, a limited number of the indexes of Vol. 73, January-June, 1916, have been printed. As long as the supply lasts they will be given out free on application.

$22,000,000 San Francisco-Oakland Bridge Proposed

Plans Will Soon Be Presented for Structure 5½ Miles Long—Propose Location Where Average Depth Is 60 Feet

The U. S. War Department has announced a public hearing to be held in San Francisco in the near future before Col. Thomas H. Rees, Corps of Engineers, U. S. A., at which plans for the $22,000,000 San Francisco-Oakland bridge will be presented and the project explained. The proposition is advocated by Harlan D. Miller, bridge engineer, of Albany, N. Y., and has been indorsed by numerous civic bodies in the bay cities.

It has been pointed out that a 5½-mile structure connecting First and Adeline Streets in Oakland with Second and Townsend Streets in San Francisco would be the shortest route. It would also reach the San Francisco shore beyond the last important pier, so that the bridge would not interfere with the shipping. The 60-ft. depth of water and weak currents are also cited as conditions favorable to the proposed location. Trains could be run on subway or elevated tracks direct to a terminal at Third and Market Streets, delivering passengers into the heart of the city.

The bridge would consist of a large number of spans all alike, except two near the San Francisco shore, where exceptionally long and high spans would be necessary to permit the unobstructed passage of ships. There would be two bascule spans in the bridge, one near each shore. Three roadways would be provided, one for high-speed auto traffic and two for trucking. Provision is to be made for steam-line and interurban electric railroad tracks with grades and curves, permitting a speed of 45 miles per hour. Interlocking safety devices similar to those on the New York subways would be expected to allow a headway of 1½ min. between trains.

It is urged that the bridge be built jointly

by the counties of Alameda and San Francisco as a public highway, and a small toll be collected for its use. Because of the heavy traffic that is expected it is estimated that the tolls would pay for the bridge in about ten years. The estimated cost of the structure is $22,000,000 and the expected annual revenue $3,450,000. Based on charges of 30 cents for each vehicle and 2 cents for each passenger on the railroads, the revenue would be distributed as follows: Passengers, $1,200,000; automobiles, auto trucks and other vehicles, $1,500,000; passenger coaches, $675,000; conduits, electric wires, cables, $75,000. Bonds would have to be issued to cover the cost of construction. The Oakland Chamber of Commerce estimates that the interest on ten-year bonds would be $1,000,000 per annum, leaving more than $2,000,000 to be applied to the sinking fund and for retiring the bonds.

Heavy Floods Cause Serious Damage in Pennsylvania

Recent heavy floods on the Susquehanna River watershed caused hundreds of thousands of dollars loss to crops, railroads and manufacturing plants along that river and its branches. Several small dams broke at Lawrenceville, Pa., inundating the town to a depth of 4 ft. To prevent an outbreak of disease the state health department dispatched medical officers, two sanitary engineers and a corps of health officers from Harrisburg and nearby points.

The Juanita River at Lewistown is said to have risen June 18 21.6 ft. above low-water mark. Slides of earth blocked highways and railroads. The waters of Tuscarora Creek washed away an abutment of a bridge of the Tuscarora Valley Railroad. An engine and three cars plunged into the stream, killing the fireman and engineer.

Landslides held up traffic on the Central, Renova and Middle divisions of the Pennsylvania Railroad. At Spruce Creek, Pa., a slide derailed a fast passenger train, but no one was injured. At Harrisburg the flood caused suspension of work on the New Cumberland Valley Railroad bridge being constructed by the Robert Grace Construction Company. Several sections of the temporary trestles are reported to have been swept away by the high water.

$3,000 Model of Riverside Park Track Plan Will Be Made

A $3,000 model is to be made of the track and tunnel plan along Riverside Park proposed by the New York Central Railroad as part of the West Side improvement in New York City. The order for its construction has been issued by the Board of Estimate. It will require several weeks to complete the model, which is expected to give various interested civic bodies a better understanding of the extent of the park changes.

Purdue University Starts Series of News Letters to Alumni

The first of a series of news letters to be sent out by the heads of the engineering schools of Purdue University to the alumni was mailed recently. The object of the campaign will be to keep the graduates in touch with the activities of the schools and develop a spirit of mutual support between the alumni and faculties.

St. Louis Engineers Made Members of Bond Election Committee

Out of a committee of thirty-one men chosen recently in St. Louis at the mayor's conference to arrange details for a bond issue campaign, five were members of the St. Louis Engineers' Club—Edward Flad, Julius Pitzman, F. G. Jonah, C. E. Smith and J. T. Dodds. The committee will make a comprehensive report to the conference the second week in July.

Mayor of St. Paul Appoints Engineer to Membership in Advisory Board

A new idea in city government is that being put into effect by V. R. Irwin, mayor of St. Paul. He is forming a mayor's advisory board, composed of representatives of all large civic organizations. Among the associations asked to elect a member to the board was the Civil Engineers' Society of St. Paul. P. E. Stevens, consulting engineer of that city and secretary of the St. Paul society, was appointed to represent the civil engineers on the mayor's advisory board.

New Haven Seeks to Enlarge Freight Cut at Boston

Plans have been prepared by the New York, New Haven & Hartford Railroad for widening the two-track cut leading to the freight terminals at Boston. The intention is to four-track the connection. Plans are now before the city authorities for approval. It is estimated that the improvement will cost $829,000 and require eight months to complete.

Good Roads Association Formed

The State Good Roads Association of Pennsylvania was formed June 26 at Harrisburg. The officers are: President, R. L. Munce, Canonsburg; secretary, A. A. Purman, Waynesburg; treasurer, W. H. H. Davis, West Chester.

$20,000,000 Flood-Prevention Project Being Considered

The Pittsburgh flood commission has been asked by Gov. Martin C. Brumbaugh of Pennsylvania to submit to him drafts for legislation to bring about co-operation between the city of Pittsburgh, Allegheny County, the commission and the national government in the construction of flood-prevention reservoirs on the Monongahela and Allegheny rivers, establishing seventeen reservoirs in Pennsylvania, Maryland and West Virginia to impound flood waters. The project will call for an expenditure of $20,000,000. Surveys have already been made. Bills will be drafted for presentation to the Pennsylvania Legislature in 1917.

Reconstruction of Paris, Tex., Progresses Rapidly

Paris, Tex., almost completely destroyed by fire last March, is rapidly being rebuilt. The court house and municipal buildings are already under construction and plans are being considered for about fifty new business houses. It is estimated that nearly $5,000,000 will be spent during the next year or so for buildings.

Not Wanted at Any Price

Pinned to a circular bearing the caption, "The Last Chance to Buy Engineering Record at $3 a Year," which further set forth the saving of $2 that would be garnered by the thrifty who subscribed before June 15, the circulation department of this journal received the subjoined repudiation of its arguments:

————. Colorado. June. the 5 1916.

to the last chance

dear surs your second note at hand and would say in advanse or rather in reply that I am vary mutch obliged to you for the intrest you seam yo manefest in my behaf in giving me a tip in regards to the raising of the rates of your paper but I do not want your paper at eny prise so you can rest contented and asshured that I will not be disapointed if the prece does go up to 10 $ insted of 3 $ so do nnot waste eny more stamps mailing special tips I have lived quite A number of years with out the assistance of the valyable information of your paper and rather thi nk i can get along likley the rest of my days byt if I should fale I then would send the proper amount for the assistance of the vary valuable paper so hoping you will not be vary mutch disepointe in not recieving the amount of my subscription and I know you will not becose if the paper si worth $5 you would simpley bee giving me $2 and that I would never stand for I am no pawper and dont think I will bee soon so good by from one that is vary mutch interested in your willfaie but more so in my own

yours vary truley

at ———— Colorado

First Successful Aeroplane Shown at Tech Dedication

Among the remarkable exhibits in the Museum of Technology at the recent dedication of the new buildings of the Massachusetts Institute of Technology was that of the first aeroplane to fly under its own power. The original Wright machine, which made its first power-driven flight of 12 sec. duration Dec. 17, 1903, was seen by the public last week for the first time.

Idaho Engineers Issue Journal

The first number of the *Idaho Engineer* is dated May, 1916. The new journal is published by the Idaho Society of Engineers, at Boise, Idaho. A page entilted "Rod Up" sets forth the policy of the journal as follows:

"The Idaho engineers are up in Boundary County tying in a preliminary to the Canadian line; they are in the Cœur d'Alene mines driving a drift on the 1500; they are at Lewiston building a highway on Union Town Hill; they are making a topog map in the Potlatch timber; they are staking out a placer claim in the Boise Basin or locating the corners for a stockman down in Owyhee County; they are putting in 10,000 hp. on the Snake River; they are building a power line in Bear Lake County—measuring water from the Magic Dam or storing water near the Wyoming line.

"Is it any wonder they seldom meet to talk it over?

"This *Idaho Engineer* wants you to know each other—to know what's doing—what the fellow in Boundary as well as the one in Bear Lake County thinks about it—what you think about it and what we all think about it, so that the Idaho Society of Engineers may think together, do together and accomplish together."

Plan Memorial to Late J. J. Hill

The adoption of a plan to convert an entire business block in that city into a memorial to the late James J. Hill is being urged by the St. Paul Association of Commerce. The project is said to involve the expenditure of more than $1,000,000, funds to be contributed from all over the country. The proposed site for the memorial square is the block between Fourth, Fifth, Sibley and Wacouta Streets.

Award Elliott Cresson Medal

The Franklin Institute has awarded the Elliott Cresson gold medal for 1916 to Dr. Robert Gans of Pankow, near Berlin, Germany, for the discovery of Permutit. The medal and diploma are awarded annually by the institute on the recommendation of its committee on science and arts "for discovery or original research adding to the sum of human knowledge irrespective of commercial value or products embodying substantial elements of leadership in their respective classes, or unusual skill or perfection in workmanship."

Floods Wash Out Bridge

Several creeks in Grant County, Oregon, overflowed last week and are said to have carried away several bridges. Floods on the west fork of the Hood River destroyed a bridge crossing that stream near the town of Hood River, Ore.

Portland Cement Included in Pavement Classification

The New York Board of Estimate and Apportionment recently included Portland-cement concrete in the classification of ordinary pavements. The board's decision was that "Portland-cement concrete pavements not less than 6 in. thick may also be laid as a preliminary pavement on streets and roads in undeveloped districts under conditions to be prescribed by the board in each particular case."

Engineering Society Activities

The Engineers' Club of St. Louis held a meeting June 28 at which F. R. McMillan, assistant professor of structural engineering at the University of Minnesota, presented an illustrated paper on time tests of concrete.

The Colorado Association of Members of the American Society of Civil Engineers elected the following officers June 10: T. W. Jaycox, president; Robert Follansbee, vice-president, and L. R. Hinman, secretary-treasurer.

The Better Community Conference at the Illinois State University June 20, 21 and 22 was addressed by Paul Hansen, chief engineer of the state board of health, who spoke on "Water Supply and Sewerage." S. A. Greeley, consulting engineer, of Chicago, discussed city wastes collection and disposal.

The Seattle Master Builders' Association, at its recent annual meeting, elected the following officers to serve for the ensuing year: C. C. Cawsey, president; Neil McDonald, vice-president; E. H. Jones, treasurer; C. W. Carkeek, secretary. George Eckman, M. J. Hursen and Otto Roseleaf were appointed trustees.

The Pacific Northwest Society of Engineers, at a recent meeting at Seattle, continued the discussion of tests of concrete floor slabs used in the construction of the Bell Street warehouse at Seattle. Papers were received from Prof. W. A. Slater, University of Illinois, and Prof. F. R. McMillan, University of Minnesota, and also from C. A. P. Turner and V. H. Fixen.

The Engineers' Society of Pennsylvania has inaugurated for the first time a state-wide campaign for additional members. A membership committee headed by William B. McCaleb, superintendent of the Philadelphia division of the Pennsylvania Railroad at Harrisburg, is making a vigorous canvass of engineers in every part of Pennsylvania. Subcommittees have been appointed in each of the state's sixty-seven counties, and an effort will be made to double the present membership of approximately 700 in thirty days. The Engineers' Society of Pennsylvania holds a particularly important position among engineers of that state because of the location of its clubhouse in Harrisburg, the state capital. The society has been active for ten years.

Engineers of Peoria, Ill., met June 15 in that city to discuss the formation of an engineers' club. The second meeting is scheduled for June 26.

The Engineers' Club of Cincinnati recently held a joint meeting with the local section of the American Society of Mechanical Engineers. Major P. S. Bond, Corps of Engineers, U. S. A., discussed preparedness from the engineer's point of view. The next meeting will be held in October.

The Engineers' Club of Seattle, at the regular weekly meeting June 15, heard C. Alan Dale, city councilman of Seattle, lectures on "Councilman Life from the Inside."

The Engineers' Society of Pennsylvania held its regular meeting June 16, at Harrisburg. The next gathering will be in September or October.

The Engineers' Club of St. Louis, at the June 21 meeting heard S. W. Bowen, chief designing engineer of the department of public utilities of St. Louis, present an illustrated paper on a proposed municipal river terminal system for the city of St. Louis.

The Rochester Engineering Society has added a number of books on military preparedness to its library. The society has been active in military work and boasts fifty members who belong to the engineering reserve of New York State.

What Engineers and Contractors Are Doing

ARTHUR B. MORRILL, formerly employed at the sewage-disposal plant of the Baltimore Sewerage Commission, has become associated with Morris Knowles, consulting civil engineer, of Pittsburgh.

FRANK J. ENGEL and HERMAN P. HEVENOR have opened offices at 220 Broadway, New York City, under the firm name of Engel & Hevenor, engineers and contractors. Mr. Engel is a graduate of the University of Pennsylvania and has spent most of his time in railroad work with the Pennsylvania and the Boston & Albany railroads. In 1912 he went to the American Bridge Company, at Pencoyd, Pa., but in 1913 took a position in the bridge department of the Boston & Albany Railroad, assisting in the design and field work connected with the renewal of many of that road's large bridges. When the valuation department was organized he was transferred to that division with the title of assistant engineer, from which position he recently resigned. Mr. Hevenor has been connected with the Brooklyn Rapid Transit Company as assistant engineer on estimating, designing and following up of that company's contractors' construction. Later he had entire charge of the design and construction of the track department of the Buda Company at Harvey, Ill. For the past five years he has been in the chief engineer's office of the New York, New Haven & Hartford Railroad, working on design, investigations and inspections.

VICTOR H. COCHRANE, of Hedrick & Cochrane, consulting engineers, of Kansas City, Mo., has been made engineer of structural steel work for that city. Mr. Cochrane is a graduate of the University of Arkansas. In 1901 he became connected with Waddell & Hedrick, consulting engineers, of Kansas City, and in 1903 was made chief draftsman. In 1905 he was made representative of his firm at the Riter-Conley Manufacturing Company's shops at Pittsburgh, in charge of inspection of steel for the Intercity viaduct. In 1906 he was appointed assistant engineer for Ira G. Hedrick, consulting engineer, of Kansas City. A year later he took a similar position with Waddell & Harrington. While in that firm's employ he had charge of the estimating and designing of bridge work costing nearly $5,000,000.

G. STEWART GILES, formerly connected with the Carolina Mineral Company of Penland, N. C., has been made inspector for the Underwriters Bureau of the middle and southern states, with headquarters in New York City.

JOHN G. MASON, formerly connected with the bridge department of the Chicago, Burlington & Quincy Railroad, has been made structural engineer in the supervising architect's office at Washington, D. C. Mr. Mason is a graduate of the University of Nebraska. Previous to his employment by the Chicago, Burlington & Quincy he was for two years inspector for the state bridge engineer of Nebraska. Mr. Mason has also had four years' experience as chief draftsman for the Westover Iron Works, Lincoln, Neb.

JOSEPH O. DROFFIN, who has for two years held a research fellowship at the University of Illinois, has just completed his studies at the engineering experiment station at that university and is now connected with McIntosh & Crandall, civil engineers, of Burlington, Vt.

W. GRAHAM COLE, formerly assistant engineer for the Baltimore Sewerage Commission, has been made safety engineer for the Maryland Steel Company at Sparrow's Point, Md.

R. H. HUTCHINSON, superintendent for R. H. & G. A. McWilliams, drainage contractors, of Chicago, will have charge of the levee work at Stamps, Ark., for which his company recently secured the contract. Mr. Hutchinson is now completing the construction of 18 miles of levee along the Red River in Miller County, Arkansas, involving the excavation and depositing in embankments of nearly 1,300,000 cu. yd. of material.

S. A. MCGOVERN has resigned as assistant engineer in charge of location and design of county drainage ditches in Brown County, Minnesota, to become assistant engineer on a 122,000-yd. paving job at Ames, Iowa.

JAMES E. SUTTON, formerly city engineer of Alameda, Cal., has been chosen by the city of Taft, Cal., to lay out and supervise the construction of its streets. A $60,000 bond election will be held soon and if it carries Mr. Sutton will be in charge of the street building work.

EDWARD L. ZELTNER has entered the employ of the U. S. government in the ordnance department of the navy yard at Washington. Mr. Zeltner has been with the C. W. Hunt Company, New York City; the Turner Construction Company and the Canadian Copper Company.

LOUIS FOCHT, engineer in the New Jersey department of taxes and assessment, has been appointed with Willis Whited, engineer of bridges for the Pennsylvania highway department, to estimate the value of the toll bridges spanning the Delaware River between Trenton and Port Jervis. Mr. Focht first took up engineering work in 1882 in the engineering department of the Lehigh Valley Railroad, where after fourteen years he rose to the position of assistant engineer in full charge of all work on the New Jersey division. He resigned to become chief engineer for the Lehigh Construction Company, after which he was employed on railway investigations in South America. He returned to the United States to become chief engineer and superintendent of the New Jersey Terminal Railway and was later made assistant chief engineer of the Mount Desert Transit Company, after which he became connected with the State of New Jersey. He was appointed chief engineer to Charles Hansel, consulting engineer, in 1910.

MELVILLE H. JAMES, secretary of the William Penn Highway Association, has made his headquarters in the Telegraph Building, Harrisburg. Mr. James and William Jennings, president of the association, have just completed an inspection of the proposed route between Pittsburgh and Philadelphia.

ALLAN R. GILCHRIST, for the past ten years city engineer of Montgomery, Ala., has been employed by the Alabama Power Company as chief engineer on the construction of a million dollar dam and power station on the Warrior River. The head offices of the company are in Birmingham.

M. J. ROCHE CONSTRUCTION COMPANY, of Cincinnati, will take over the business of the Roche-Bruner Building Company, which for years has had its offices in the Johnston Building. The officers of the new company are M. J. Roche, president; Mark Bruner, vice-president, and Thomas Roche, treasurer.

J. A. COYLE, superintendent for the Consolidated Engineering Company, of Baltimore, will have charge of the sewer job at East Palestine, Ohio, for which his company recently secured the contract.

ESSELSTYN - MURPHY COMPANY, engineers, have opened consulting offices in the Penobscot Building, Detroit. N. H. Esselstyn, who has been engaged in engineering work since 1891, will continue to act as construction engineer for the Detroit Edison Company. Previous to his connection with the Edison Company he was for fifteen years with Westinghouse Church Kerr & Company, during which time he was active in many large works, including the electrification of the Long Island Railroad and the Rochester branch of the Erie Railroad. He was also connected with warehouse construction for the Mississippi Glass Company. He is chairman of the Michigan committee on increase in membership of the American Society of Mechanical Engineers. As construction engineer for the Detroit Edison Company he had charge of the design and construction of the Governors Creek power plant. L. F. Murphy was educated at Cornell University. He spent his summers between school terms on power-plant engineering work. In 1909 he became connected with Westinghouse Church Kerr & Company, but in 1910 went to Helena, Mont., for J. G. White & Company. Late in that year he was made assistant superintendent of construction for the Detroit Edison Company. He recently resigned to take a position as manager of the Walkerville (Ontario) Light & Power Company, which he left to become associated with Mr. Esselstyn.

JAMES COLLIER, engineering contractor, has just completed a $60,000 sewer job for Steamboat Springs, Col., and returned to Denver to engage in new work. The Steamboat Springs job is Mr. Collier's first contract after resigning as assistant engineer in the department of public works of Denver to enter the contracting business.

M. E. READY, formerly assistant engineer in the U. S. Reclamation Service, has entered the designing department of the Chicago, Milwaukee & St. Paul Railway at Chicago. He has been with the reclamation service for nine years, seven of which he spent on the Orland project and the remainder in the Northern Division.

W. N. BROWN, of Brown & Clarkson, civil and mining engineers, Washington, D. C., has returned from Lake Wales, Fla., where he has been laying out a villa site and orange-grove subdivision covering some 3000 acres in Polk County.

N. W. DOUGHERTY, for the past two years assistant professor in the civil engineering department of George Washington University, has been made associate professor of civil engineering at the University of Tennessee, succeeding Prof. William W. Carson, resigned. Professor Doughtery is a graduate of the University of Tennessee, class of 1909, and of Cornell University, 1913. He also took a graduate degree at the latter institution in 1914. He was an instructor in civil engineering at Cornell University from 1910 to 1914.

R. J. LOVE was recently made engineer in charge of the $325,000 Monroe County (Tennessee) road construction. Mr. Love was graduated from the University of Tennessee in 1904, after which he engaged in railroad work in the South and in Mexico. He went to South America in 1911, where for two years he surveyed a line from Lake Titicaca basin in Peru across the Andes to a tributary of the Amazon River. Since 1913 he has been engaged on pike road construction in eastern Tennessee.

ARTHUR D. PETERS, formerly special engineer for the Lake Erie & Western Railroad, has been made superintendent of that road at Lima, Ohio. Mr. Peters was born in 1879 at Springport, Mich., and was graduated from the engineering department of Michigan Agricultural College in 1903. In 1906 he was made draftsman for the Lake Shore & Michigan Southern Railway and later was transferred to the land and tax department. In 1911 he was made real-estate agent for the Lake Erie & Western and became special engineer in 1913.

T. A. IRVINE has been made city engineer of Titusville, Pa. Mr. Irvine was graduated from the civil engineering department of Allegheny College in 1908. He was recently connected with the engineering department of the Baltimore & Ohio Railroad in West Virginia and Maryland.

LIEUT.-COL. C. A. F. FLAGLER, Corps of Engineers, U. S. A., will take temporary charge of the Baltimore engineering district, formerly under the supervision of Col. John Biddle, whose appointment as superintendent of the U. S. Military Academy at West Point was noted in a previous issue. Lieutenant-Colonel Flagler will supervise the Baltimore Division in addition to his work in the District of Columbia.

HAROLD D. MORTENSON, president of the Pelican Bay Lumber Company, of Klamath Falls, Ore., has been elected president of the California Sugar & White Pine Manufacturers' Association. The membership of the organization includes the leading pine manufacturers of the Pacific Coast.

F. C. THORPE has left the employ of J. J. Jobat, contractor, of Peoria, Ill., to become division engineer in charge of construction of Division 3, Vermilion County bond roads.

ANDREW F. MACALLUM, whose appointment as city engineer of Ottawa, Canada, was noted in the Engineering Record for May 27, is now leaving Hamilton to assume the duties of his new position. After graduation from the University of Toronto, Mr. Macallum entered the railway engineering field. He served in the engineering departments of the Canadian Pacific, Grand Trunk, Toronto, Hamilton & Buffalo and Minneapolis & St. Louis railways. For three years he studied sewerage and waterworks systems in several Canadian cities. In 1905 he was placed in charge of 80 miles of construction for the Transcontinental Railway. Two years later he opened consulting offices in Toronto and reported on the continuation of construction of the Alaska Central Railway now being constructed by the federal government. He was also consulting engineer for West and North Toronto on development of water power, electric railway construction and municipal works. Mr. Macallum was made city engineer of Hamilton in 1909.

BARRY DIBBLE, electrical engineer for the Minidoka (Idaho) project of the U. S. Reclamation Service, has been made project manager. Mr. Dibble was graduated from the electrical engineering department of the University of Minnesota in 1903. He spent his summers between school terms in the employ of railway and power companies. On graduation he became designer and construction engineer for the Cincinnati & Columbus Traction Company. In 1904 he was put in charge of operation of the Shawinigan Water & Power Company's station at Shawinigan Falls, Que. A year later he was made assistant superintendent of the St. Paul (Minn.) Gas Light Company. He became connected with the U. S. Reclamation Service in 1909.

R. E. SPEAR has resigned as assistant city engineer of Bartlesville, Okla., to become connected with the city engineering department of Flint, Mich.

JUSTIN F. BARBER has recently been made assistant engineer on the construction of the Hetch-Hetchy Valley Railroad for the city of San Francisco.

EDMUND M. BLAKE'S appointment as engineer for the Holbrook, Cabot & Rollins Corporation was noted in the issues of May 20 and June 3. In the first item mention was made that Mr. Blake was engineer on the Arrowrock dam. This was corrected in the June 3 issue, when a detailed biography was published. The dam in question was constructed under the direct supervision of Charles H. Paul, assisted by James Munn and A. B. Mayhew, superintendent of construction and principal engineering assistant respectively.

FLOYD W. ALLEN, formerly deputy in the Kings County county engineer's office at Seattle, has resigned to become engineer for Water District 2, comprising some 7000 acres outside the limits of Seattle. Mr. Allen is prominent in the affairs of the Engineers' Club of Seattle and the Pacific Northwest Society of Engineers.

H. W. JOHENNING has been made engineer in charge of the new bureau of franchises and minor privileges of Baltimore. He was formerly one of the engineers for the sewerage commission of that city.

Obituary Notes

JOSEPH OTIS OSGOOD, chief engineer of the Central Railroad of New Jersey for the last fifteen years, died June 28 at Newark, N. J. He was born in 1848 at Cohasset, Mass. He entered railway service in 1865 as rodman for the Eastern Shore Railroad, now a part of the Pennsylvania system. From 1870 to 1871 he was in the employ of the Portland & Ogdensburg Railway as resident engineer. He was made assistant to the chief engineer of the Maine Central Railroad in 1871, but resigned two years later to become resident engineer for the State of Massachusetts on the improvement of South Boston Flats. He was employed on railway construction in Colorado and New Mexico for the Atchison, Topeka & Santa Fe Railway from 1878 to 1880, and for the following two years was chief engineer of the California Southern Railroad. In 1883 Mr. Osgood was made chief engineer of the Boston Hoosac Tunnel & Western Railroad. During 1885 and 1886 he was engaged in making examinations of and reports on railways. Late in 1886 he was made chief engineer in charge of rebuilding the Toledo, St. Louis & Kansas City Railroad, which position he held until 1887, when he became chief engineer of the Lake Shore & Michigan Southern Railway. Two years later he left the Lake Shore to open an office in New York City for consulting practice in railway engineering, and he remained in private practice until his appointment as chief engineer of the Central Railroad of New Jersey in 1901.

HARRY A. HALL, deputy engineer of Pierce County, Washington, died June 6 at Tacoma at the age of 60. He was a graduate of the Massachusetts Institute of Technology. For fifteen years he was in the service of the board of park commissioners at Boston. He went to Tacoma in 1909 and in 1914 was resident engineer on the Auburn dam. He had recently been resident engineer in charge of what is known as the county-line cut on the intercity improvement on the Puyallup River. His service in the office of the engineer of Pierce County covered a period of two years.

Civil Service Examinations

New York.—Examinations for positions in the state, county and village service will be held July 15 in cities throughout the state. Applications must be in the hands of the Civil Service Commission at Albany by July 5. Positions to be filled are: Bridge designer at a salary of $1,501 to $2,100; superintendent of construction, $1,800; junior assistant in engineering departments, $901 to $1,200.

Examinations Previously Announced

Date		See Eng. Record
Aug. 21-25.	Second Lieutenant, civilian candidates	April 1
July 5.	U. S. assistant sanitary engineer. Salary $1,600	June 3

Engineering Record

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Use of Waterworks Land

IN this country the full possibilities of the joint use of land by waterworks and park departments and other interests have not been realized. What can be done in this respect was told in E. P. Goodrich's report on city planning before the recent convention of the American Waterworks Association. As illustrating one of the uses to which reservoir areas may be put he cited the case of the Lake Montebello area at Baltimore, which is utilized as a golf course by the Baltimore Country Club. This practice might be followed with advantage in other cities. Of course, lands in the vicinity of reservoirs should be carefully guarded to prevent the runoff of polluting matter into the water, but by turning the marginal lands into the fairways and greens of a golf course the territory is placed in use without danger to the water supply. Other cities should not be neglectful of the revenues which might be secured from putting their waterworks lands to work.

Quality in Concrete

NEW possibilities in specifying concrete are suggested in the paper by Cloyd M. Chapman, presented at the recent meeting of the American Society for Testing Materials, part of which will be found on page 50 of this issue. He would make strength tests the basis for fixing the proportions to be used. In the discussion, R. J. Wig, of the U. S. Bureau of Standards, stated that the government was working along the same lines, a fact quite clearly shown in the recently issued bulletin on the strength of concrete. One of the important advantages of the proposed specification, which would require continuous testing as the concrete goes into the structure, is the incentive which it would afford the contractor to produce the best possible concrete. With the knowledge that the product must show strength values not below a given limit, he would endeavor to develop methods for insuring uniform and satisfactory concrete without loss of time or efficiency. Thus, in addition to the manifest advantages of economical proportions with the commercially available aggregates, such a specification would be a powerful stimulus for the improvement of quality.

Federal Road Aid

TERMINATING years of agitation, Congress has passed a federal-aid road bill of such proportions as to satisfy for the present the insistent federal-aid advocates. There is little likelihood that the President will refuse to sign the measure, as the Secretary of Agriculture is known to be favorable to it. The bill, fortunately, follows the lines of that drawn up by the American Association of State Highway Officials, and pork-barrel features are consequently excluded. The apportionment of funds is on definite lines, based on state area, population and post-road mileage; the state must match dollar for dollar the government's money, and no payments are to be made from the national treasury until the Secretary of Agriculture has satisfied himself as to the quality of the work. Of special value is the provision that no further federal aid will be forthcoming for states and counties which fail to "properly maintain" the federal-aid roads already built. Much progress has been made in awakening engineers and communities to the need for proper maintenance. No argument, however, is quite so potent as that of the withholding of funds. After the government has followed this course of insisting upon proper maintenance for five years it is reasonably certain that the states and counties will have learned better than ever before the need for maintaining the roads once they are built. If this lesson can be well taught that alone might be adequate return to the taxpayers for the $75,000,000 expenditure that the measure authorizes. The inclusion of the clause is a tribute to the persuasive abilities of those who framed and pushed the bill.

How the Railroads Are Being Valued

EVER since the passage three years ago of the federal Valuation Act the Engineering Record has recognized the great importance of the valuation of the railroads, and has followed the developments much more closely than any other journal has done. The important valuation conferences have been "covered," and the "fundamental principles" have been discussed at length in the editorial pages. Readers of the Engineering Record know that it has disagreed emphatically with many of the popular theories, and that with certain exceptions it upholds the railroad view. Involved with these principles, and yet quite apart from them, are the problems connected with the actual work of evaluating 250,000 miles of railroad at a cost of more than $50,000,000. So gigantic and many-sided is the undertaking that it is difficult to describe or picture it comprehensively. In a series of articles, the first of which appears on page 43, Mr. Stark of this journal's staff presents some of the outstanding features. The first article reviews the organization of the work from the passage of the Valuation Act, and gives a bird's-eye view of the present activities of the Division of Valuation. The second article will go into the detail procedure of the inventory as handled in the Eastern District. In succeeding articles what some of the railroads are doing will be discussed. It should be recognized that the country is large, that a wide variety of conditions require a variety of treatment and that what is here recorded may not tally with the experiences of some of those engaged in the work. The author is simply offering snapshots taken from as many vantage points as possible, hoping that they will give those outside of the work a better conception of what is being done, and suggest to some of those in it better ways of doing it.

The Lowest-Bid Curse

"THAT it is false economy to award contracts to contractors who have not had the necessary experience or have not the required equipment or financial resources." This is one of the conclusions in the report of the Department of Conservation and Development of New Jersey. It is a conclusion drawn with regard to road construction, but of course it applies with equal force to all classes of construction. No, there is nothing new about the pronouncement; there is, however, every reason why it should be made because communities, laboring under the low-bid curse, continue daily to award contracts to those who do not even know how to bid, much less how to do the work on which the bid is made. This and other journals have deplored this condition of affairs for years; numberless solemn papers have been read on the subject. Now a state department which has made an exhaustive study of roadbuilding announces that the award of contracts to incompetent contractors (and they always think that they can do work for less than a well-equipped and responsible contractor will bid) is one of the principal causes of road failures. Must we go on forever doing something that everyone agrees is foolish and not economical? Or has the subject been talked about long enough, and the time for action arrived? If we are not yet willing to give officials enough liberty to choose the best bid, as distinguished from that which is merely the lowest, we have not progressed very far in improvement of the standards of public service and public servants.

Engineering Reminiscences

AS THE MEN who have made America's engineering works famous pass one by one to the great beyond, one cannot but regret that all too seldom they leave behind them reminiscences or autobiographies which might be an inspiration to future generations. Dr. Corthell, the latest to join "the innumerable throng," left, so far as is known, no such record. And what a fund of reminiscence, of tales of accomplishment, of anecdotes regarding the great men with whom he worked, has been lost. He could, and did, regale many a company with stories of Eads, of Morison, and of his own engineering experiences. It was

almost prophetic that a guest in one of these companies early this year remarked that "before he [Dr. Corthell] goes he should write an autobiography." Probably the thought never occurred to Dr. Corthell. Too busy with his part in the world's work, ever attacking new problems, encouraging new enterprises, he thought little of the past and probably would have undervalued the influence of anything he might write. Corthell and Noble and Schneider—dozens of these engineering giants are gone. It is idle to bemoan the loss of the records they might have left. But there are still with us stalwarts who can record for us, and most graciously, the human side of the engineering of the last thirty or forty years. They will probably not do it of their own initiative. Their friends must urge them to the task.

Societies and Reminiscences

THE THOUGHT will occur to readers of the preceding note on engineering reminiscences that their publication may not easily be arranged for. Without a doubt many who have had interesting experiences have not the faculty of putting them in an attractive way. Further, the reputation of the writer must be very wide to make an autobiographical venture a commercial success. It is conceivable, in fact it is certain, that many reminiscences of great inspirational value would not find a commercial publisher. They need not, therefore, remain unwritten and unpublished. Is there here not an opportunity for "society service," a subject on which this journal has frequently dwelt in recent issues? Some of these proposed reminiscences would be of greater value to the profession than much of the inconsequential stuff which appears in society publications. The elimination of a few papers of this sort would make room for some "human" material. It is realized that the acceptance of such contributions would be a delicate matter—to refuse what was prosy and unsuitable without hurting the feelings of those who might offer them. But difficult matters are not to be shunned merely because they are difficult.

Student Inspection Trips

AN IMPORTANT and yet neglected educational opportunity is the student inspection trip to manufacturing plants, construction operations or to finished structures of unusual magnitude and interest. While most institutions make a few such trips yearly, too often the students fail to obtain the inspiration and knowledge which a little better planning and handling would bring. In an address before the Technical Publicity Association of New York City Professor Furman, of Stevens Institute of Technology, effectively presented the sources of waste in these trips and the ideal to which they should approximate.

He pointed out that incompetent guides, instead of the best-informed and most successful of the plant's engineers, are put in charge of the students. The biggest engineer in the plant should be persuaded to explain the meaning of the various operations and the inter-relation of parts to one another and to the final product. Lifelong impressions of the plant would thus be carried away by the young men, while the engineers themselves would be a source of inspiration to their neophyte brethren.

Furthermore, the number of students to one guide should be relatively small. Every man should be able to hear the explanations. In the confusion and noise of most manufacturing plants it is very difficult to hear, yet explanations are imperative if full benefit is to be derived.

The Engineering Record, which has often commended the co-operative plan of engineering education used by Dean Schneider at Cincinnati, makes the suggestion that more conservative educators can accomplish something, at least, along the same line by making greater use of student inspection trips. In the vicinity of our great cities there is a wealth of opportunity for visits to all kinds of engineering operations. Such trips should be largely increased in number and variety and should be given a fixed place in the curriculum. The students, moreover, should be required to submit reports to insure retention of the knowledge and inspiration gained.

A Difference of Opinion

A LETTER in a recent issue of the *Journal* of the Engineers' Society of Pennsylvania comments on that publication's policy of urging engineers to participate in civic affairs and to voice their views on public questions. With this policy the correspondent differs. He says: "In this age of specialization a thorough, careful man has time for few matters beyond his own profession. Specialization spells efficiency. We need go no further than the much-quoted example of Germany to show what specialization can do for industrial and economic development. This (the Engineer's Society of Pennsylvania) is a technical society, and it seems to me that the journal representing the society should be devoted to purely technical subjects."

As the readers of the Engineering Record know, it, too, has consistently advocated a larger participation by engineers in public affairs of an engineering character. That policy, it is glad to say, has been heartily indorsed, though here and there are found individuals who want a magazine whose sole theme is technical. A well-rounded service to the engineering profession demands that a journal have the welfare of the profession as a whole in mind. Certainly that welfare requires more than the mere equipment of the engineer with the latest technical information. It demands that he go upward and onward; that his ethical standards be raised; that his relations with his fellows be improved so that the uttermost in co-operation is possible; that his position before the public be ever more prominent, in order that he may influence the community to its own advantage through the material services which he and his structures can render. Surely it must be recognized, even by the most technical, that our civilization on its material side is the work of the engineer, and that the physical improvement in our environment has been a necessary prerequisite for our political, economic and social development.

To divorce oneself from the relations which will allow the profession still better to do its work for the improvement of the nation and the race is to shut the door of progress. We most heartily agree with the editors of the *Journal* when they dissent from their correspondent's view. Extreme specialization leads to narrowness and prevents the discharge of those larger duties which the engineer, as a citizen, owes the nation. It prevents him from making a contribution to the progress of the race, a privilege that every unselfish man heartily welcomes.

The New Cement Specifications

PROBABLY the most important action taken at the meeting of the American Society for Testing Materials in Atlantic City last week—so far, at least, as the readers of the Engineering Record are concerned—was the passage of the new cement specification to letter ballot, with the understanding that if adopted they are to become effective Jan. 1, 1917. As is generally known, there have been two standard cement specifications for many years—those of the government and of the American Society for Testing Materials. Attempts to harmonize them proved abortive. Finally a joint conference committee, on which the government, the American Society for Testing Materials and the American Society of Civil Engineers were represented, was appointed. This body has been working for several years, and the specifications evolved and now reported are the result. With the conference there has been working the very large committee on cement of the American Society for Testing Materials.

There is excellent promise that the new specifications will be adopted by the government. Its adoption by the American Society for Testing Materials is practically certain. As for the American Society of Civil Engineers, the action will be limited to the acceptance of the report by the board of direction. Very likely, then, we shall soon have only one standard cement specification. The principal change in favor of higher quality of cement is the increase of fineness from 75 to 78 per cent, for passage through the 200-mesh sieve. No change is made in the test for constancy of volume, the center around which the storm has raged in recent years. On the chief item of divergence between the two older specifications—the method of determining the time of setting—the new specifications are a compromise; either the Gillmore needles or the Vicat apparatus may be used.

While there may be rejoicing that the divergence in specifications will soon be of the past, the new requirements are only a slight improvement over the older ones. Cement chemists claim that the specifications go as far as present knowledge of cement permits. Be that as it may, one might have expected, from the travail and stress through which the conference and the committee have passed, that something

more would have been produced. One is tempted to repeat the quotation, "The mountain has been in labor . . ." Nevertheless, the vote of fifty-five in favor of the specifications, with no negatives and only three refraining from voting, should be taken as evidence that under present conditions the reported specifications are the best that are commercially feasible.

Army Reorganization and the Engineer Officers' Reserve

SINCE the Army Reorganization Act went into effect July 1 the chief interest of technically trained men in the measure centers about the organization of the engineer section of the Officers' Reserve Corps, for which definite provision is made in the new legislation. When the tentative draft of the bill was prepared last year one of its most unfortunate clauses placed a limit of 45 years upon the age of an applicant for a reserve commission. In an editorial in the Engineering Record of Dec. 18, 1915, page 747, the undesirability of this feature as applied to the engineer reserve was pointed out. It would have excluded from service engineers, occupying important executive positions in civil life, who would be of invaluable aid to the War Department in the event of a national crisis. In the measure, as finally signed by President Wilson, it is stated specifically that the age limits for other branches of the service do not apply to the engineer section of the Officers' Reserve Corps.

For this revision the profession has to thank the members of its joint committee, representing five of the national engineering societies, who were quick to see and correct the fallacy of this feature of the bill when it was first prepared. The act, very wisely, does not attempt to specify in detail how the engineer section of the Officers' Reserve Corps shall be organized. This work has been left to the War Department, which is now formulating the plan of organization and will issue an invitation to engineers to apply for commissions as soon as the requirements for admission to the several grades between second lieutenant and major have been definitely determined.

As it now stands upon the statutes the act provides for an Officers' Reserve Corps consisting of sections corresponding to the various arms, staff corps and departments of the regular army. The President alone is authorized to commission reserve officers in all grades up to and including that of major. The commissions of reserve officers cover a five-year period and may be renewed in the same or higher grades for successive periods of five years. In time of actual or threatened hostilities reserve officers may be assigned to temporary duty with the regular army or as officers in volunteer organizations or at recruit depots. They are entitled to the pay and allowances of the corresponding grades in the regular service, with increase in pay for length of active service.

An important feature of the act makes provision for the instruction of officers of the reserve corps. They may be called upon each year for fifteen days' service in the field, where they will receive the benefit of guidance in practical work by regular army officers. Every army man who has addressed audiences of engineers on the subject of military training recently has emphasized the absolute necessity of field service rather than a mere perusal of text books. Of course this field instruction for reserve officers is contingent upon appropriations for this specific purpose. Certainly the money will be well spent in improving the efficiency of the engineer branch of the reserves, for the European War has demonstrated that technically trained men are needed, as never before, in military operations as they are carried on today.

For the purpose of securing an additional reserve of enlisted men for military service an Enlisted Reserve Corps also has been authorized.

The way is now open for mobilizing effectively the nation's technically trained men. It is safe to predict that when the War Department's call for the enrollment of reserve officers is made there will be a hearty response from the engineering profession.

Who Should Select the Pavements?

IT is quite customary to allow citizens to select the type of pavement to be laid in front of their property. The custom can be ascribed without doubt to the prevalence of that very excellent institution, the special-assessment system. The theory seems to be that since the citizens pay the bill, they should have the right to say what they shall buy. While there is reason back of the theory, the relation of the property holders to the purchase of a pavement is quite different from that of the normal purchaser to the things he buys. Taken generally, a buyer knows the wares he contemplates purchasing. He does not always possess the technical knowledge expected of large organizations. He will not buy a suit of clothes by specification as does the government in purchasing army uniforms. Nevertheless, he has some standard based on experience.

With pavements it is different. The average citizen pays no attention to the condition of the streets, though possibly the advent of the automobile requires that this statement be qualified. Even when he does notice them, he is not sufficiently familiar with traffic conditions and construction details to know why one pavement proves a success and another a failure. One might contend that the average citizen may be qualified to pass some sort of judgment on the type in use on his own street for a term of years. But even were this granted —which this journal does not—there would still be inability to judge of the merits of alternative types.

Were the citizen left to himself, to judge by his experience and by the data placed at his disposal by a competent city-engineering department, the results might not be so bad. Unfortunately, from the time a new pavement is proposed to the date of signing contracts he becomes the object of attack of the material salesmen. Intent only on getting their products used, these men urge the use of their materials, whether or not they are adapted to the particular conditions. Even an engineer has need for great steadiness to resist this selling assault. What hope, then, is there that the layman will pass a reliable judgment? The result is obvious. The salesman with the glibbest tongue, or the one who can win a group of influential citizens, will get his material used. The real merits of the case do not receive consideration. The pavement is bought on price—first cost—not on quality. Total cost is entirely lost sight of.

Every engineer engaged in city work can cite instances to show the pernicious influence of the pavement-material salesman. In a recent case four different types were being laid on adjoining streets, though all conditions, traffic included, were identical. There was no excuse for the difference. The engineers admitted it. The variable factors were the skill of the material salesman and the mentality of the property owners. In another case, where citizens decided upon an undesirable type of paving, an opposing paving interest, with the assistance of an engineer, asked the signers of the petition the reason for their choice. They had no reason, except that a representative of the paving company, accompanied by an influential citizen, had visited them and requested their approval. When the facts were laid before them they withdrew their signatures with as much alacrity as when they had given them.

Fortunately some cities are abandoning this objectionable method of pavement selection. One improvement, and a great one, consists in putting in the hands of the city engineer the power to designate two or three types from which a selection must be made. Even this, however, is a makeshift. Granted that for given traffic and other conditions, two or three types are equally satisfactory—which is obviously not true—the engineer would nevertheless be in a better position to make a selection than the layman.

Without a doubt the best method of procedure is to have the city engineer designate the type that must be used. His choice would be predicated on all the factors that should be considered — foundation conditions, traffic, ability of the district to stand the assessment, characteristics, cost, and life of various surfacings. If this be deemed an unwarranted inroad upon the right of the citizen to indicate for what his money should be spent, reference may be made to the conditions which obtain in connection with other municipal engineering works governed by the special-assessment system. The property holders are not consulted as to the design of the sewerage system or the width of streets.

Manifestly the course here advocated does not preclude considerations of the wishes and views of the citizens—they should be given a hearing. Their views, though, will be but one of the factors.

Abandonment of the present system is necessary before city paving in this country will be on a satisfactory basis.

Finish Deep Bridge Substructure, Designed to Reduce Work Under Water, Month Ahead of Time

Giant Driver for 138-Foot Piles, Large Mixer Boat and Removable Dams Handled by Floating Crane Used to Build, 105 Feet Below Low Water, Foundations on Which Pumping Averaged Less Than 18 Feet

By FRANK M. CORTELYOU
Resident Engineer, Vancouver, Wash.

THE SUBSTRUCTURE of the Interstate bridge over the Columbia River at Portland, Ore., has been completed a month ahead of schedule in spite of six weeks' delay and notwithstanding that new construction problems had to be worked out. These problems were presented by a design which utilized the possibility of securing very long piles to concrete a large proportion of each pier base under water and save expensive construction, as was described on page 18 of the Engineering Record of July 3, 1915. The giant floating driver, overhanging the full width of the cofferdams and able to handle 138-ft. piles; removable cofferdams handled by a 50-ton floating crane and fitted in turn to the pier cribs, which remain in place, and a floating concrete plant which placed the 20-ft.-thick pier bases, the shafts rising 37 ft. above low water and the abutments back from the shore line, are among the construction features of the work. The pile driving was of unusual interest, an average penetration of 103 ft. being obtained under one pier and a large jet being plunged to full penetration in the sand bottom before setting each pile.

First Highway Bridge Across Lower Columbia

The structure is best known as a highway bridge because it is the first on which highway traffic will be carried across the lower Columbia River. Also it will remove the last obstacle to the Pacific Highway, which has been blocked only at this one point in the entire stretch from Mexico to Canada. In addition to highway traffic, however, the bridge will carry six lines of rails to provide double tracks for both broad and narrow gage electric cars. Work on the bridge was started in March, 1915, and the contracts require it to be ready for traffic on Oct. 31, 1916. The total length of the thirteen truss spans and one girder span over the main channel of the river shown in the accompanying drawing is increased, by long fills and the two girder bridges required to cross low land and sloughs on the Oregon side, to a total length of 4 1/3 miles.

The concrete bases of piers in the river proper were all built in open cribs on piles. The abutments consist of two shafts, each resting on a separate base connected at the top by a reinforced-concrete wall, which extends only a short distance below the bridge seat. Thus the horizontal thrust on the pier from the fill is greatly reduced and a considerable saving effected.

The first work on the pier foundations was to excavate each pier site, removing enough material so that the sides could take a natural slope and still leave the desired clear area at the level of the pier base. While this excavation was in progress timber cribs (22 x 79 ft. in plan for piers 2 and 3, 16 x 57 ft. for piers 4 to 13 inclusive, and 15 x 54 ft. for pier 1) were built up to a height as great as could be floated in the depth of water available. As the excavation was finished at each pier the unfinished crib for that site was floated to place and its framing completed. A cofferdam of the same plan dimensions as the crib was then fitted on top and the two sunk until the crib rested on the bottom at the proper depth.

DUMB-BELL PIER SHAFT COMPLETED

After the piles were driven inside this open caisson, the concrete base was poured through a tremie to within 2 ft. of the level at which the piles were to be cut off, forming the unusually thick pier base, with embedded piles, which is a feature of the design. The crib would then be pumped out, the piles cut off by hand and the remainder of the concrete placed in the open. Forms for the shaft were then built up above water level and the concrete completed to this point within the protection of the cofferdam. When the concreting was completed above water level the cofferdam was lifted off, ready to be used for the next pier.

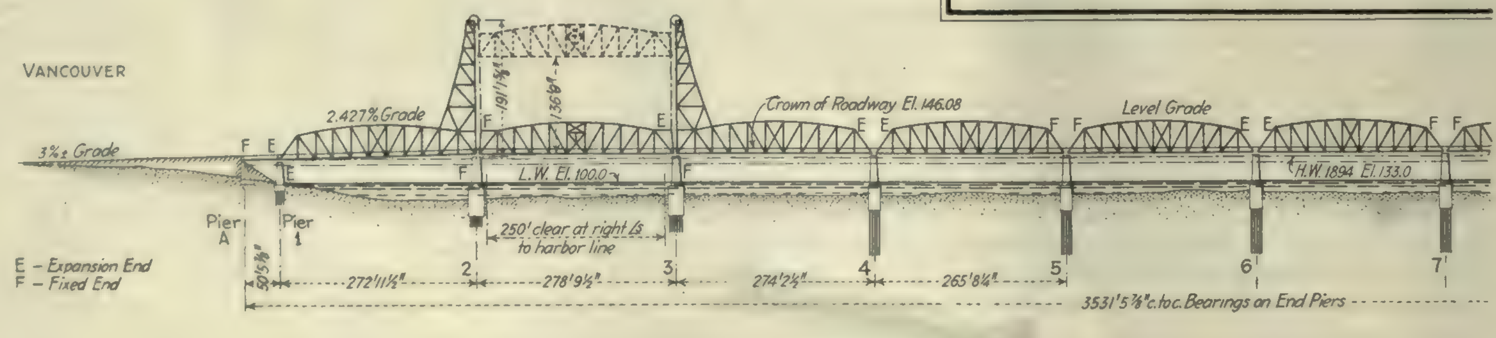
Pier Excavation Used in Approach Fill

Practically all the preliminary excavation was done with a dipper dredge having a 4-yd. bucket. It was not feasible to use a boom long enough to swing this material beyond the limits of the excavation, so it was loaded on barges and rehandled to a fill in one of the approaches. In order to dispose of this excavated material economically the substructure contractor took a subcontract for a portion of the approach fill that could be conveniently placed by this method.

The depth of the excavation at each pier was ordinarily about 20 ft., and from five to seven days of two 8-hr. shifts were required to complete it. The excavation for piers 2 and 3, which are to support a 272-ft. liftspan and the towers for raising it to a 175-ft. clearance above low water, was carried down about 25 ft. below river bottom. The excavation for each of these piers required about twenty 8-hr. shifts. The dipper dredge used for this work was able to excavate at a depth of about 48 ft. below the surface of the water.

Cribs and Removable Caissons

The timber cribs, filled with concrete up to the top of the pier bases, were left in place as part of the permanent construc-



IN COUNTRY WHERE PILES MORE THAN 100 FEET LONG ARE OBTAINABLE, DEEP PIERS FOR MAIN CHANNEL SPANS SHOWN WERE

tion. The cofferdams used above this point were built in the same as the cribs, except that the thickness of the cofferdam timbers decreased with the height. These cofferdams were handled as units by a 50-ton floating derrick, which lifted them into place on top of the completed cribs and later removed them after the pier shaft had been carried above the water level. In removing several of these dams the dead lift approached the capacity of the crane. Three cofferdam units were built for piers 4 to 13 inclusive, and one cofferdam of a larger size was used for the two piers under the liftspan towers.

CRIBS SUSPENDED DURING CONSTRUCTION

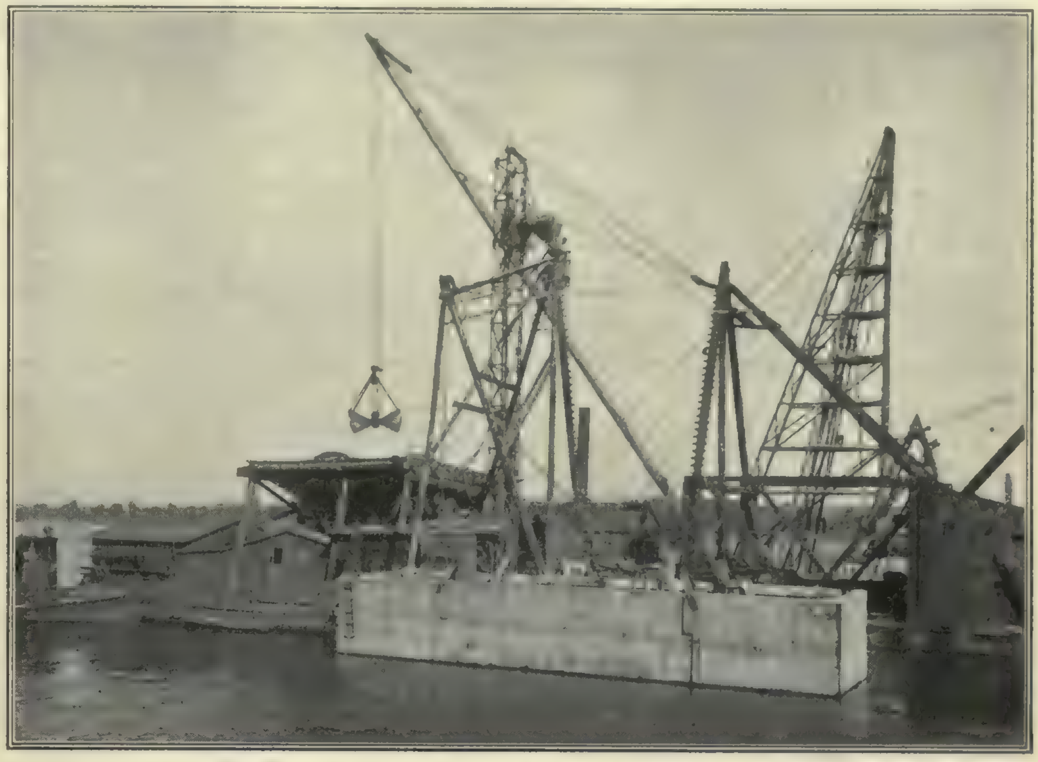
To facilitate handling the cofferdams it was found desirable, as with the cribs, to begin their construction near the shore and when partly completed to float them to deeper water to be built up to final height. At the point selected as shipyard, parallel rows of piles were driven, separated by a distance slightly greater than the pier width. Suspended from caps on these piles were two pairs of four-sheave tackles, which supported two crossbeams passing beneath the bottom timbers of the crib or cofferdam. At the desired stage the structure was lowered by the tackles until it floated.

In fastening the cofferdam to the crib, ten 1-in. rods were used, located at each corner of the crib and at the ends of each strut. The lower ends of these rods were U-shaped and attached by means of a bolt to a strap plate bolted to the crib. The tops of the rods passed through a 3-in. plank laid across the corner or along the sides of the cofferdam. The joint between crib and cofferdam was calked with oakum, which was then battened over to keep it in place. A 2 x 4 was also spiked around the lower edge of the cofferdam on the inside and to the top of the last course of the crib, this being possible, as the top crib timber was 2 in. thicker than the bottom of the cofferdam. During the placing of these rods and the calking of the joint the derrick which placed the cofferdam still held part of the weight, so as to prevent the crib and the cofferdam from overturning.

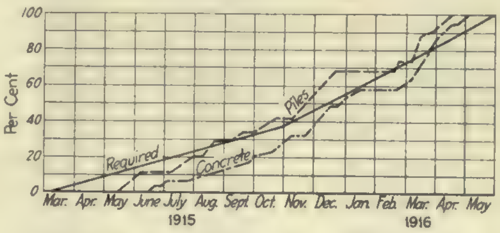
In order to sink the cribs, sand boxes were provided for weight by extending side timbers beyond the ends of the crib, laying a suitable floor and supporting it on inclined struts. The sides and ends were roughly boxed up to hold the material used for ballast. Usually very little digging had to be done when the cribs were lowered, as it was found that the original excavation did not rapidly fill up.

RIGGING TO PLACE CRIBS

Two methods were tried for guiding the cribs during sinking. The first method made use of four guide piles, one near each corner of the crib on the outside. These were square timbers, and each one passed through two steel straps fixed to the sides of the crib—one near the top and another near the bottom. Before driving these guide piles the dipper dredge was set just below the pier and firmly anchored by its spuds. By means of lines from the crib to the end of the dipper arm, the crib was shifted so as to be lined in by two transits on shore, and when satisfactorily located the guide piles were driven. As this method was not very successful, owing to the difficulty of holding the crib with the dredge and the time required to get the crib into line, it was abandoned in favor of a new plan.



FLOATING MIXER PLANT PLACED CONCRETE 40 FEET UNDER WATER TO 37 FEET ABOVE



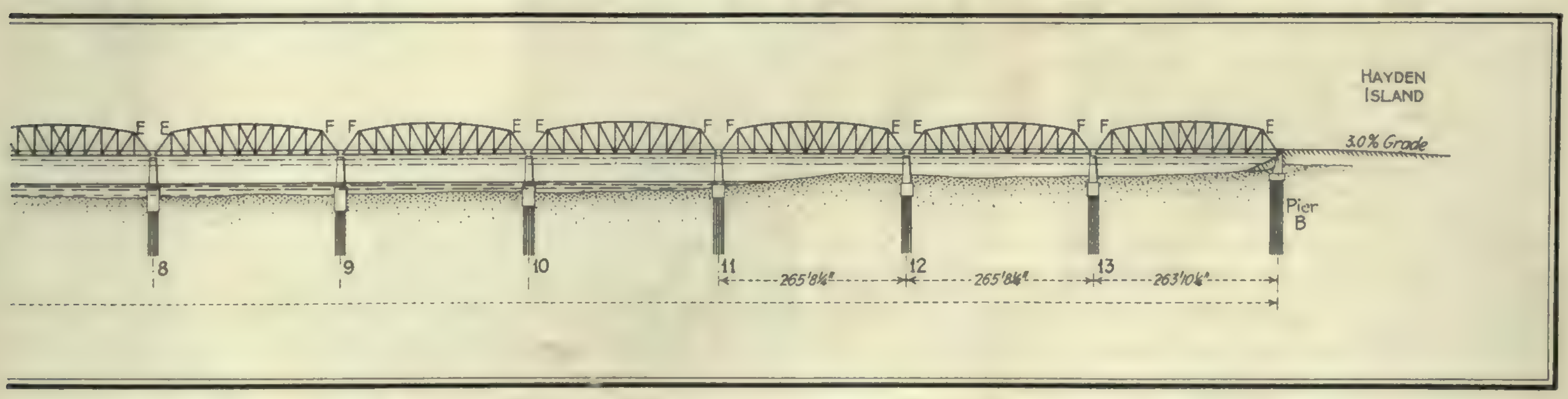
ACTUAL PROGRESS EXCEEDS REQUIREMENTS

Under the new plan dolphins were driven about 150 ft. above the center line of the bridge and 50 ft. on either side of the pier center line. The dipper dredge was then anchored by its spuds about 50 ft. below the downstream end of the crib and a line was run from each corner of the crib to the dredge, those from the upstream ends first passing through single-sheave blocks on the dolphins. The crib could then be easily handled and shifted by means of these lines and no further difficulty was experienced.

OVERHANG DRIVER 122 FEET HIGH

It was considered worth while to build a special driver for putting down the piles, and it was found that the special features developed greatly facilitated the work. The driving equipment was mounted on a wooden scow 32 x 100 ft. in plan and 7 ft. deep. The leads of the driver, designed to handle 138-ft. piles, extended 122 ft. above the water and were constructed so as to overhang the front end of the barge about 22 ft. This overhang permitted the driving of all the piles in a pier without having to shift the driver from one side of the cofferdam. The lower platform on this overhang was about 15 ft. from the water. This clearance was necessary in order that the leads might be swung clear of the cofferdam top at low water.

The driver was equipped with a No. 2 Vulcan steam hammer and two 4-in. jet pipes about 110 ft. long. The hammer was mounted in a steel frame, which served as an extension to the driver leads when the head of the pile got below the lower platform of the driver. This permitted driving until the head of the pile reached the water

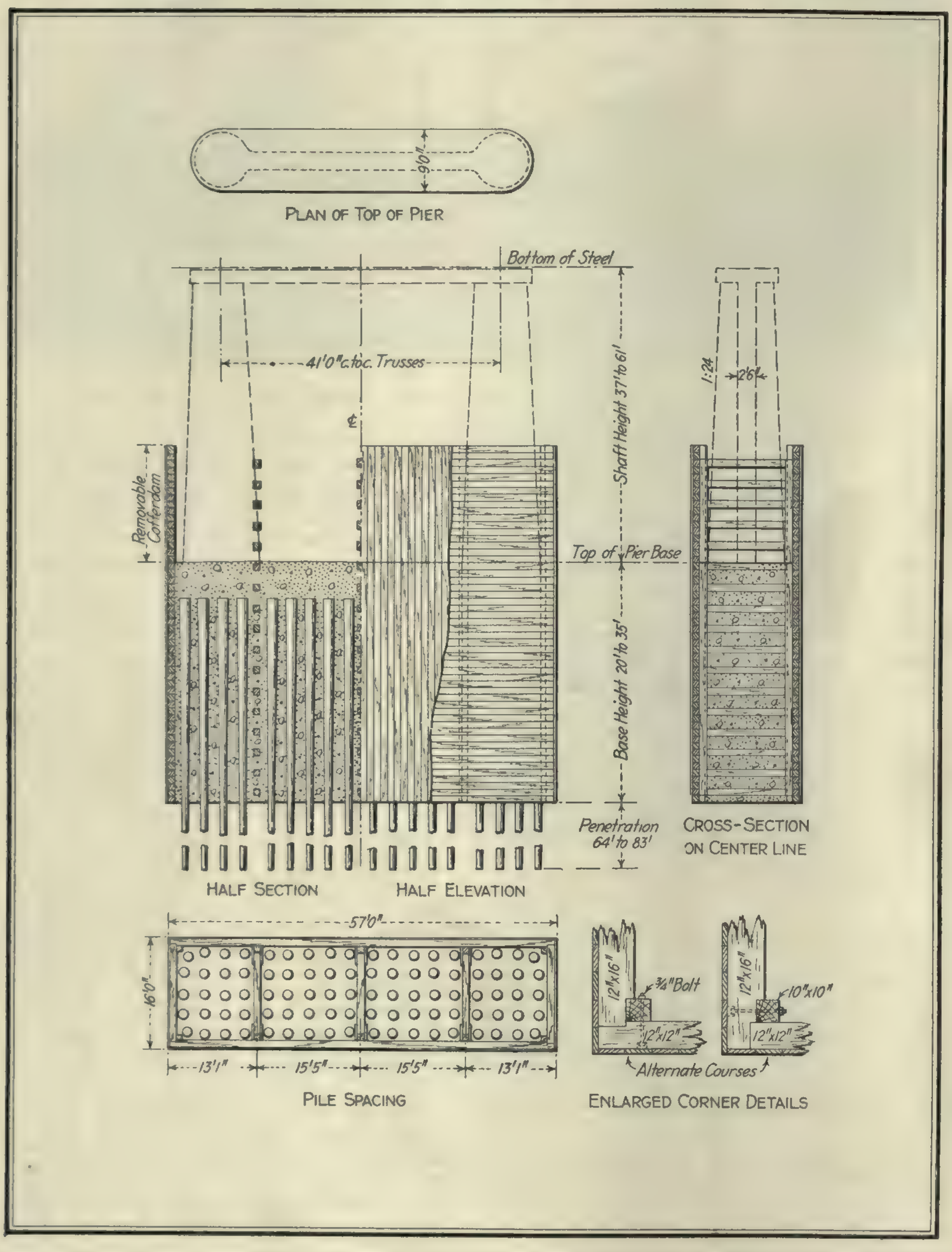


BUILT BY EMBEDDING GREAT LENGTH OF PILING IN UNDER-WATER CONCRETE SEALS 20 FEET THICK, GREATLY REDUCING PUMPING

surface. Two 12 x 18 x 10 x 12-in. compound duplex pumps were used for supplying water to the jets. Each of these had a capacity of 900 gal. per minute. From each pump a 7-in. discharge line ran to the front of the barge and there joined a 10-in. line running up the driver frame to a height of 68 ft. above the deck. From this point the water was carried to each side of the driver by a 7-in. line and then to a connection with the jet pipes by about 70 ft. of 4-in. rubber hose.

Originally a 4-drum hoisting engine with 7 x 10-in. cylinders was installed. This was connected to handle the hammer line, pile line and each of the jet lines on the main drums. Later an 8 x 12-in. two-drum hoisting engine was added for handling the jets, as it was found that the original engine did not have enough power, and also that one engineer had considerable difficulty in attending to all four lines and to the pumps at the same time. An 800-hp. boiler supplied steam for the two engines, the hammer and the pumps.

The driving time shown in the table does not include the time spent in making repairs, except in the case of such minor repairs as broken water or steam hose. Most of the time lost at first was spent in correcting defects which developed in the rig after it was put in operation, but after the first three or four piers there was very little time lost. The material into which the piles were driven was fine sand with an occasional layer of clay. At piers 1, 2 and 3 the piles reached a hard, cemented gravel, which accounts for their small penetration. As it was found possible to secure the long piles required it was considered advisable to specify these lengths and eliminate follower troubles. The average length of piles used in piers 4 to 13 inclusive and in the Hayden Island abutment was 119.9 ft.



PERMANENT CRIB, REMOVABLE COFFERDAM AND DUMB-BELL SHAFT FEATURES OF SUBSTRUCTURE

Before setting each pile the jets were put down their full length at the point where the pile was to be driven and were then quickly withdrawn, the pumps being stopped as soon as the jets started back. The pile was then picked up, set in the leads and dropped. The hammer was then lowered onto the pile and the jets again put down and worked up and down as long as the pile would go down under the weight of the hammer. Steam was then turned into the hammer and the pile driven to refusal with the jets working.

After some experience it was found that there was a decided advantage in first making a hole with the jets. The piles were ordinarily dropped for more than half of their penetration, and the weight of the hammer took them down still farther. The second lowering of the jets then secured an additional penetration, so that ordinarily the piles had to be driven only the last 10 or 15 ft. In many cases the jets took the piles down for the full penetration without requiring any hammering. It was found best to get the piles down as far as possible before starting the hammer, as the vibration seemed to make the sand settle around them and greatly to increase the difficulty of driving after the first 10 or 15 ft.

It was also found to be important to keep the piles straight, accurately located and driven vertically. As soon as a pile came in contact with one previously driven, excessive hammering was required for small additional penetration. Care was taken to keep the jets straight and with their lower ends close to the point of the pile, as it was found that if the jets got away from the pile the water was liable to follow up a pile previously driven, not only being of no help to the hammer, but actually involving the risk of lifting the other pile. This happened, fortunately without damage, in three or four cases with 120-ft. piles. It was also found to be necessary to keep the jets moving, as otherwise they tended to freeze in and cause considerable loss of time. The jets were not fastened to the piles, but each jet was held in place and guided by one man.

PENETRATION OF PILES AND TIME REQUIRED FOR DRIVING

Pier No.	Piles in pier	Penetration specified, ft.	Average penetration, ft.	Time required for driving, hr.
1	60	20	12.5	18
2	182	15	14.3	73
3	182	25	18.0	82
4	90	64	68.0	46
5	90	64	65.8	40
6	90	64	64.7	48
7	90	64	70.7	29
8	90	64	70.0	43
9	90	64	70.4	35
10	90	70	73.2	47
11	80	81	80.6	83
12	80	83	84.8	54
13	80	83	85.1	64
B	84	105	103.4	92

The jetting brought up considerable material, which had to be cleaned out of the crib before placing concrete. This was done with a hydraulic siphon operated by the pumps on the driver. The hose from one jet was connected to the siphon and the other jet was used to stir up the material. Ordinarily there was from 4 to 6 ft. of sand to be cleaned out of each crib.

FLEXIBLE FLOATING CONCRETE PLANT

The concreting plant was located on a 33 x 110-ft. barge equipped with sand and gravel hoppers and a 1-cu. yd. mixer. Sand and gravel were delivered from barges into the hoppers by a derrick boat with a clamshell bucket. Mounted on the barge was a steel elevator tower 90 ft. high, from which the concrete was dumped into the distributing hopper, passing thence through a chute into an 8-in. pipe, which delivered it directly to the forms or to a 10-in. tremie for deposit under water. The tremie was hung from a boom which could swing so as to deliver to any part of the crib, and was raised and lowered by the same engine as the hoist. The only trouble with the tremie occurred on the first day, when it was noticed that the material did not run through the pipe readily. The trouble was

located in a joint between two sections of the pipe where a workman had failed to place a rubber gasket in a flanged coupling and the pipe was consequently not watertight.

LITTLE DIFFICULTY WITH PUMPING

The cribs were pumped out by means of a 10-in. pulsometer, which handled the work easily except in the case of the first crib, where a 10-in. centrifugal pump was also required. The first concrete was permitted to set at least 36 hr. before starting

PUMPING HEAD ON CRIBS

Pier No.	Head, ft.	Pier No.	Head, ft.
1	14.6	8	17.0
2	15.4	9	12.6
3	25.8	10	12.6
4	19.2	11	17.9
5	24.1	12	13.3
6	22.4	13	13.8
7	22.8		

to pump. All the joints in the cofferdam, and in the crib from a point 6 ft. below the elevation at which the piles were cut off, were calked with oakum. As an additional precaution to prevent the water from coming up along the inside of the crib timbers, the fourth timber below the pile cutoff level was made 2 in. thinner than those above and below, thus keying the concrete of the seal into the crib. Most of the leakage into the cribs was through the joint between the crib and cofferdam. On being pumped out the large leaks in the cribs were calked from the inside, so that the leakage during the concreting of the remainder of the base was easily handled by a 3-in. pulsometer.

The accompanying table gives the head of water on each of the cribs after they were pumped out, the head being measured to a level 1 ft. below that at which piles were cut off.

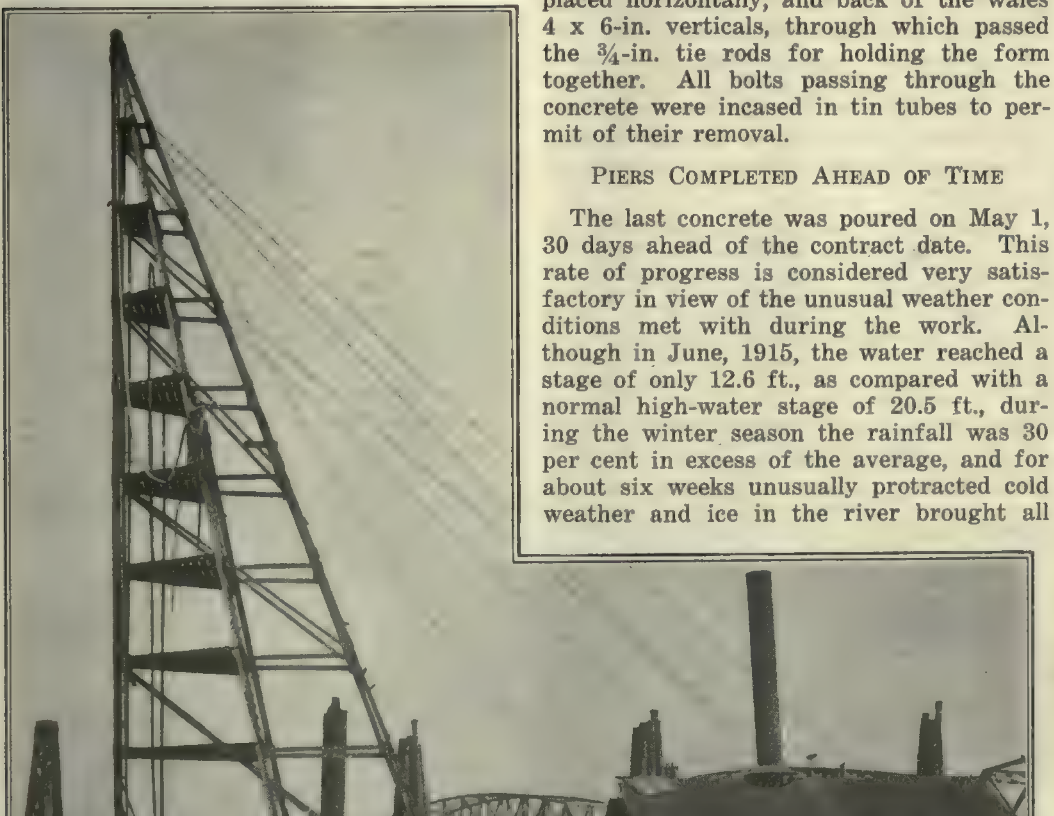
FIFTY TONS OF REMOVABLE COFFERDAM BEING LIFTED OVER PARTLY FINISHED PIER SHAFT

For the forms for the tapering shafts of the pier 2-in. lumber was used, set vertically and with wedge-shaped pieces to care for the batter. These forms were tied across by $\frac{3}{4}$-in. horizontal rods spaced on 2-ft. centers. Wooden segmental shapes were set inside as spacers at 6-ft. intervals and removed as the concrete was carried up. The forms for the webs were all made of 1-in. shiplap, laid horizontally against vertical 2 x 6-in. studding spaced on 2-ft. centers. Back of the studding, and at about 4-ft. centers, 3 x 12-in. wales were placed horizontally, and back of the wales 4 x 6-in. verticals, through which passed the $\frac{3}{4}$-in. tie rods for holding the form together. All bolts passing through the concrete were incased in tin tubes to permit of their removal.

PIERS COMPLETED AHEAD OF TIME

The last concrete was poured on May 1, 30 days ahead of the contract date. This rate of progress is considered very satisfactory in view of the unusual weather conditions met with during the work. Although in June, 1915, the water reached a stage of only 12.6 ft., as compared with a normal high-water stage of 20.5 ft., during the winter season the rainfall was 30 per cent in excess of the average, and for about six weeks unusually protracted cold weather and ice in the river brought all work to a standstill. Since that time the progress made is particularly notable, over 30 per cent of the total number of piles (1376) and 40 per cent of the total concrete yardage (about 17,300 cu. yd.) having been placed within a period of two months.

Harrington, Howard & Ash (formerly Waddell & Harrington) of Kansas City, Mo., are the consulting engineers in charge of the design and construction, for whom the writer is resident engineer in charge. The Pacific Bridge Company, of Portland, built the substructure.



GIANT DRIVER OVERHUNG FULL WIDTH OF PIERS AND HANDLED 138-FOOT PILES

Quick Repair of Embankment Prevents Floods in Pomona, Cal.

By reconstructing an old embankment, known as the Fleming Dam, begun thirty years ago as a wall of loose boulders designed to keep the waters of the Santa Ana River from flooding Claremont and Pomona, Cal., the Pomona Valley Protective Association recently made the old work a stable and almost modern wall in a comparatively short time. A trench was excavated 3 ft. below the lowest point in the wash and a concrete wall was laid to a height of about 6 ft. A rock and gravel fill was constructed on the downstream side to a height of about 5 ft. more and of sufficient width at the top for a roadway. The face of this was covered with a layer of boulders and two widths of heavy wire fencing laid over the boulders. These were wired together and pieces of heavy galvanized wire, which later served to hold the entire mattress together, were placed 28 in. apart. On top of this layer of netting were put cobblestones 8 or 10 in. in diameter. The wire netting was then pulled up over this layer of rock, drawn taut with crowbars and securely tied to the netting below by the wires referred to, in much the same manner as tying a quilt. The upper edges of the netting were wired together. At distances of 30 ft. concrete was poured into the cobblestone apron, tying the whole mass together and yet making it sufficiently flexible to meet any change of ground level. At frequent intervals lengths of netting 15 or 20 ft. long, tied together to form a tube, were filled with boulders and placed to divert the water from the wall toward the center of the channel. The entire cost of construction was about $2.50 per foot.

Recommends Steel Pipe for 37-Inch Water Main 9⅔ Miles Long at Rochester

Edwin A. Fisher Favors Lock-Bar Line After Detail Analysis of Alternate Proposals for Steel and Cast Iron for Conduit 3

BASING his decision upon a detailed analysis of first cost of construction, cost of maintenance and durability of material, Edwin A. Fisher, consulting engineer to the city of Rochester, N. Y., has recommended that of the alternate bids received April 19 for a cast-iron and a steel pipe line 37 in. in diameter and 51,000 ft. long the one calling for a steel main of the lock-bar pipe be selected. In the matter of first cost for the proposed line, known locally as Conduit 3, the steel pipe showed a saving of $44,235 as compared with cast iron. This saving, Mr. Fisher calculated, would keep the steel pipe in repair for 38 years—assuming that no recoating would be required for the first 25 years—while at the same time a fund of more than $140,000 would be created. Mr. Fisher's findings are concurred in by John F. Skinner, principal assistant engineer, and Frederick P. Elwood, city engineer, in a report dated May 9, from which the following extracts have been taken:

KIND OF MATERIAL

Separate proposals were invited for furnishing the necessary 37-in. cast-iron pipe and special castings, and also for hauling and laying it. Alternative proposals were invited for furnishing, hauling and laying complete 37-in. lock-bar steel pipe for the same purpose. Three bids were received for furnishing the cast iron, ranging from $326,110 to $332,465, the lowest being that of the United States Cast Iron Pipe & Foundry Company, for $326,110. For hauling and laying cast-iron pipe, eleven bids were received, ranging from $130,155 to $165,810, the lowest bid being that of Desiderio & Sattler, amounting to $130,155. One bid for furnishing, hauling and laying 37-in. lock-bar steel pipe was received from the T. A. Gillespie Company of New York City. This bid amounted to $412,030 for the work complete.

The total cost of the cast-iron line, based upon the lowest bids received, is: For material, $326,110; for hauling and laying, etc., $130,155, or a total of $456,265.

The bid for a lock-bar steel pipe was $412,030, making a difference in cost in favor of the steel pipe of $44,235.

The total length of the line is 51,000 ft. The cast-iron bid is, therefore, $0.867 per lineal foot more than the lock-bar steel ($4,560 per mile), or about 10¾ per cent.

After citing a number of cases of cities using steel conduits Mr. Fisher states that the specifications for the new main at Rochester call for better material than was used in the city's Conduit 2, and at the same time conform to current metallurgical practice. He then discusses the relative merits of lock-bar and riveted pipe.

LOCK-BAR VS. RIVETED PIPE

A single riveted seam in tension, according to the report, can have but 55 per cent of the strength of the unpunched plate. A double riveted seam has about 70 per cent, whereas the lock-bar joint develops 100 per cent—the strength of the plate.

In the case of light heads, such as occur at the southern end of the conduit and in the section constructed in 1914, the limiting feature in the thickness of the plate was not its tensile strength, but its stiffness; ¼ in. was assumed as the least allowable thickness. The single-riveted longitudinal seam would, in general, have been sufficiently strong.

In the middle section of the conduit, or that now under consideration, the heads and the corresponding bursting pressure on the pipe are considerably greater. Hence, although ¼-in. metal is of sufficient strength when the longitudinal seam is made by means of a lock bar, additional thickness of metal would have been required in the case of a riveted longitudinal seam. Such addition to the thickness and consequent weight of the pipe would have materially increased the tonnage, and hence the cost of the work. It was therefore deemed advisable to omit the consideration of any steel plate except the lock bar.

As an insurance against weakening the plate by corrosion, 1/16 in. additional thickness has in all cases been added to the computed thickness required to withstand the internal water pressure.

COATING

An essential element in a steel pipe line as at present constructed, Mr. Fisher states, is a protective coating which will exclude moisture from contact with the plate. Experience during the last 25 years demonstrates, he believes, that bituminous pipe dips have not fulfilled the above conditions, especially where pipes have been laid in wet clay soils and in places where the conditions were such as to stimulate corrosion.

In the light of Rochester's experience the following specification for the coating of the steel pipe was included in the present proposals:

> Immediately after the fabrication of the steel pipes and while the plates are clean, dry and free from dirt, grease, loose scale and rust they shall be painted by hand both inside and out, with one coat of boiled linseed oil. After the pipes are delivered at the site, they shall be painted by hand, both inside and out, with Detroit Graphite Paint No. 501 and, after a sufficient period for the hardening of this coat, it shall be followed in a similar manner by one coat of Detroit Graphite Paint No. 106. Both of these paints shall be received in original packages and shall be thoroughly agitated with a paddle before being dipped from the original containers. The paint as delivered shall be used without the admixture of any oil dryer or thinning material. During the operation of coating and the period of drying or hardening, the pipes shall be kept dry and under cover from the weather. When both coats are sufficiently hard, or approximately one week after the second painting, the pipes shall be painted by hand with one coat of Trus-Con special paint. Pipes whose coating is unsatisfactory to the engineer will be rejected. Any painting of abraded places that is necessary after the coating has been applied shall be done with such paint, and in such manner and place as the engineer may direct. The cost of furnishing and applying the coating material and paint as aforesaid must be included in the prices bid per foot for pipe furnished and laid complete.

The careful performance and inspection of the work called for under this paragraph of the specifications, according to Mr. Fisher, is as important as any other provision, and must be strictly enforced.

The additional cost of coating the pipe as specified over the cost of the usual bituminous dip is estimated at $0.55 per lineal foot, or a total of $28,050 for the 51,000 ft.

CAST IRON AND STEEL

In comparing a 37-in. cast-iron water main for the portion of Conduit 3 in question with the same size lock-bar steel water main the report considers:

1. *Carrying Capacity.*—From the best information available it is believed that the two kinds of pipe are of equal capacity.

2. *Reduction of the Coefficient of Discharge by Age.*—Rochester's records show that the loss in delivery due to age is substantially the same for riveted steel as for cast iron.

3. *Leakage.*—Repeated measurements of the leakage of Conduit 2 show a very small leakage, well within the limits of good practice for cast-iron lines.

4. *Durability.*—Cast-iron pipe has given continuous service for long and indefinite periods—in Rochester's case for more than 43 years. Cases are cited of cast-iron pipe over 100 years old. It is not possible to set a definite limit to the life of a cast-iron water main.

Whether cast-iron pipe as now manufactured will have an equal life with pipe made 100 years ago might be questioned.

"Experience with wrought-iron pipe for a period of 40 years," according to the report, "and with steel for nearly 30 years, indicates very clearly that the composition of the metal, the character of the protective coating, as well as the intelligent care of the line, are factors which determine the serviceable life of wrought iron and steel mains. In our own case a wrought-iron main 3/16 in. thick, coated with asphalt and coal tar pitch, 43 years old, is apparently in good condition to-day, and promises to last for a long time.

STEEL MAINS VARY

"Steel main laid within the last 30 years differ materially in condition at a given age, depending upon the composition of the steel, the nature of the protective coating, the character of the soil in which the pipe is laid, the chemical properties of the water flowing through the main and the intelligent care of the line. Unless all these conditions are known and considered comparisons of different lines are of no value.

"In our own case, as stated, we have prescribed the best obtainable product of the steel mills for the purpose, and specified a coating that by long experience is best adapted to our conditions, having thoroughly protected Conduit 2 in places for 12 years.

"We believe, from a careful inspection of this coating, that it will be in better condition in three years more (the end of 15 years) than any of the original coating on this line. As no considerable amount of Conduit 2 required repairs or recoating until it was at least 10 years old, we may safely estimate that no recoating of the new line (Conduit 3) will be required for 25 years after construction. Assuming that Conduit 3 will require similar treatment in regard to recoating as has Conduit 2, the integrity of the portion of the line in question may be maintained for an indefinite period without cost to the Water Works Repair Fund, provided the difference in original cost amounts to a sum large enough to produce an income sufficient to pay for this work."

As regards cost of maintenance, Mr. Fisher submits the following figures: The cost of maintenance of a cast-iron line is generally small, due to leaks in lead joints at 12-ft. intervals, and infrequent, but sometimes serious, breaks in the metal. The cost of maintenance of a properly constructed cast-iron line for the first 25 years, we believe, will be fully equal to that of a lock-bar steel line constructed as herein described, after which the maintenance of a steel line, due to recoating, will much exceed that of the cast iron.

The portion of Conduit 3 in question is 37½ per cent of the total length of Conduit 2, and the average condition relative to cost of recoating similar. The cost of recoating this portion may therefore be taken at 37½ per cent of the total cost.

Cost of Recoating

The amount expended in recoating the total length of Conduit 2, as per table prepared by Mr. Skinner, was for 13 years:

From 1903 to 1915 inclusive	$122,851.91
Or an everage of, per year	9,450.15
37½% of which is	3,496.55
The total cost of $122,851.91 may be subdivided as follows:	
For the first 5 years it was	$21,762.62
An average of, per year	4,352.53
37½% of which is, per year	1,632.20
For the next 8 years it was	101,089.18
An average of, per year	12,636.12
37½% of which is, per year	4,738.54

It has been assumed that no recoating would be required for the first 25 years and that an average of $1,632.20 per year would be expended the next five years.

Steel is $44,235 less than cast iron:	
$44,235 at 4% for (25 + 5) 30 years	$143,471.80
Less cost of recoating for 5 years (average per year $1,632.20)	8,840.52
Net sum remaining for future maintenance after 1946	$134,631.28
$134,631.28 at 4% for 8 years amounts to	184,252.33
Recoating for the next succeeding 8-year period, based upon the repairs of Conduit 2 for the last 8 years, would cost $4,738.54 per year or, accumulating at 4%, it would amount to	43,662.00
Deducting this from the above, we will have left in the year 1954	$140,590.33
Which at 4% interest will yield in perpetuity an annual maintenance fund of $5,623.61, while at all times after 1954 the principal sum of $140,590.33 will still be available.	

The foregoing $5,623.61, at the rate of $3.08 per lineal foot, will recoat 1826 ft. of conduit per year, or 3.58 per cent of this section, which is about 25 per cent more than the average rate of recoating of Conduit 2 for the last 8 years. It will therefore be seen that if the conduit is constructed of steel, the present saving of $44,235 will keep it in repair for the next 38 years, while at the same time a fund of over $140,000 will have been created for future use.

In view of the foregoing statements and of the conditions on this portion of the line, Mr. Fisher is of the opinion that the adoption of the steel conduit, with the saving of $44,235 at this time, will not entail unwarranted expense upon a future generation. He therefore recommends that the contract be awarded to the lowest bidder for steel pipe.

SINGLE ELECTRIC UNIT HANDLES SEVEN AND EIGHT COACHES ON 2-PER CENT GRADES

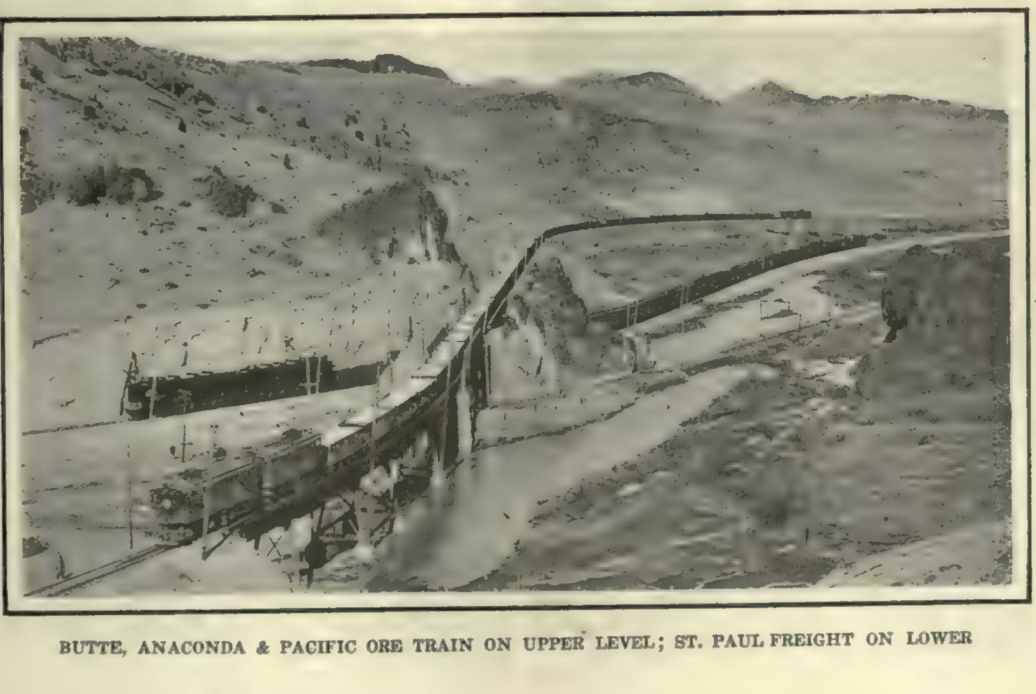
Advantages of St. Paul Electrification Show

Six Months of Electric Operation Demonstrate That Greater Tonnages Can Be Handled at Higher Speeds

ELECTRIC operation of the Rocky Mountain division of the Chicago, Milwaukee & St. Paul Railway has now undergone a six months' trial, and certain advantages appear to have been demonstrated. One of these is a material reduction in running time. On one 21-mile 2-per cent grade alone the time for passenger trains has been reduced from 1 hr. 5 min. to approximately 40 min. In the freight service it has been found that where steam locomotives have required from 10 to 12 hr. to make 115 miles, electric locomotives can meet a schedule of from 7 to 8 hr. for the same distance.

The capacity of the new locomotives has been thoroughly tested. Trains of 3000 tons have been hauled east and 2800 tons west, a helper being used on the heavy grades. On some of the runs, where the grades are less than 1 per cent, trains of as many as 130 cars and as heavy as 4000 tons have been hauled by a single locomotive. It has been shown that much heavier trains can be hauled with the electric locomotives than by steam, and furthermore the capabilities of the electric equipment are not impaired by bad weather. During a series of record-breaking temperatures last December, Mallet engines were frozen up at several points and were rescued, with their trains, by electric locomotives.

Through passenger trains of 650 tons are hauled 220 miles by a single electric locomotive. Steam operation required a change of engines midway. Local passenger trains are handled by a half unit.



BUTTE, ANACONDA & PACIFIC ORE TRAIN ON UPPER LEVEL; ST. PAUL FREIGHT ON LOWER

Regenerating Braking

The regenerative braking has proved an easy solution to a difficult problem on the long mountain grades. Electric freight trains usually descend the maximum grades at 17 miles per hour, but half that speed can be maintained if desired. In case there are no other trains between the substations, to absorb the power generated by a descending train, the power passes through the substation machinery and is readily absorbed by the extensive system of the power company.

There are forty-four electric locomotives on the division—twelve passenger, thirty freight and two switching. They operate on the 3000-volt direct-current system, being the first to use so high a direct-current potential. (See the Engineering Record of Nov. 28, 1914, page 581, and that of Oct. 23, 1915, page 518.)

The foregoing information and illustrations are taken from an advance copy of a bulletin, "An Epoch in Railway Electrification," about to be issued by the General Electric Company, builder of the St. Paul locomotives.

Congress Passes $85,000,000 Good-Roads Bill

Measure Approved by Both Houses Last Week Has Been Submitted to President Wilson for Signature

ON JUNE 28 the good-roads bill agreed on in conference between the representatives of the House of Representatives and the Senate was passed by both houses and sent to the President for his signature. It is known that the Secretary of Agriculture has approved the bill, and there is little doubt that before this number of the Engineering Record reaches its readers the measure will have become law. The bill appropriates a total of $85,000,000 of federal money to be spent during five years. Of the total, $5,000,000 is made available for the fiscal year ending June 30, 1917, and $10,000,000, $15,000,000, $20,000,000 and $25,000,000 respectively for the succeeding years.

The states contribute an amount equal to that paid by the national government, though the federal payment may not exceed $10,000 per mile, exclusive of the cost of bridges of more than 20-ft. clear span. The basis of distribution is as follows: One-third in the ratio which the area of each state bears to the total area of all the states; one-third in the ratio of state population; one-third in the ratio which the state mileage of rural-delivery routes bears to the total mileage of such routes.

The appropriations detailed in the foregoing account for $75,000,000. The remaining $10,000,000 is to be expended for the development of the resources of the national forests; but this is to be entirely repaid to the government by crediting to the highway fund 10 per cent of all revenues from the forests until the total is made up.

The main appropriation is to be expended through state highway departments. Notification will be given them annually of the amount available for appropriation. They will then file with the Secretary of Agriculture "project statements" setting forth the work that is proposed in order to get the appropriation. If the project be approved, the state highway department will furnish the Secretary with surveys, plans, specifications and estimates. These in turn must be approved. The bill provides that federal money may be spent only on projects that are "substantial in character." Items for engineering, inspection and unforeseen contingencies shall not exceed 10 per cent of the total estimated cost of the work. If approved, payment on the project shall not be made until the Secretary has satisfied himself that the road has been properly constructed in accordance with the plans and specifications. Provision is made for partial payments as the work progresses.

The government's administration charges shall not exceed 3 per cent of the appropriation, and the estimated amount is to be deducted before the distribution by states is determined.

A very important provision insures proper maintenance of the federal-aid roads, at least during the effective life of the present measure. The states, or their legal subdivisions charged with maintenance, must maintain the roads. If any road is not properly maintained, "the Secretary of Agriculture will so notify the state highway department. If within four months of the receipt of the notice the road has not been put in a proper condition, then the Secretary must refuse to approve any project for road construction in that state, or in the subdivision responsible for the neglect, until the road is in satisfactory condition."

MAXIMUM ALLOTMENT OF ROAD-BUILDING FUNDS TO STATES DURING ANY FISCAL YEAR

State	Population: Population	Population: Per cent of total population	Population: Amount	Rural free delivery: Number of routes	Rural free delivery: Aggregate length of routes miles	Star routes: Number of routes	Star routes: Aggregate length of routes miles	Per cent of total miles of R. F. D. and star routes	Amount	Specific amount	Total amount of aid to each state
Alabama	2,138,093	2.34	$255,996	1,065	25,845	251	2,589.09	2.36	$258,184	$65,000	$579,180
Arizona	240,354	.22	24,068	28	677	88	2,391.73	.26	28,444	65,000	117,512
Arkansas	1,574,449	1.72	188,168	558	13,366	520	6,069.38	1.62	117,228	65,000	430,396
California	2,377,549	2.60	284,440	408	9,553	396	7,564.85	1.42	155,348	65,000	504,788
Colorado	799,024	.87	95,178	207	5,472	271	4,724.00	.85	92,990	65,000	253,168
Connecticut	1,114,756	1.22	133,468	281	6,219	65	359.06	.55	60,170	65,000	258,638
Delaware	202,322	.22	24,068	58	1,509	12	58.71	.13	14,222	65,000	103,290
Florida	752,619	.82	89,708	233	5,546	176	1,716.59	.60	65,640	65,000	220,348
Georgia	2,609,121	2.85	311,790	1,493	36,610	145	1,381.43	3.16	345,704	65,000	722,494
Idaho	325,594	.36	39,384	162	4,061	155	3,161.62	.60	65,640	65,000	170,024
Illinois	5,638,591	6.16	673,904	2,844	68,979	80	717.77	5.79	633,426	65,000	1,372,330
Indiana	2,700,876	2.94	321,636	2,072	50,774	90	733.88	4.28	468,232	65,000	854,868
Iowa	2,224,721	2.42	264,748	2,116	55,929	36	275.73	4.68	511,992	65,000	841,740
Kansas	1,690,949	1.84	201,296	1,859	50,838	123	2,058.30	4.40	481,360	65,000	747,656
Kentucky	2,289,905	2.50	273,500	800	18,765	786	7,843.45	2.21	241,774	65,000	580,274
Louisiana	1,656,388	1.81	198,014	275	6,504	283	2,492.44	.75	82,050	65,000	345,064
Maine	742,371	.81	88,614	478	10,970	288	2,561.62	1.12	122,528	65,000	276,142
Maryland	1,295,346	1.41	154,254	422	9,698	156	1,210.58	.91	99,554	65,000	318,808
Massachusetts	3,366,416	3.67	401,498	278	6,684	140	862.60	.63	68,922	65,000	535,420
Michigan	2,810,173	3.06	334,764	1,759	48,046	150	1,551.58	4.12	450,728	65,000	850,492
Minnesota	2,075,708	2.27	248,338	1,581	43,676	190	2,560.63	3.84	420,096	65,000	733,434
Mississippi	1,797,114	1.96	214,424	894	21,512	236	2,462.41	1.99	217,706	65,000	497,130
Missouri	3,293,335	3.59	392,746	2,166	51,455	452	5,310.99	4.72	516,368	65,000	974,114
Montana	376,053	.41	44,854	94	2,506	262	6,541.00	.76	83,144	65,000	192,998
Nebraska	1,192,214	1.30	142,220	1,086	29,233	211	4,554.27	2.81	307,414	65,000	514,634
Nevada	81,875	.09	9,846	4	85	81	2,807.60	.24	26,256	65,000	101,102
New Hampshire	403,572	.47	51,418	246	5,564	122	909.47	.54	59,076	65,000	175,494
New Jersey	2,537,167	2.77	303,038	311	7,149	110	553.09	.64	70,016	65,000	438,054
New Mexico	327,301	.36	39,384	28	801	218	4,860.61	.47	51,418	65,000	155,802
New York	9,113,614	9.94	1,087,436	1,949	44,970	486	3,648.97	4.04	441,976	65,000	1,594,412
North Carolina	2,206,287	2.41	263,654	1,378	31,961	396	4,042.54	2.99	327,106	65,000	655,760
North Dakota	577,056	.63	68,922	630	18,401	163	2,608.55	1.75	191,450	65,000	325,372
Ohio	4,767,121	5.21	569,974	2,545	60,917	149	1,041.16	5.15	563,410	65,000	1,198,384
Oklahoma	1,657,155	1.81	198,014	957	25,504	288	4,125.00	2.46	269,124	65,000	532,138
Oregon	672,765	.73	79,862	253	6,187	248	5,294.43	.95	103,930	65,000	248,792
Pennsylvania	7,655,111	8.36	914,584	1,906	49,963	562	3,962.82	4.48	490,112	65,000	1,469,696
Rhode Island	542,610	.59	64,546	49	996	18	87.61	.09	9,846	65,000	139,392
South Carolina	1,515,400	1.65	180,510	860	20,420	114	1,177.96	1.80	196,920	65,000	442,430
South Dakota	583,888	.64	70,016	621	18,271	190	4,021.74	1.85	202,390	65,000	337,406
Tennessee	2,184,789	2.38	260,372	1,611	38,313	207	2,276.41	3.37	368,678	65,000	694,050
Texas	3,896,542	4.25	464,950	2,019	49,251	628	10,179.40	4.94	540,436	65,000	1,070,386
Utah	373,351	.41	44,854	55	1,235	113	2,541.11	.31	33,914	65,000	143,768
Vermont	355,956	.39	42,666	343	7,610	137	1,166.77	.73	79,862	65,000	187,528
Virginia	2,061,612	2.25	246,150	1,101	24,557	666	6,295.00	2.56	280,064	65,000	591,214
Washington	1,141,990	1.25	136,750	349	8,539	173	2,450.77	.91	99,554	65,000	301,304
West Virginia	1,221,119	1.33	145,502	420	9,403	475	4,946.22	1.19	130,186	65,000	340,688
Wisconsin	2,333,860	2.55	278,970	1,691	41,717	145	1,510.27	3.59	392,746	65,000	736,716
Wyoming	145,965	.16	17,504	21	592	157	4,137.03	.39	42,666	65,000	125,170
Total	91,641,197	100	$10,940,000	42,567	1,056,897	11,430	147,365.50	100	$10,940,000	$3,120,000	$25,000,000

Province of Quebec Encourages Water-Power Developments

THE PROVINCE of Quebec, Canada, with its long-term leases, does not regulate the rates of power companies and their charges to consumers. It makes no conditions in its leases as to what is to become of the leased property and the improvements at the end of the leasing period, the theory being that the courts may safely be relied upon to be fair both to public and to private interests when the time comes to take over such properties, if they are to be taken over.

The aim of the provincial officials is to invite and encourage the investment of private capital. The hydraulic service of the Department of Lands and Forests surveys and makes reports on the potential water powers in the province, exploits them and seeks in legitimate ways to encourage development. The results of its surveys and investigations are public property.

When the investigation of a given site is completed, the province determines the reasonable value of the power privilege and offers the lease at auction, the award going to the highest bidder whose offer exceeds the upset price fixed by the government officials. Under this law Quebec has leased twenty-four power sites, ranging in size from 38 to 180,000 hp., since the present law went into operation in 1906. The total development under the leases aggregates 480,598 hp.

Recapture is ignored in the Quebec leases, with the idea on the part of the government officials that the question as to compensation and valuation should be left open to be settled by the courts in accordance with the policies which may prevail in the distant future when leases expire.

The development at Cedars Rapids in the St. Lawrence River (see the Engineering Record of Oct. 25, 1913, page 461) was made under such terms, and that instance may be cited as typical, although it is the largest single development under the Quebec law. It is capable of developing 180,000 hp., and was leased in 1910 for a term of 99 years. The power company, under its lease, is to pay an annual rental of $600 from the date of the signing of the lease, with additional yearly charges on the quantity of 24-hour electric horsepower development, as follows: For the first 50,000 hp., 15 cents; on the next 25,000 hp., 20 cents, and on any quantity over 75,000 hp., 30 cents. At the expiration of each thirty-year period the government reserves the right to advance the rate.

Iron-Ore Production in 1915 14,000,000 Tons Greater Than in 1914

The iron ore mined in the United States in 1915 reached a total of 55,526,490 gross tons, the greatest output made in any year except 1910 and 1913, according to figures of the U. S. Geological Survey. The shipments totaled 55,493,100 gross tons, at a value of $101,288,984. The quantity mined was an increase of 14,000,000 tons over the output in 1914. The average value per ton in 1915 was $1.83, as compared with $1.81 in 1914. It is estimated that in 1916 the production of iron ore from the Lake Superior district alone will possibly be 60,000,000 tons, and there will probably be an increase in price of 70 to 75 cents a ton for this grade of ore.

What the Government Valuation Division Is Doing and How the Work Is Handled

Organization Built Up from Bottom and Many Problems New to Valuation Met—Sixty Roadway Parties Now Covering 4000 Miles of Road Monthly

By C. W. STARK
Associate Editor, Engineering Record

THREE YEARS AGO Congress passed the Valuation Act—an act which imposed on the Interstate Commerce Commission a task that dwarfed everything ever done before in the way of valuation. Other valuations of carriers had been made, usually for specific purposes; important though they were, each stood on its own merits, and established no general precedents; each was used once and virtually set aside. Some were for taxation purposes, and the railroads were not overanxious to have every hidden item recorded. In other cases, where rates were at issue, the railroads had fought hard for every item, but the state commissions or other bodies that opposed them had no standardized rules bearing on the subject, consequently the establishment of a point in one case did not insure its acceptance in the next. The federal act intimates that the valuations may serve many purposes, and calls for different figures—original cost, reproduction cost, new, depreciation and other elements of values—that may be utilized for any of these purposes; figures that must be classified as to items, segregated as to states and corporations, and so recorded as to permit keeping continuously up to date in the future. To the railroads and the governments alike it is of the utmost importance that the inventories be complete.

The act covers all carriers doing interstate business. Of railroads there are 250,000 miles, and in addition there are the telegraph and telephone lines. The cost and time required are still somewhat conjectural, but the latest estimates are that the cost to the government alone will have been $20,000,000, and that the work will not be done before 1920. When the act was passed there was no organization whatever to carry it out. Now 1000 men are employed, sixty roadway and numerous other special branch parties are in the field and more than 50,000 miles of railroad have been covered as to grading and track.

Director and Engineering Board Appointed

Announcements were made as they occurred of the appointments of a director of valuation and an engineering board, the division of the country into five districts, the assignment of the members of the board to the districts, the creation of district engineers and the holding of civil-service examinations to secure men for various positions. Only fragmentary information has gone forth as to the shaping of the organization from this point and the carrying out of the work. The aim of this article is to tell what in a general way has been done and is being done.

Even while the first civil-service examinations were pending and no men were available, the heads of the Division of Valuation found much to do. One of the first tasks was to learn which roads do interstate business. This may seem simple. The fact is that many short lines wholly within one state do interstate business, while of the scores of corporations, large and small, that constitute the average trunk line some may, because they do no such business, be outside the jurisdiction of the Division of Valuation. Geographical location, therefore, cannot be made the sole test. The division has not yet the complete list of the properties it must value.

Map Order Issued

Before the government can economically take up the field measurement of the physical plant of any individual railroad it must know what that railroad claims to own or use for railroad purposes. The question of maps, profiles and other records to be furnished by the carriers was fully discussed by the carriers and the Division of Valuation some two years ago, and Valuation Order 1—specifications for maps and profiles—was issued by the government. Its main requirements have been discussed in the Engineering Record.

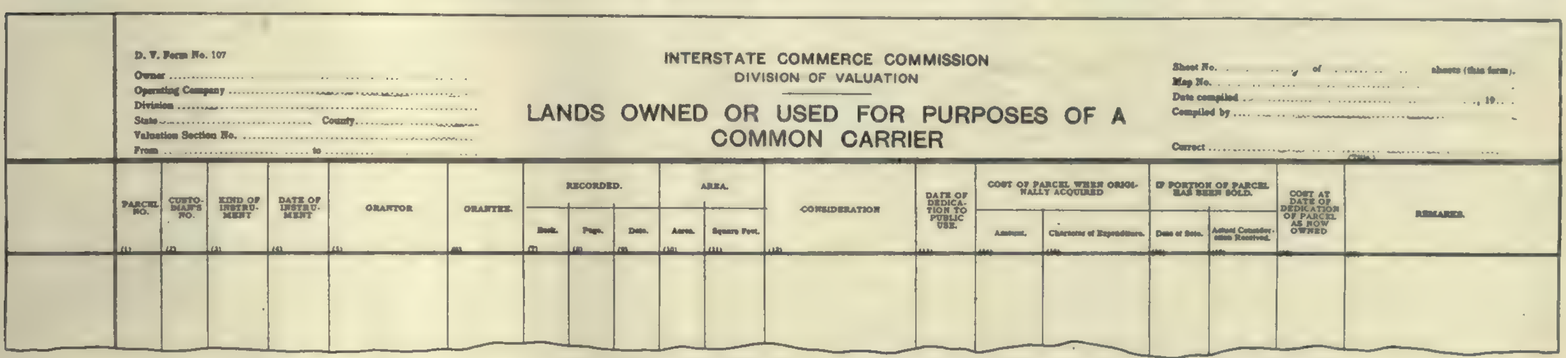
While this order prescribes definite standards for future maps, the government has recognized that many existing maps, though not of exactly the prescribed form, may be perfectly serviceable. Consequently government representatives have visited the main offices of most of the railroads, inspected their maps and indicated which would be acceptable. All maps and profiles must be filed within thirty days after the date as of which the carrier is to be valued.

Supplemental to the map order are various orders calling for schedules of different classes of property. Order 7 covers land, and stipulates forms for a complete record of each parcel covered by a separate instrument of conveyance, one form listing land used for common-carrier purposes and the other covering that not so used. Order 8 covers equipment. Two forms are given for each of a number of classes of equipment—locomotives, passenger-train cars, freight-train cars, floating equipment, shop machinery and the like; one form gives a full outline of the characteristic features of the unit, while the other gives its cost to date, including freight, testing and additions and betterments. These, like most of the schedule orders, must be filed within thirty days of the date of valuation. Order 13, which calls for "a complete inventory of the quantities, units and classes or kinds of property in its roadway and track; bridges, buildings and all other structures; signals and interlockers; telegraph and telephone lines; electrical apparatus; and all fixed property except lands and equipment included in Valuation Orders Nos. 7 and 8," empowers the director of valuation to require the filing of this inventory "upon such dates, in such detail, upon such forms and for such part or parts" as he desires, classified according to the Interstate Commerce Commission's accounts.

The proper treatment of industrial tracks constitutes no small problem in the work, owing to the variety of forms of ownership of such tracks and the variety of agreements between carrier and industry. Order 12 requires the carriers to file a prescribed form listing the industrial tracks along its lines and giving full information as to their ownership. This is one of many phases of the valuation problem that has probably not been gone into thoroughly in other valuations. It is well known, however, that the ownership of the tracks varies all the way from that in which the railroad owns both the land and the track material to that in which the industry owns both, does its own switching and excludes the carriers' locomotives. In some instances the industry has granted to the carrier the strip of land on which the track rests; in others the industry retains the ownership of the land, but the carrier lays claim to the track itself. The Division of Valuation, however, governs itself by the ownership of the land. If the railroad owns the land it is assumed to own the track; if it does not, it must produce proof that it owns the track. This emphasizes the great importance of accurate determination of the right-of-way.

Program for Valuation

The maps and profiles, with the foregoing and other schedules, form the foundation and guide for the government in its field inventory—the checking of the data supplied by the carriers and the measurement and classification of the items of property. When the Valuation Act was passed some of the railroads were well equipped as to


D. V. Form No. 107
Owner
Operating Company
Division
State County
Valuation Section No.
From to

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

LANDS OWNED OR USED FOR PURPOSES OF A COMMON CARRIER

Sheet No. of sheets (this form).
Map No.
Date compiled , 19..
Compiled by
Correct

Parcel No.	Custodian's No.	Kind of Instrument	Date of Instrument	Grantor	Grantee	Recorded.			Area.		Consideration	Date of Dedication to Public Use.	Cost of Parcel When Originally Acquired		If Portion of Parcel Has Been Sold.		Cost at Date of Dedication of Parcel as Now Owned	Remarks.
						Book.	Page.	Date.	Acres.	Square Feet.			Amount.	Character of Expenditure.	Date of Sale.	Actual Consideration Received.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)

THIS FORM AND ONE SOMEWHAT DIFFERENT FOR LAND NOT OWNED OR USED FOR CARRIER PURPOSES ARE PRESCRIBED BY ORDER 7

D. V. Form No. 78.

Owner

Operating Company

Date of Report as of

Correct

Title

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

51—STEAM LOCOMOTIVES
REGISTER OF EQUIPMENT

Sheet No. .... of .... sheets (this form).
All locomotives on this sheet for track of .... gauge.
Supporting data will be found on D. V. Form No. .., sheets

Locomotive No. (1)	Initials (Owner.) (2)	Builder. (3)	Builder's No. (4)	Date Built. Mo. (5)	Date Built. Yr. (6)	Type (Whyte Symbols.) (7)	Cylinders. (Diameter and Stroke.) (8)	Service. (9)	Diam. Drivers Over New Tires (10)	Working Steam Pressure. (11)	Weight on Drivers. (12)	Tractive Effort by I. C. C. Formula. (13)	Diam. of Boiler Outside First Ring (14)	Tender Capacity. Water. (Gallons.) (15)	Tender Capacity. Fuel. (16)	Weight Light. Engine. (17)	Weight Light. Engine and Tender. (18)	Mileage to Date since Last General Repairs (19)	Remarks. (20)

D. V. Form No. 79.

Owner

Operating Company

Date of Report as of

Correct

Title

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

51—STEAM LOCOMOTIVES
REPORT OF ORIGINAL COST TO DATE

Sheet No. .... of .... sheets (this form).
Supporting data will be found on D. V. Form No. .., sheets

Locomotive No. (1)	Builder. (2)	Date Built Mo. (3)	Date Built Yr. (4)	Weight Light. Engine. (5)	Weight Light. Engine and Tender. (6)	Freight Data. Purchased F. O. B. (7)	Freight Data. Receiving Station on Owning Road. (8)	Original Cost to Date (in Dollars). At F. O. B. Point. (9)	Design, Inspection, Messenger Service Setting Up, Breaking In, Fixtures Tools, Misc (10)	Freight Paid. (11)	Total. (12)	Net Cost of Additions and Betterments. (13)	Grand Total (14)	Remarks. (15)

TWELVE PAIRS OF THESE, WITH MEMORANDUM OF ADDITIONS AND BETTERMENTS AND DETAIL SUPPORTING STATEMENT, COVER EQUIPMENT

records, while many were quite the reverse. The government, therefore, has worked out and is working out a program whereby each district starts the valuation of a few additional carriers each year.

Valuation Orders Nos. 1 and 5 stipulate that each road must be valued as of June 30 of some year, and that each road must be notified at least six months before that date. Order 5, issued in November, 1914, requires each steam railway carrier to file, within thirty days after the date of valuation, complete maps and profiles of its property as of the date of valuation. This order did not apply to the roads already under valuation. The Boston & Maine, for instance, which was one of the first roads in the Eastern District to be taken up, received notice Jan. 16, 1914, that the government field work on its property would be taken up about May 1. This was two days after the issuance of the map order, Order No. 1, and prior to the formation by the railroad of a valuation department. It was found that more than half of the road would re-require resurveys and new maps, and in this work the railroad has barely kept ahead of the government, the roadway parties of both virtually completing their task at the beginning of last winter. The Boston & Maine work is described in the Engineering Record of Oct. 30, 1915, page 538

Working Organization Developed.

All of the foregoing has to do with the preparing of the way—the notifying of the railroads what data they must furnish, and in what form. While these various orders were being prepared the Division of Valuation was developing a working organization from the eligibles of the civil-service lists. Field squads and office forces were organized. The field work was divided into several branches—roadway and track; bridges; buildings; mechanical; signals; electrical, telegraph and telephone; land. Full instructions were prepared and printed for each branch.

The great advantage of co-operation between carrier and government received early mutual recognition, and this recognition crystallized into the duplicate-note agreement. This agreement provides that if the railroad will send out a "pilot engineer" with each government field party to point out the elements of property and give all the pertinent information possible as to ownership, use, age and structure, the government will in turn furnish him with a duplicate set of the field notes. While the execution of this agreement is optional with the railroads, all under valuation have signed it except a few very small roads which have little or no engineering organizations and whose managements feel that they have little to gain or lose by the valuation. The duplicate agreement is the very basis of the adopted method of prosecuting the work, of the combination camp-and-office cars, and of the elaborate note forms to be described in a later article.

How the Field Work Is Done

In general the inventory is being done by government forces. Some idea of the way the field work is being done has been presented in this journal in the article entitled "Accommodations de Luxe for Federal Valuation Engineers," in the issue of Dec. 26, 1914, page 696, which deals with the handling of the track and roadway parties in the Western District, and in the Boston & Maine article previously mentioned. The largest parties are the track and roadway parties, which generally consist of nine men. The original plan of having them make hotels their headquarters has been set aside by the development of the combination camp-and-office car or cars, the all-around advantage of which for a large party is obvious. The special branch parties, consisting of one or two men each, working with the railroad's pilot, are obliged to rely on outside accommodations.

The workings of the roadway party are a story in themselves, and will be so treated. Suffice it to say here that it is its duty to measure and record every bit of fixed physical property not in the field of a special branch party, and that it must note over to the special parties all structures, such as bridges and buildings, that it has not covered. Furthermore, the notes must be summarized, condensed and tabulated in such manner that when transmitted to the district office they can be fully understood by men who have not seen the conditions on the ground.

Other Parties Cover Special Structures

While the roadway parties are inventorying what may be called the ordinary structures, the other parties, consisting of one or two men each, are making records of the special structures or elements of property. The bridge, building, signal and telegraph and telephone parties follow the roadway parties (although not necessarily in the same month) in order to have the benefit of the chaining and other notes made by the roadway party. If the carrier has good plans, they are in general relied upon for the bridges, stations and other larger

D. V. Form No. 135.
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Owner

Operating Company

Division State

Valuation Section No.

From to

Miles of Main or Branch Line.

Reprinted by General Secretary, Presidents' Conference Committee, Federal Valuation.

INTERSTATE COMMERCE COMMISSION
DIVISION OF VALUATION

LIST OF INDUSTRIAL TRACKS

Sheet No. of sheets this form).
Date of Inventory as of , 19
Date compiled , 19
Compiled by
Correct (Title)

Location. Survey Station, Mile Post and Nearest Railroad Station (1)	Industrial Track Agreement. Carrier's No. (2)	Industrial Track Agreement. Date (3)	Industrial Track Agreement. Parties to Agreement and Industries Served. (4)	Right of Way and Track Map Reference. Map No. (5)	Right of Way and Track Map Reference. Track No. (6)	Ownership and Length in Feet. Carrier. Items Owned. (7)	Ownership and Length in Feet. Carrier. Length (8)	Ownership and Length in Feet. Industry. Items Owned (9)	Ownership and Length in Feet. Industry. Length. (10)	Ownership and Length in Feet. Total Length. (11)	Year Built. (12)	Remarks. Give extracts from agreement in support of carrier's claims concerning ownership of lands and improvements involved. (13)	Notebook Reference. Book (14)	Notebook Reference. Page (15)

ORDER 12 PRESCRIBES A FORM FOR LISTING INDUSTRIAL TRACKS AND GIVING FULL INFORMATION AS TO THEIR OWNERSHIP

structures; if not, detail measurements must be made. The mechanical parties make careful examination of not less than 10 per cent of each type or series of equipment. The land parties examine the deeds and other papers offered by the railroad to establish their title to the land claimed, and also make a careful study of adjoining lands and prices as indicated by assessments, records of sale and opinions of experts and old inhabitants.

The field parties are manipulated from the district office to suit the conditions of weather, preparation of the railroads and the like. For example, the roadway parties that worked on the Boston & Maine last summer were transferred at the coming of winter to Virginia and New Jersey. One of them was assigned to a certain part of the Central of New Jersey that was ready for them. This party disposed of certain minor lines of this road, as well as a short independent railroad, and was sent to the New York, New Haven & Hartford this spring, partly because it was desired to finish the New Haven during warm weather and partly because some divisions of the Central of New Jersey are not yet ready as to maps and other data.

The office forces assemble all other data received from the roadway parties and the special parties and summarize them according to states, corporations or any other districting system desired.

Condition Per Cent and Unit Prices

The railroads have consistently opposed the recording of condition per cent, holding that only deferred maintenance should be taken into account. The field forces of the Division of Valuation are instructed, however, to make estimates of service condition per cent, filling out blanks which give, in addition to the item and its location, the age of former service, age of present service, remaining service life, quality when installed, maintenance, source of data and special notes. There is also a column to check off if the carrier's representative agrees.

No attempt has been made as yet to fix unit prices. This will require a separate journey over each part of the line by a price expert. Meanwhile a cost-data bureau has been organized, and while nothing has been given out officially as to its findings or lines of endeavor, it may fairly be taken for granted that the bureau has been assembling useful information.

Typical Legal Problem

Each district has an attorney to pass upon the legal problems that arise. These problems are many and varied. Here is one: Two railroads built long ago terminated on the opposite banks of a wide and navigable river. A ferry service joined the two lines. The two railroads consolidated and sought a permit to bridge the river. This was granted on condition that all passenger trains stop on both banks of the river and carry local passengers across. In time the line became a very important one, carrying a heavy high-speed traffic; and the stopping of all trains at the river became oppressive. Relief was asked from the public authorities, and the negotiations ended in a permit to build a second bridge alongside the first and the discontinuance of the stop proviso, the old bridge, however, to be turned over to the county as a highway bridge. And the two bridges stand side by side to-day, one carrying trains, the other highway traffic. The legal question is, Should the highway bridge be included in any or all of the cost estimates as part of the railroad property "used and useful"?

As to the rate at which the Division of Valuation is doing its work, little can be said, because nothing of the sort has ever been done before, and there is no standard to measure by. Neither can the progress being made now be taken too definitely to estimate when the entire work will be done. The roadway parties are averaging from 4 to 5 miles of all tracks daily for twenty-five working days per month, hence the sixty parties of the Division of Valuation are covering about 6500 miles of all tracks per month. The telegraph parties go much faster, while the speed of the bridge, building and mechanical men naturally varies widely.

There are many fundamental problems to be solved before a final report can be made on any single railroad, as the various valuation conferences testify. It can be confidently stated, however, that the Division of Valuation is shaping its course in such a way as to avoid the necessity of doing the work over if rulings are made on the various moot points.

In view of the conditions surrounding the valuation—the belief of the railroads at the outset that the entire project was needless and a waste of money, the distrust by private interests of the reliability of the civil-service method for obtaining competent men, the fact that many fundamental questions of vital importance are still being debated by the parties concerned—the work of the Division of Valuation appears to be going on with remarkably little friction.

Observatory on Standpipe

In his annual report for 1915, George A. Stacy, superintendent of the Marlborough (Mass.) water department, urges the joint use of city-owned lands for reservoir and park purposes. He suggests, also, that the city's standpipe could readily be converted into an observatory. A platform erected on the inside of the supporting columns, below the bottom of the tank, Mr. Stacy points out, could be provided with seats and protected with a wire fence on the outside. The observatory level could be connected with the ground by a winding covered stairway. The view from this point of vantage, he says, cannot be equaled between the Blue Hills and Wachusetts.

Cleveland Street Railway Flushes City Streets

Car with 4488-Gallon Tank Cleans 4850 Feet of One Side of Street in 12 Minutes with One Filling of Tank

By H. C. EBELING
Engineer Cleveland Railway

A DISCOVERY by the city officials that a provision of the Tayler ordinance, under which the Cleveland (Ohio) Railway operates, provided that the railway should also "operate hospital and supply cars for the city and such other cars for exclusive municipal purposes as the city shall furnish and maintain," led them to require the railway company to operate tank cars to be employed in flushing and cleaning the streets. Prior to the arrangement whereby the railway company flushed the streets it was required under its franchise to

CAR WILL FLUSH NEARLY A MILE OF STREET, ONE SIDE, IN TWELVE MINUTES

sprinkle them, consequently it had a number of service cars for this purpose. When the municipal authorities decided to avail themselves of the provisions of the ordinance, the railway company was instructed to convert its sprinkling cars into flushers. With the advent of the street-car flusher it was no longer necessary for the railway company to sprinkle the streets, because the dust and refuse were flushed away sufficiently often to make sprinkling unnecessary to keep down the dust. Furthermore, under the old arrangement the expense of sprinkling its right-of-way was borne by the railway, but under the new plan the city reimburses the company to the extent that it furnishes and maintains the flusher cars, pays the cost of operating them, including the wages of the employees and the cost of the power, but contributes nothing toward fixed charges or for track maintenance and renewals.

Converting Sprinklers Into Flushers

It was a comparatively simple task to equip the old sprinkler tank cars so that they would serve as flushers. A De Laval centrifugal pump, direct connected to a 15-hp. Westinghouse motor mounted on the same base as the pump, was placed on the front platform of the car. The suction line of the pump was connected to the tank as close to the bottom as possible. The discharge line was furnished with a Y fitting, and a line from each branch of the Y connected to a nozzle over each track rail and about 11 in. above it. A

quick-opening lever gate valve was placed in each branch of the discharge line and arranged to be opened and closed from the car platform by means of foot-pedal operating levers. Each valve is operated independently so that either or both sides of the street may be flushed. The motor operates at 550 volts or the trolley voltage, and it is equipped with a suitable starting rheostat.

The nozzles are designed to discharge a fan-like sheet of water over the surface of the street, the nozzle on one side of the car being so adjusted as to clean the devilstrip and the track upon which the car operates, and the other nozzle catches the refuse washed from the track and devilstrip by the first nozzle and carries it to the curb, whence it flows to the sewer. The flushing nozzles are made of cast brass with inner and outer casings. The inner casing has a narrow slot through which the water passes, and the outer casing has a slot a trifle wider. The width of the stream of water is controlled by turning the inner casing. Under ordinary conditions a slot ¾ in. wide by 6 in. long is used.

Additional Cars Ordered

The converted sprinkler cars proved so satisfactory that the company was requested to build two additional double-truck flusher cars. This is the type of flusher shown in the accompanying illustration.

While much depends on the condition of the street and the skill of the operator of these flusher equipments, some idea of their effectiveness may be obtained from the following data taken from the original flusher cars:

Capacity of the tank, gallons	3247
Width of part of street flushed, feet	25
Distance flushed, feet	3500
Time required, minutes	8

On this basis the double-truck or large flushers, having a capacity of about 4488 gal., will flush 4850 ft. of street on one side only in about 12 minutes with one filling of the tank.

Compares Three Types of Lock-Gate Design

Malcolm Elliott, U. S. Assistant Engineer, Defines the Proper Sphere for Vertically and Horizontally Framed Gates

THE LOCK GATES at Panama, Keokuk and Louisville, all for locks 110 ft. wide and about 48 ft. high, but each of a different design, were contrasted by Malcolm Elliott, U. S. assistant engineer, Louisville, in a paper presented recently before the Western Society of Engineers. The Louisville gate is vertically framed, the Panama gate belongs to the horizontal beam type and the Keokuk gate to the horizontal arch type.

Summarizing the comparison between horizontal arch and beam gates Mr. Elliott ventured the opinion that in general arches are more economical and when adequately stiffened against torsion are every bit as satisfactory as girder gates, and that the adoption of the latter type of gates is justified only in special cases where the increased depth of recess would increase the cost of the lock by an amount greater than the saving due to the adoption of a more economical type of framing. This opinion, stated Mr. Elliott, seems to be substantiated by modern practice. The largest gates in this country are those at Keokuk, Sault Ste. Marie and the Cascades Canal, and these are all of the arched type. The Panama gates are of the beam type and no doubt the adoption of this type is justified in this case on account of the locks being in pairs, making it desirable not to increase the width of the foundation as would be necessary with arched gates.

When Vertical Framing Is Desirable

Turning now to vertical framing it is apparent at once, continued Mr. Elliott, that it depends on the ratio of height to length whether or not vertical framing will be more economical than horizontal framing. For instance, no one would claim that vertical framing would be more economical for the lofty gates of the Panama Canal, some of which are 82 ft. high and only 64 ft. long. On the other hand vertical framing is clearly indicated for the low-lift locks of the Ohio River where the miter gates adopted will be from 17 to 22 ft. high and 62 ft. long. The question is then, at what ratio of height to length do the two general types give equal weights? A mathematical analysis of this problem is not altogether satisfactory, because there are too many auxiliary parts to each type of gate which will not be shown by general equations.

By analysis the weights of horizontal girders and vertical girders are found to be equal when the height is 70 per cent of the length. The figures given, however, do not include a large amount of auxiliary framing, such as the vertical diaphragms in horizontally framed gates and auxiliary horizontal members in vertically framed gates. From actual designs Mr. Elliott has formed the opinion that the extra framing, not expressed in general equations, is greater with horizontal than with vertical framing, and that the ratio found as a result of analyses should be increased to about 1:1. That is, vertical framing and horizontal girders will weigh the same when the height of the gate is equal to its length. When arches are used for the horizontal framing the weights will be equal when the height is about three-fourths of the length. This latter opinion is based largely on the similarity in weight of the Keokuk and Louisville gates.

Vertical Framing Easy to Construct

A cost-involving element considered by Mr. Elliott almost as important as the weight is the facility of construction. For three reasons the advantage in this regard should be with vertical framing, whether compared with horizontal beams or horizontal arches. First, a vertically framed gate is built on rectangular lines with an almost entire absence of curved work. Second, the erection of that type of gate is much simpler because there are fewer members. Large horizontally framed gates are built up a panel at a time, necessitating careful alignment at each step, while with vertically framed gates, once the few principal members are erected all other parts may be fitted into place without extraordinary attention to alignment and elevation. Last, with the provision for adjustment by means of the adjustable diagonal members, there is no need for extraordinary precision in erection. That it is impossible to use adjustable diagonal members in a horizontally framed gate may, at first sight, Mr. Elliott admitted, seem to be a broad and perhaps extravagant statement; but the fact remains that despite the obvious advantage in using such a system it has never been done with large steel horizontally framed gates, and Mr. Elliott states that he is not aware of any method by which it could be used advantageously. Without such a system a gate must be built with such precision and stiffness that when the falsework is removed it will hang in an approximately true position; but with an adjustable diagonal system this extraordinary care is not required, because if the gate is not absolutely true it can be straightened out with the diagonals.

No Special Operating Advantage for Any Type

The real test of the desirability of any type of lock gate, according to Mr. Elliott, is its ability to perform successfully the functions for which it is designed. Compared with this consideration the element of first cost is trivial, because the cost of the lock gate is generally but a small part of the total cost of a lock, and it would be folly indeed to economize on the first cost of the gates when such economy would result in a continuing loss in efficiency and service. So far as Mr. Elliott has been able to ascertain, there is no marked difference in ease or efficiency of operation between the several types. The cost of maintenance should be less with vertical than with horizontal framing, because of the absence of the large number of small cells into which the latter type is divided by the many intersecting horizontal and vertical members. These cells collect a large amount of deposit in a muddy stream and are difficult of access for cleaning and painting.

In safety or ability to withstand being struck by boats or other shocks, it is not believed that horizontal framing has sufficient advantage (if, indeed, it has any advantage) over vertical framing to influence the choice of type. Generally speaking, when a heavy boat going at high speed hits a lock gate the latter will be wrecked, regardless of its type.

Examples of Each Type

There are examples of each type in successful use, although horizontal framing so far has seemed to be standard for large gates. The largest vertically framed gates in use are in the Transatlantic Dock and Bellot Basin at Havre, France. These are for a lock width of 100 ft. and are about 35 ft. high. In this country the largest gate of this type is in the 80-ft. lock at St. Paul. The ratio of height to length is about 1:1. These are the only examples of vertical framing for large locks, so far as is known to Mr. Elliott, but others are to be built in the near future. All of the Ohio River locks, which are not yet built, other than the Louisville lock, are to have vertically framed gates. In these gates the dimensions clearly point to vertical framing, because the locks are 110 ft. wide and the height of the gates varies from 17 ft. to 22 ft. Vertical framing as applied to small gates has been used very successfully on the 45-ft. locks of the Kentucky and Big Sandy rivers.

At Louisville, while vertical framing for the large lower gate was not approved, this type is to be used for the upper gate and guard gate. Both of these span an opening 110 ft. wide. The upper gate is to be about 62 ft. long and 25 ft. high, while the guard

gate is of the same length and about 44 ft. high.

Mr. Elliott drew the following conclusions in regard to the relative merits of the three types—vertical framing, horizontal beams and horizontal arches, as applied to lock gates. He believes the advantages of vertical framing within certain dimensional limits have not been sufficiently recognized.

1. There is no very marked difference between the three types so far as efficiency of operation is concerned. The advantage, if any, is with vertical framing, because of a probable smaller maintenance cost.

2. There is little if any advantage of one type over any other type in ability to withstand shocks.

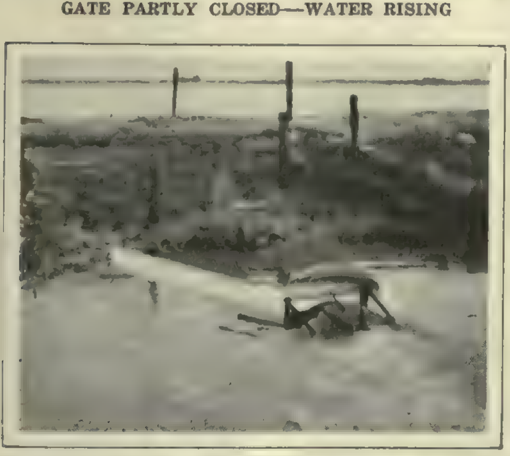
3. Based on conclusions 1 and 2 it may be said that the choice of type should be controlled generally by the relative costs. Generally speaking the most economical type should be selected.

4. Horizontal arches are in general cheaper than horizontal beams. An exception to this rule may occur in the case where the adoption of the arch would result in a large increase in the width of the foundations, on account of the greater depth of the gate recess. This condition does not frequently occur.

5. Vertical framing will weigh less than horizontal beams when the height is less than the length; and will weigh less than horizontal arches when the height is less than three-fourths the length.

6. Vertical framing is superior to horizontal framing as regards facility of construction and simplicity of design.

GATE PARTLY CLOSED—WATER RISING



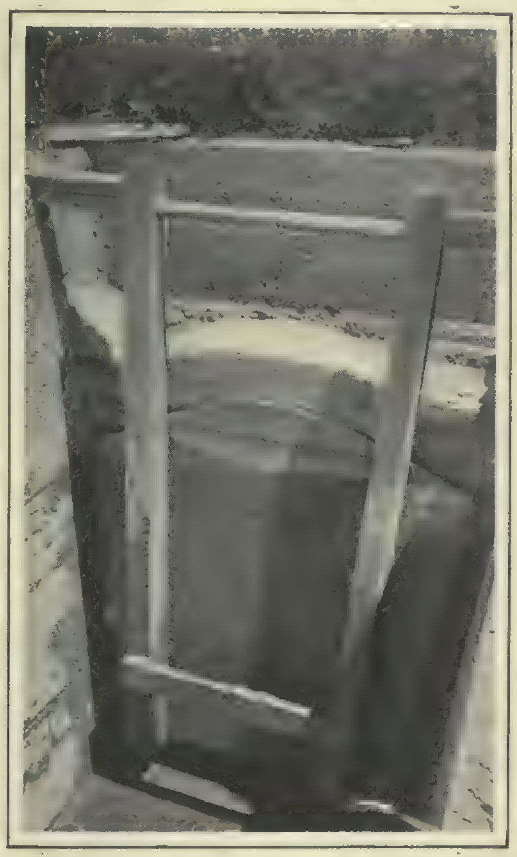
CAST-IRON GATE DISCHARGING

Automatic Drainage Gates Lessen Need of Pumping

Developed Primarily for Tidal Conditions, Prove Equally Useful Where There Is No Tidal Rise and Fall

LYING, as his lands do, below the high-water mark of a neighboring river, the rancher in the so-called "Island Country" in the Sacramento and San Joaquin valleys, California, is constantly confronted with the necessity of guarding his property against becoming sodden from excess drainage. Pumping in many cases cannot be avoided, but, though the river at high level is always above the lowest part of the land, there are many times when its surface is lower than water on the cultivated territory. Considerable expense has been saved by making use of an automatic gate that allows outward flow, but closes against high water in the river.

Two principal types are used. One of these consists of a concrete culvert under the levee, or bank, and a wooden gate swung from an overhead bar. The commendable feature of this type is that the concrete portion is permanent. Its objectionable features are that it is expensive, difficult to install on account of tides, and requires a special foundation and that the wood cover is not so sensitive as might be desirable.



WOOD GATE NOT SUFFICIENTLY SENSITIVE TO WATER-LEVEL CHANGES

Another type considerably used consists of a cast-iron gate swung from an overhead support and closing an Armco corrugated-iron pipe. This gate is said to be extremely sensitive to changes in water level, and is practically watertight when closed. If it is desirable to make the culvert pipe watertight it can be done by extra-close riveting and soldering, or by an asphalt dip. The cost of this class of installation is said to be less than half the cost of the first.

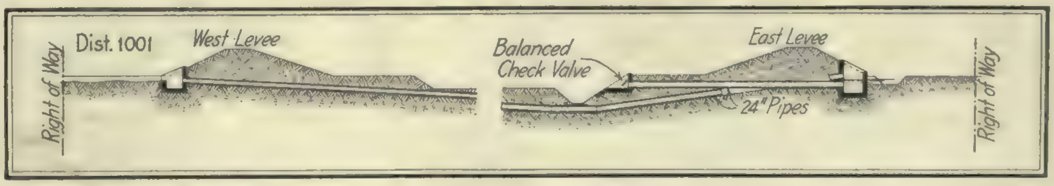
WATER FROM LOW LANDS DRAINING THROUGH INTAKE

CAST-IRON GATE ATTACHED TO CORRUGATED PIPE AT OUTLET END

USES

In Reclamation District 1001, Sacramento County, the cast-iron-gate type was used for the purpose of siphoning small drains from one side of a cut-off canal to the other, on conduits to allow excessive run-offs from the district itself to reach the drainage canal, and for the handling of water to be regulated on either side of the canal for irrigation purposes.

In handling the water from one side to the other the corrugated pipe was built into concrete basins at either end. In controlling excessive run-off water the front gate was designed to operate under very small variations of head.



SYSTEM OF DRAINS AND AUTOMATIC-GATE CONTROL USED ON RECLAMATION DISTRICT

Present New Methods of Testing and Experimental Results of Value to Civil Engineers and Contractors

Abstracts of Some of the Papers Delivered at the Nineteenth Annual Meeting of the American Society for Testing Materials at Atlantic City, June 27-30

Apparatus for Determining Soil Pressures Devised

Equilibrating Disk for Use with Air-Pressure and Electrical-Contact Indicator Gives Satisfactory Results

By A. E. GOLDBECK and E. B. SMITH
Office of Public Roads and Rural Engineering, Washington

THIS PAPER describes an apparatus for measuring the pressure under earthfills or against walls. A small cell having a thin brass, annular diaphragm is buried at the desired position, with pipe and electrical connections to an air supply and electrical equipment. Air pressure within the cell equilibrates the external soil pressure as indicated by breaking electrical contact, and the pressure is read on a pressure gage. Typical calibration results are given.

Difficulty of Problem

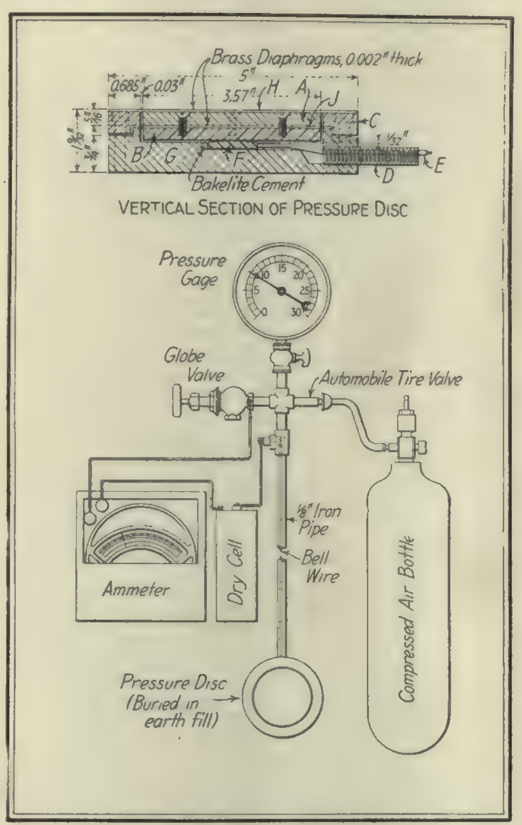
Measurement of the pressure of earth against or under a wall or other structure is rendered difficult because the location at which measurements should be made is almost impossible of access without disturbing the soil, and such measurements have not been accomplished, because no apparatus seems to have been designed for this use whose action does not have some influence on the very pressure it was constructed to measure.

In view of the fact that friction and cohesion between soil particles exist, it is evident that an apparatus employed for the measurement of soil pressure should be so constructed that no movement of its parts will take place. If the measurement requires a movement against the soil, a higher pressure than actually exists will be indicated. On the other hand, should a movement away from the soil be necessary, an indication lower than the true pressure will be obtained. The authors have therefore attempted to develop an apparatus which will measure the pressure of an earthfill with practically no disturbance of its natural conditions. In considering such an apparatus it was deemed advisable to develop the idea of a portable cell of small size, capable of indicating at some remote station the value of any pressure coming upon it.

Description of Apparatus

After much experimenting, a diaphragm cell has been developed as shown in the accompanying diagram. A cast-iron base *G* is fitted with a diaphragm *J*, held in place by the annular ring *C*. On each side of this diaphragm are disks, *A* and *B*, securely and rigidly held together by means of Bakelite cement and machine screws. These plates have an annular clearance from the ring *C* of 0.03 in., thus allowing only a small annular portion of the diaphragm *J* to be the flexible element. The diaphragm *H* served the double purpose of protection and of stiffening the plates *A* and *B* against side motion and eccentric loads. In the base *G* is placed a slightly crowned contact support *F*, held in place and electrically insulated from the base by Bakelite cement. An insulated bell wire *E* is soldered to the support *F* and passes to the outside connections through the ⅛ in. pipe *D*.

In the development of this cell an attempt was made to reduce the movement of the disk and diaphragm to the very smallest possible value. It was found that



APPARATUS TO DETERMINE SOIL PRESSURE

a movement of 0.001 in. or more against the soil fill required a very large increase in load. By the adoption of cast iron and steel in the construction, with the use of Bakelite as a cement and insulator under the contact support, and also for cementing the disks to the diaphragm, and by reducing the deforming length of the loaded parts, the elastic deformation has been reduced to about 0.0003 in. The movement necessary to break the electrical contact is not over 0.00001 in. With the present construction and type of cell it has been found easy to obtain check readings on wet and dry sand and on damp clay, without appreciably changing the load on the material.

Some Results of Tests

Tests were made to gain some idea of the maximum amount of air to be expected in the cell due to its expansion against the fill. The accompanying table shows the results.

The experience gained by the authors in the use of this cell leads them to the opinion that the methods of trial and calibration used are far more severe than any conditions that can possibly be met with in its actual use. It is, nevertheless, realized that the apparatus is capable of being improved so that it will give more precise readings, and the authors are still working toward that end. However, when the enormous variations in the condition of fills are considered it is probable that the present error of the instrument is negligible.

RESULTS OF TESTS FOR ERROR OF INSTRUMENT

Initial load on disk, lb. per sq. in.	Load on disk at breaking of contact, lb. per sq. in.	Load indicated by mercury gage, lb. per sq. in.	Error, lb. per sq. in.	Material
10.0	10.0	10.2	0.2	Damp sand, clay
15.0	15.0	15.6	0.6	Damp sand, clay
20.0	20.0	21.0	1.0	Damp sand, clay
5.3	5.3	4.7	0.5	Dry sand
8.3	8.3	7.8	0.5	Dry sand
11.0	11.0	11.2	0.2	Dry sand
13.8	13.8	14.0	0.2	Dry sand

It is intended to bury a number of these cells in a horizontal or vertical position within earthfills. One set of indicating and controlling instruments mounted in a convenient carrying case is all that is necessary for reading any number of pressure cells. The cost of each cell when made in lots of ten should be about $15 and the cost of one complete indicating and control apparatus without a case would not exceed $40.

There are a number of other uses to which the apparatus may be adapted. Thus, the pressure of concrete in forms may be determined very readily, that of ensilage in silos, the pressure of various finely divided solids in bins, and that of any material that may be slightly compressed without an appreciable increase in the pressure exerted against the instrument.

Clamped Splices Tested for Concrete Reinforcement

Investigation of Three Types Shows That Full Working Stress of Steel Reinforcement Is Developed

By E. L. LASIER
Laboratory Assistant, Bureau of Standards, Washington, D. C.

U-BOLT clamped splices of both 17 and 21-in. lengths were tested by the writer to determine the load at first slip and the maximum load the splice would resist. Three different classes of splices were tested: (1) lap splices not embedded in concrete, (2) butt splices not embedded in concrete, and (3) lap splices embedded in concrete. The steel in all cases consisted of 1-in. square cold-twisted bars.

The loads necessary to produce first slip had a range of from 7000 to 50,000 lb. The maximum loads which the splices withstood varied from 23,000 to 69,000 lb. The ratios of load at first slip to yield point of bar for clamped splices not embedded in concrete varied from 12 to 21 per cent, and

for splices embedded in concrete from 53 to 83 per cent. Ratios of maximum loads to tensile strength of bar ranged from 31 to 61 per cent for unembedded splices and from 79 to 95 per cent for embedded splices.

CONCLUSIONS

As a result of these tests it was found that (1) lap splices are stronger than butt splices, (2) splices in which the two overlapping bars are of opposite twist apparently are stronger than splices in which the bars are of like twist, (3) the lengths of lap, as to the two lengths tested, did not apparently affect the strength of the splices, (4) embedding the splices in concrete increases their strength materially, and (5) clamped lap splices embedded in large masses of concrete undoubtedly can safely withstand a unit load equal to the allowable unit stress in the steel reinforcement.

Test Endurance and Impact Strength of Metals

New Machines Devised to Apply Alternating Torsion Stresses and Impact by Shearing Unnicked Specimens

By D. J. McADAM, Jr.
Metallographer, Engineering Experiment Station, Annapolis, Md.

THE following methods of endurance and impact testing have been originated at the U. S. Naval Engineering Experiment Station. Although sufficient time has not been available to compile a very complete series of results obtained with a great variety of metals, the experiments have been carried far enough to show that the methods are of value.

ALTERNATING TORSION TEST

The testing of failed shafting and of forgings intended for use in shafting led to the idea that endurance tests by means of alternating torsion would give results of considerable value. A satisfactory machine, however, for carrying out such tests was not available until one was invented by L. E. Foster, working in the metals laboratory of the station. This machine, a modification of the Upton-Lewis type, has been used in a number of tests at the station and has demonstrated its value in determining the serviceability of metals. Alternating torsional stress is applied to one end of the specimen by an arm which is given a reciprocal motion by an eccentric attachment to a rotating wheel. The stress is measured by the movement of two springs which resist the motion of an arm attached to the other end of the specimen.

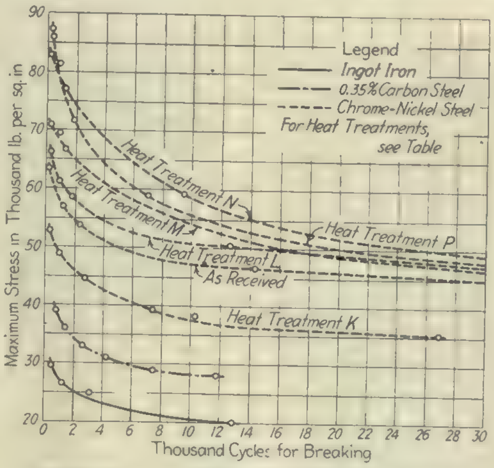
TESTS AND RESULTS

Tests have been made with plain carbon steels, alloy steels of various composition, and with nonferrous alloys. The observation of the material during test often proves as valuable in determining the quality of the metal as the numerical values obtained. Metal which contains slag or other forms of segregation soon shows cracks extending along the lines of segregation, while uniform material usually shows no crack until it breaks transversely. In longitudinal specimens the failure often starts by longitudinal cracks, while transverse specimens of the same material show no cracks until the final transverse break. Since a cylindrical test specimen 1½ in. long and ½ in. in diameter is used, plenty of opportunity is afforded to study the surface of the metal under test.

The results obtained with various kinds of steel are illustrated by the curves in the accompanying diagram. In these curves, nominal maximum stresses are plotted as ordinates and the number of cycles to break as abscissæ. Though the stresses are beyond the elastic limit, they are calculated by use of the same formulæ that apply before the limit of elasticity has been reached. The stresses are therefore merely "nominal." The chrome-nickel steel, which had received various heat treatments as noted, had the following chemical composition in per cent: Carbon, 0.30; manganese, 0.60; nickel, 3.50, and chromium, 0.70. The heat treatment given by the manufacturer was: Quenched in oil

RESULTS OF ALTERNATING TORSION TESTS

Treatment letter	Reheated to —deg. F., held ½ hr.	Cooled in	Reheated to —deg. F., held ½ hr.	Cooled in
K	1450	Furnace	....	....
L	1450	Oil	1300	Furnace
M	1450	Oil	1200	Furnace
N	1450	Oil	1100	Furnace
P	1450	Oil	1000	Furnace



RESULTS OF ALTERNATING TORSION TESTS

from 1600 deg. Fahr. and annealed at 1350 deg. Fahr. It will be noticed that the heat treatments (given at the station) for five specimens in the diagram differ chiefly in the temperature of final annealing. As this temperature is lowered the curves become higher, but their steepness is greatly increased.

A method of impact testing has been developed at the station which it is believed is free from many of the disadvantages of methods previously used. So far as can be learned by the writer this method has not been previously used. The method consists in the shearing of an unnicked specimen by impact, and the measuring of the energy thus utilized. Although this impact shear could be applied by various methods, it was applied in these experiments by means of a swinging pendulum, as in other well-known methods now in use. The residual energy in the pendulum is measured by the height to which the pendulum swings after the specimen is broken.

Although various kinds of steel were used in these tests, the specimen (⅜ x ¼ in. in cross-section) was always sheared off so as to give a smooth cut. The piece cut off showed practically no deformation. One advantage of the use of unnicked specimens is that the same specimen, about 1½ in. long, could be raised after each cut and thus sheared several times. With uniform material very consistent results were obtained in this way.

RESULTS OF IMPACT TESTS

There is no easily discovered relation between the results of impact tests and those of tension tests. For example, ingot iron with low tensile strength and high ductility gives nearly as good impact results as the chrome-nickel steel of high tensile strength and rather low ductility. The results with the chrome-nickel steel lead to the same conclusion. As the final drawing-back temperature is lowered, the tensile strength and elastic limit are raised, while the elongation and reduction of area are not much affected until a drawing-back temperature of 900 to 1000 deg. Fahr. is reached. The impact-shear results, on the other hand, drop rapidly as soon as the drawing-back temperature falls below 1200 deg. Fahr. Evidently, therefore, the impact-shear test is of value in detecting brittleness, even when the brittleness is not revealed by the ordinary tension tests.

The 0.35 and 0.5 per cent carbon steel, in the annealed condition, gave slightly lower values than those obtained with 0.1 and 0.2 per cent carbon steels. By oil quenching and tempering, however, the medium-carbon steels gave results about equal to those obtained with ingot iron. Evidently, therefore, these tests indicate that the pearlite-ferrite structure does not give quite as good impact results as the sorbitic structure, in which the carbon is more evenly distributed.

The results obtained with the nickel steel, having 0.35 per cent carbon and 3 per cent nickel, were somewhat surprising. Neither annealing nor oil quenching and tempering gave results equal to those obtained with plain carbon steels, although the tension-test results were greatly improved by the latter heat treatment. Annealing gave slightly better results than the quenching and tempering. Since it is possible that the samples used are not entirely representative, further experiments will be made before final conclusions are drawn.

The effects of various heat treatments on steel of various kinds will be investigated further and a comparison of results by tension, torsion, impact and endurance tests of various kinds will be made.

Strength the Essential in Concrete Aggregates

New Form of Specifications Offered Which Makes It Possible to Utilize Good Material Close at Hand

By CLOYD M. CHAPMAN
Engineer-in-Charge, Westinghouse Church Kerr & Company, New York City

INSTEAD of specifying that concrete aggregates, particularly sand, be of a certain fixed minimum standard of quality, which may not be attained in certain localities, it is proposed that specifications be made to read, in effect, as follows: "The materials used shall be of such quality, and shall be used in such proportions, as to produce a concrete which shall show a compressive strength of 2500 (or 2000 or 1500) lb. per square inch at the age of 28 days, when tested in accordance with the standard methods of testing."

A brief outline is given of the manner in

which this form of specification is utilized in practice by Westinghouse Church Kerr & Company and the method of checking up the quality of fine aggregates as they are received on the job, by the use of the sand tester. [See the Engineering Record of June 26, 1915, page 821, and the series of articles beginning in the issue of June 12, 1915, page 734.—EDITOR.]

ACCEPTABLE SPECIFICATIONS

To be generally acceptable, specifications for concrete aggregates should fulfill two requirements: (1) they should insure the production of suitable concrete if the aggregates are properly used, and (2) they should permit the use of materials found in the vicinity of the work, if such materials are capable of producing concrete of the required quality. The present method of specifying may insure the quality of the material, but it does not permit the use of a wide choice of aggregates from which first-class concrete may be made.

Present specifications for sand require that it shall, when tested as prescribed, show a compressive strength approximately equal to that obtained from standard Ottawa sand. A rigid adherence to these specifications would mean that in many sections of the country no concrete work could be done without importing aggregates from a distance. The result is that the specifications are ignored in those localities and the work is done without them.

On the other hand, where most excellent materials are available the present specifications for sand do not permit of variation of the proportions used, no matter how good the materials may be. Wherein lies the incentive to a contractor or builder to use any better materials than the cheapest, if he is compelled by the specifications to use a certain arbitrary mix, regardless of quality or material?

NEW SPECIFICATIONS SUGGESTED

In order to cover and include all materials which are capable of producing concrete of the quality required for the particular service it is to perform it is only necessary to specify the result required instead of specifying the materials used.

Let it be assumed, for instance, that for mass foundations and footings, for retaining walls and abutments and for similar service a concrete which has a compressive strength of 1500 lb. per square inch at the age of 28 days is suitable. For reinforced walls and matts where stresses are moderate a compressive strength of 2000 lb. at 28 days may be required, while for reinforced floor slabs, beams, girders, columns, etc., a minimum compressive strength of 2500 lb. per square inch at the same age may be necessary. By specifying the results required and permitting the use of such materials as will produce these results when tested under the specified and standardized conditions, it is possible not only properly to safeguard the products but to permit the use of such materials as are available in each locality.

In operating under such specifications it is of great importance that specimens of the concrete produced on the job be regularly made and tested. It is also of the greatest importance that a close check be maintained on the quality of the materials used, so as to insure a reasonable uniformity, and to know that these materials are at least equal in quality to the materials used in arriving at the proportions required to give the quality of concrete called for in the specifications.

The regular and systematic testing of the size of the aggregate gives data which will permit the engineer to tell without further tests whether the aggregates will produce a better or a poorer concrete than that produced by the original or standard sample. This fact is based upon the well-established principle that, other things being equal, the aggregate with a granulometric-analysis curve most nearly approaching the line of maximum density will produce the best concrete.

Among the tests made on sand are several granulometric-analysis guide charts made with a sand tester. As the sand arrives on the job the inspector makes the test with the sand tester and compares the resulting chart with the guide chart. If the results show greater variation than is permissible, the matter is taken up with the one who supplies the sand.

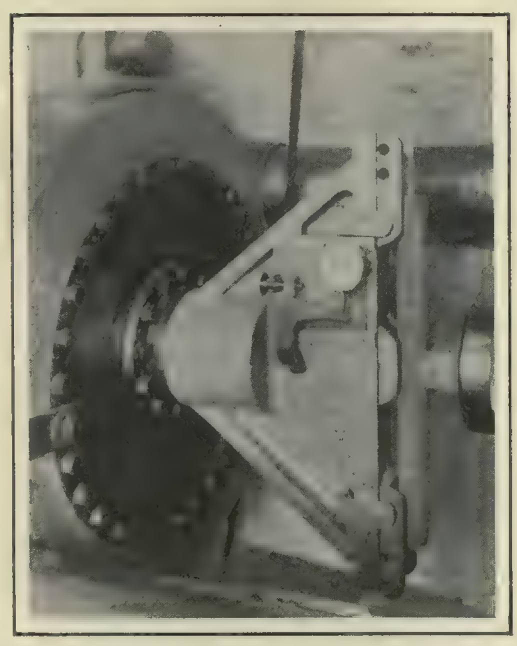
Experience with this form of specification has shown it to be advantageous in localities where the available aggregates are not up to the standards now specified.

Device Measures Deflection of Arbitration Bar

New Apparatus for Use with Emery Testing Machine at Watertown Arsenal Is Designed to Utilize Ames Dial

By H. L. MORSE
Major, Ordnance Department, U. S. A., Watertown Arsenal

THIS PAPER presents the design of an apparatus for testing the standard cast-iron arbitration bar. The deflection-measuring device of the apparatus utilizes the Ames dial by means of a thrust spindle and bell crank in such a way as to give an accurate measurement of deflection at the instant of fracture of the bar and at the same time avoid any probabilities of injury to the dial.



APPARATUS IN PLACE ON MACHINE

The problem presented was to measure, at any load or at rupture, the deflection at the center of a practically cylindrical rough casting of 1¼ in. diameter supported at both ends, with a free span of 12 in., and stressed transversely by a load applied at the center of the span. Variability of length between supporting points was made necessary for the reason that the best length of the arbitration bar might ultimately be determined to be 16 or 18 in.

DESCRIPTION OF MACHINE

The machine to which the apparatus was to be applied is the familiar Emery horizontal type. As the starting point of design was conditioned by the design of this machine, to the two pistons of which the loading and weighing elements of the apparatus must be attached, so the final as well as the intermediate character of the train of elements of the deflection-measuring device was conditioned by the choice of the Ames dial as the deflection indicator. This dial was chosen because several were available, the laboratory personnel was accustomed to its use, and simplicity, durability and sufficient accuracy seemed therein to be admirably combined.

The photograph shows the apparatus designed to meet these conditions as it appears in the testing machine, with the arbitration bar in place ready for tests.

Up to the time of writing, about thirty bars had been tested with entirely satisfactory results, with a possible exception of the behavior of the spring. A recent test of the accuracy of the deflectometer in place, using an inside micrometer against the wedge end of the spindle, showed an apparent error of 0.0008 in. in a total movement of 0.03 in. Of this error probably half was due to the flexure of the micrometer mounting. The design is such that the deflectometer is not subjected to any appreciable stress during the test, so that it is proper to assume that the error just noted is the maximum which will occur in actual use. This degree of accuracy is believed to be entirely sufficient for this character of test.

Wear of Concrete in Roads—How Tested

Tests Used for Determining Resistance of Wearing Surface Briefly Reviewed—Rattler Test Advantageous

By D. A. ABRAMS
Material Research Laboratories, Lewis Institute, Chicago

THE extensive use of concrete as the wearing surface of roads and pavements has given renewed interest to experimental studies of the wearing resistance of concrete. If weather resistance and structural stresses are properly provided for, the life of a road will depend on the wearing resistance of the material of which it is built. Satisfactory wearing resistance is one of the most important considerations of any materials to be used in road surfaces.

Numerous testing machines have been designed for use in determining the abrasive resistance of natural rock, cement mortars and brick. The following are typical of the methods which have been used: Dorry hardness testing machine; sandblast; Deval abrasion testing machine; pavement determinators, and the Talbot-Jones rattler.

EXPERIMENTS WITH RATTLER

The writer is now making studies of the wearing resistance of concrete at the structural-materials research laboratory, Lewis Institute, Chicago, in which the Talbot-Jones rattler is being used. The test pieces consist of blocks 8 in. square and 5 in.

thick, cast in metal forms made from 5-in. steel channels. They are arranged around the perimeter of the drum of the rattler.

About 200 concrete blocks have been tested in this way. The tests thus far have been carried out primarily for the purpose of studying the action of the machine. A few variations in the mix, aggregates, condition of storage of the concrete, etc., have been made, but the tests are not considered to be of sufficient scope to justify presenting the results at this time. The loss in weight due to the tests has varied from 8 to 25 per cent.

This method of making wear tests of concrete by the use of a rattler is believed to have the following advantages: (1) the concrete is subjected to a treatment which approximates that of service: (2) the test piece is of usual form and of sufficient size so that representative concrete can be obtained; (3) the test pieces are convenient to make, store and handle; (4) the cost of the tests is not excessive; (5) the machine used is found in numerous testing laboratories; (6) the wearing action takes place on the top or finished surface of the concrete; (7) several tests may be made at the same time, thus enabling more representative results to be obtained; (8) tests may be made on sections of concrete cut from roads which have been in service, and (9) other paving materials, such as brick, granite blocks, etc., may be tested in the same way.

The tests indicate that this method may prove of considerable value in studying the relative merits of different aggregates, mixes, consistencies, time of mixing, surface treatments, etc., on the wearing resistance of concrete. It can readily be used as a control test on blocks made at frequent intervals as the work progresses.

Convict Labor on Roads Not Always Economical

Convict labor under certain conditions is not economical, according to Dr. L. I. Hewes, engineer of the Office of Public Roads and Rural Engineering. This office is conducting an experimental convict road camp near Atlanta, Ga., with a view to a thorough study of the subject. It has already been found that the prevailing system of feeding the convicts involves a waste of 4½ cents per day per man in the one item of ordering supplies and disposing of waste. In other localities the methods of guarding and the expense items not charged will run the cost of convict labor beyond the value of the service performed.

Steam Shovel Removes and Loads Old Pavement and Foundation

Granite-Block Pavement Being Laid on Broadway, Brooklyn, to Replace Worn-Out Wood Block—Joints Made with Tar and Sand

MOVING forward at the rate of 400 to 600 ft. a day, despite interruptions caused by the passing street cars, a steam shovel is removing from Broadway, Borough of Brooklyn, New York City, the old wood-block pavement and 5-in concrete foundation, over a strip 11 ft. wide, and loading it on trucks to be carted away, preparatory to repaving the street with improved granite blocks.

A gang of laborers follows the shovel and removes the earth remaining to the new subgrade, 3 in. below the old. This is compacted by a 10-ton steam roller, and the new concrete, 6 in. in thickness, is placed at the rate of 137 sq. yd. an hour by a machine with a rated capacity of 100 sq. yd. an hour. In this class of paving in Brooklyn the present practice is to fill the joints with a 1 : 1 mixture of fine screened sand and tar. Labor is saved over the usual methods of making this mix with a hand-operated mixer.

MACHINE TEARS UP AND CRUMBLES OLD CONCRETE FOUNDATION

A Heavy Traffic Street

Broadway between Havemeyer Street and Myrtle Avenue, the limits of the work, is a heavy traffic street. During the working hours there is an almost continuous stream of trucks. There is also a street-car line on which cars pass every few minutes, and overhead is an elevated railway.

The steam shovel is operated by two men and equipped with a ½-yd. bucket. The boom is so placed that it can be lowered parallel to the ground and raised and rotated about a horizontal axis to load the trucks. The bucket slides back and forth along the boom and has a flap bottom controlled by a line from the engine.

Ir operation the boom is lowered to a position approximately parallel to the ground and the bucket slides back and forth along it, digging its teeth into the material to be excavated until it has its load. The boom is then raised and the load dumped into a truck standing alongside.

Concrete Broken Up by Bucket

The concrete in general is thoroughly broken up by the teeth of the bucket, though at times slabs as big as 2 and 3 ft. in diameter are picked up and dumped. The space in which the shovel works is confined on both sides and above by the elevated railroad structure and the passing surface cars. The truck loading is accompanied by many unavoidable delays, such as trucks being compelled to pull out at frequent intervals to permit the car traffic to pass and getting the shovel over street intersections where it is not desired to tear up the old pavement for the time being. Despite the delays the shovel removes and loads 600 lin. ft. of block pavement to a width of about 11 ft., or from 400 to 600 lin. ft. of 5-in. concrete foundation in an 8-hour day.

FLAP BOTTOM ENABLES BUCKET TO UNLOAD INTO TRUCK

The shovel, which was manufactured by the Keystone Driller Company, of Beaver Falls, Pa., requires, besides the engineer and fireman, a foreman and two laborers, the latter to bring up the teams and level up and lay planks under the wheels for it to travel over. It moves forward under its own power.

New Subgrade Lower Than Old

As the new subgrade is about 3 in. lower than the old, a gang of laborers follows up the shovel to remove the necessary material and level the grade preparatory to its being compacted by a 10-ton steam roller.

Following the roller comes a Koehring paver, which mixes the concrete for the new 6-in. foundation to 1:3:6 proportions and places it by means of an extension boom on which the delivery car runs. Laborers level this off and tamp it. The rated capacity of the mixer is 100 sq. yd. a day. On this work it is doing 137 sq. yd.

On top of the concrete foundation a 1-in. thickness of sand is spread, and on this the improved granite blocks, measuring from 3¾ to 4¼ in. in width, 4¾ to 5¼ in. in depth and from 8 to 12 in. in length, are laid with joints of not less than ⅜ in. and not more than ½ in. wide.

The joints are filled flush to the surface in two pourings with a mixer of fine screened sand and tar mixed in equal proportions. Both the sand and the tar are heated to not less than 250 deg. Fahr. and not more than 325 deg.

Formerly the joints in this class of pavement in Brooklyn were partly filled with small gravel, and then the tar was poured into them to fill the voids between the gravel. The method was always very unsatisfactory, because no matter how carefully the workmen were watched, the tendency was to fill the joints with the gravel so that the tar would penetrate only a short distance into the joint, giving a very unsatisfactory result.

The usual way of making this mix in the borough is by puddle, men with pails standing near the pavers and mixing the joint materials as they are brought to them.

On the Broadway work the mix is made in a machine devised by Fred Hesse, gran-

SAND AND TAR MIXTURE POURED FROM PAILS

ite paving contractor, of Brooklyn. The machine consists of a rectangular iron tank through which an axle, carrying 3-in. blades spaced 7 in. center to center, is run. The axle is rotated by one man turning a handle, connected to it by cogwheels set at right angles. The heated sand and tar are poured in through the open top of the tank and the mixed product flows out through a pipe in the front into pails, by which it is carried to the joints and poured.

Though the labor of five men is saved over the ordinary method of making the mix, the machine is unsatisfactory, in that not being connected directly to the tar heater there is danger of the material becoming chilled while being carried to the mixer. An improvement has already been perfected by Mr. Hesse, a patent for which has been applied for. This will be connected directly to the tar heater and will be operated by a gasoline motor.

The joints are poured twice. In the first pouring they are filled to the top, but contraction on cooling and gradual settlement to the bottom leave a space in the upper section. On the second pouring these voids are filled up flush with the top of the block and slightly overflowing. No working of the material or puddling is done. The two pourings complete the joint work.

The work 's being done by the Charles A. Myers Contracting Company of Brooklyn under the direction of the Bureau of Highways of the borough, of which H. H. Schmidt is chief engineer. E. D. Rhame, division construction engineer, is directly in charge of the work.

Cheap Devices Used in Reconstructing Truss Bridges Eliminate Costly Centering

Two Problems Analyzed in Detail Show How Warren Double Intersection Truss and Pettit Truss Highway Bridges Were Strengthened

By E. J. DOYLE
Consulting Engineer, Albany, N. Y.

HOW to devise economical methods for making repairs or strengthening existing bridges is often a difficult problem. In many cases the outlay necessary to put the bridge into proper condition safely to sustain the increasing live loading, especially on highway spans, is so high that the work is postponed until economical repairs become impossible. By eliminating the relatively high cost of centering, a large saving can be obtained. Simple erection devices, with careful computation of the existing stress and well-planned operations in changing members, making connections and strengthening splices will be described by two typical examples, showing an estimated saving of $4,800 and $2,700 respectively.

ANALYZING A PROBLEM

Consider the case of an ordinary riveted truss bridge, with plank roadway and sidewalks, that has been in use for a period of fifteen years and is in need of repairs. A careful examination will disclose that the lighter members, such as diagonals and wind braces, are rusted away to a considerable extent at their contact points with the floor, gusset plates or other places where dirt and moisture lodge. The chord members will be found to be deteriorated to the greatest extent at connection points, such as splices, gusset and batten-plate connections and where pockets exist.

The actual amount of metal lost may be small and yet the effective cross-section will be seriously reduced. The structure as a whole may be in a fair state of preservation, and if the defective members could be reinforced or replaced at a reasonable cost per pound for new metal, repairs would often be promptly made; but it often happens that conditions under the bridge are such that the cost of a system of falsework would be as much as 25 per cent of the cost of a new bridge and therefore nothing is done.

REPAIRING WITHOUT FALSEWORK

The writer has repaired several structures such as described above and has found that it pays big dividends in the form of money saved to analyze a repair problem with as much care as would be taken in the design of a new bridge. A case in point was the repair of the Rensselaer Street viaduct at Troy, N. Y. This structure carried traffic from a city street and was located over the terminal yards of the Boston & Maine Railroad. It consisted of a two-span double-intersection through Warren truss with riveted connections. The longest span is shown in outline in Fig. 1.

The reconstruction plans called for the replacing, in whole or in part, of all diagonals and the reinforcing of the lower chords with heavy plates, which were to be riveted to the face of the channels. Before reconstruction work was started a careful examination was made of all truss members, the least effective section of each being determined and tabulated in a table. The strength value of each member was computed and tabulated, a unit tensile value of 15,000 lb. being allowed. Stresses due to dead loads, with roadway pavement and base removed, were computed on the assumption that each web system would take all the loads and that only one system would be loaded at a time.

To allow the replacing of web members, provision was made for removing one entire system of diagonals at one time by relieving it of any load. This was done by setting up saddles, shown in Fig. 1, over the upper-chord panel points of the B system, and throwing loads from the A system into the B system by drawing up on the

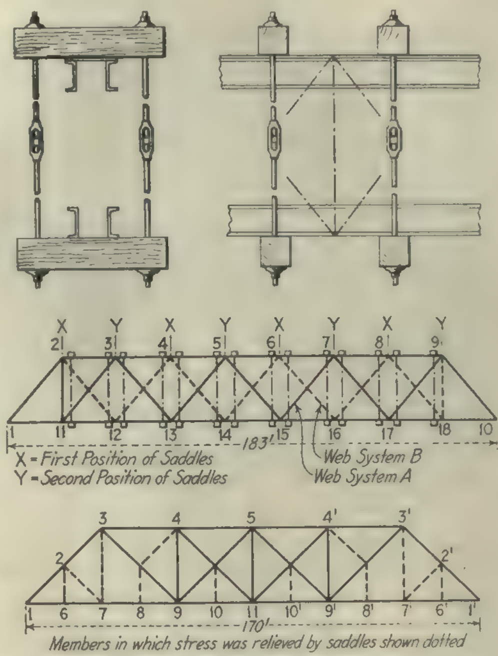


FIG. 1—DOUBLE INTERSECTION WARREN TRUSS, WITH DETAILS OF SADDLE

turnbuckles. The A system members were then cut out and replaced, after which the saddles were released, set up over the upper-chord panel points of the A system and drawn up, throwing the B system loads into the A system. The B system members were then cut out and replaced. The hardwood timber was used in the saddles. The bars were upset, with a nut on each end, and the turnbuckles were placed to come about 3 ft. above the floor line. As but one truss was repaired at a time, saddles were required for only one system.

The reinforcing plates that were placed on the face of chord channels necessitated cutting away the rivets of the diagonal and splice connections. This work was made possible without shoring by the method illustrated in Fig. 2. Pins about 1 ft. longer than the out-to-out spacing of the chord channels were made of shaft steel, slightly tapered for a distance of 2 in. from each end and of a driving-fit size.

In placing the reinforcing plates at the diagonal connections, opposite rivets in pairs were cut out and a pin driven in their place, another pair of rivets cut out and replaced with a pin, this being repeated until all rivets were replaced with pins except that a few rivets were replaced with bolts to secure the connection temporarily. The

reinforcing plates were then put in place over the ends of the pins, drawn down close with bolts, and one pin at a time backed out and replaced with rivets until the connection was riveted up.

Reinforcing Spliced Joints

The general method of placing the reinforcing plates at the chord splice points was the same as described for the diagonal connections, except that it was necessary to remove the old splice plates *a*, Fig. 2, to allow the new reinforcing plate to come into contact with the face of the chord channels. Before any pins were driven, new splice plates *b* were put in position as shown, about 3 in. from the back of the channels, to allow the backing out of the rivets. A pair of rivets was then cut out and replaced with a pin driven through the new splice plates, the operation being repeated as described in the former case. The new splice plates *b* were then drawn down to the back of channels with bolts, the old splice plates *a* removed, the reinforcing plates put in place over the ends of the pins, the old splice plates replaced on the outside of the reinforcing plates, the pins backed out one at a time and the connection riveted up.

Before this method of repairing was adopted a study was made of the ordinary method of centering, but due to the fact that the structure was located over the railroad yards at a point where several crossovers existed and where very little accommodation for supports could be had, its cost would be excessive. An estimate indicated that a system of centering would cost about $5,000.

The cost of materials used for saddles and pins was $76, and the cost of manipulating them was about $125, so that the total cost of supporting by the method adopted was about $200, as against an estimated cost of $5,000 for the ordinary method of centering. The work was carried on without a mishap or difficulty of any kind, and it is believed that the repair work was done in less time than would have been required to construct a system of centering.

Application to Heavy Pettit Truss

Another instance where the principle of supporting without the use of falsework was adopted was in connection with a heavy

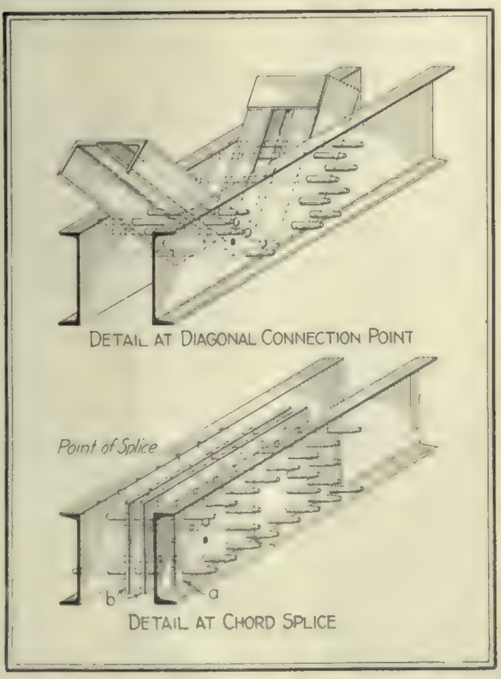


FIG. 2—DIAGONAL JOINT AND CHORD SPLICE DETAILS

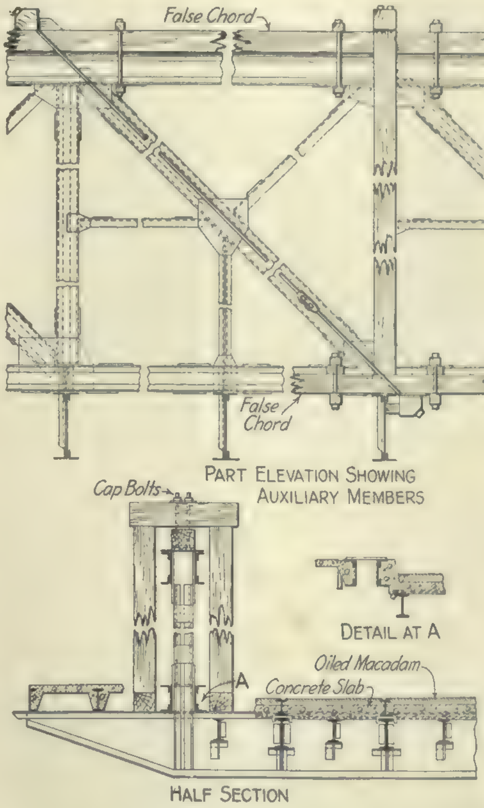


FIG. 3—PETTIT TRUSS, WITH DETAILS OF AUXILIARY MEMBERS

Pettit through riveted truss that was to be repaired and reinforced to carry heavier interurban electric car loads than those for which the bridge was designed. An outline of the truss and typical details are shown in Fig. 3. The bridge had a single span of 170 ft., a 24-ft. roadway and two 6-ft. sidewalks, with two lines of electric-car rails in the roadway.

The reconstruction plans called for reinforcing all chord and end-post members and also web members 3-7 and 3-9 with plates, all other web members to be removed and replaced with heavier sections. The floorbeams were to be reinforced and the track stringers replaced with heavier sections, as well as other work that need not be mentioned here because not a material consideration in the centering problem. Because of the increased live load and an increase in the dead weight of steel work, the macadam pavement was replaced with 1½-in. asphalt and the slag concrete base with 5-in. crushed stone with heavier reinforcement.

Before the reconstruction work was started all truss members were examined, the least effective section of each determined and its strength value computed. Stresses due to dead loads with pavement and concrete removed were computed. Stresses due to concentrated loads which would be necessary to bring the shear in any main web member to zero were computed, and the sections, least effective areas, strength values, maximum loads due to any combination of loadings, etc., were tabulated.

Web Members Relieved of Stress

The web members were relieved of stress by two methods, some by one method and some by a combination of the two. The dotted members, Fig. 3, were relieved of stress by the saddle arrangement shown, and the main web members by eccentric ballast loading, which created a zero shear and therefore a zero stress in the member to be removed. In applying the principle of eccentric loadings to relieve stress, however, the stress was not brought to zero by the loadings, but the last 10 per cent was relieved by the saddle and false-post arrangement shown. This was done so that any section of the truss would not be in an unstable condition, which would be the case should the loadings be finely balanced to create a shear of absolute zero.

The secondary web members were relieved of stress in a group. Thus saddles were hung from 3 to 6 to relieve members 2-6 and 2-7, from 3 to 7 to relieve members 3-7, from 3 to 8 to relieve members 4-12 and 12-8, and from 4 to 10 to relieve members 13-10. The members when free of stress were cut out and replaced or reinforced as required. The main web members were of necessity relieved of stress, removed and replaced singly or in pairs of the same panels. Thus, to relieve members 3-9 and 4-9, ballast was concentrated at points 7 and 9 in such quantity that the shear in 3-9 and 4-9 was reduced to 10 per cent of its original amount. The saddle and false post shown in the figure were then put in place and the stress in the members brought to zero by drawing up on the turnbuckles of the saddle rods and by screwing down the nuts on top of the post caps.

The ballast was made up of cement sacks filled with fine gravel, to weigh 100 lb. each. The weight of ballast that would be required was computed in advance and tabulated in a table, care being taken not to load any member in excess of its computed strength value.

Reinforcing the Splices

The reinforcing plates that were to be placed on chords and end posts were put in place by the same general method as has been described for the double intersection Warren truss and as shown in Fig. 2, except that the splices were made with double splice plates. The procedure is illustrated in Fig. 4: 1 shows a chord section with old splice plates *a* and *b*; 2 shows pins driven in the place of rivets and old splice plates *a* removed; 3 shows new reinforcing plate *c* in place or ready to place, new and longer splice plates *d* in place and bolted at the ends or ready to place. The old splice plates *b* are then backed away from the channels, and 4 shows the pins backed out and replaced with bolts, the old splice plates *b* left free; 5 shows the new splice plates *e* in position clear from the backs of the channels and pins redriven, after which the new plates *e* are closed in to the backs of the channels, and 6 shows the pins again backed out and rivets driven in their place. The chords were made up of plates and

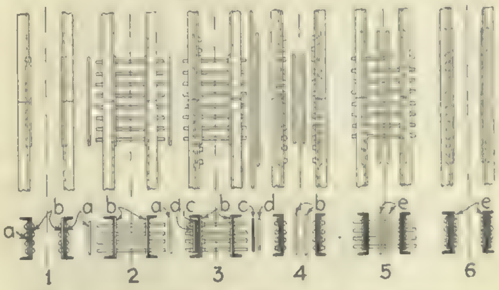


FIG. 4—SUCCESSIVE STEPS IN REINFORCING SPLICE IN CHORD

angles, but to permit a clearer illustration, channels are shown in Fig. 4, and the top and bottom splice plates are not drawn.

As shown in Fig. 3, false chords were employed to take up the horizontal components of the stresses in the saddles. The false chords, which were of long-leaf pine, were placed over the whole length of the

chords and were secured by blocks and bolts as shown. The blocks of the saddles were of hard wood, the saddle rods being upset at the ends. Only such number of saddles and falst posts as were necessary for one operation were made, being moved as required. False chords were made for but one truss, and reset for the second truss.

APPROXIMATE RELATIVE COSTS

The method of relieving stress by eccentric ballast loading worked out with entire satisfaction, but a few minutes being required in any case to place or remove the ballast. No exact data were kept of the cost of material in the auxiliary members or of its manipulation, but an approximate estimate made up from general cost sheets indicated that the supporting members were made and manipulated at a cost of less than $800. A system of falsework could not have been constructed for less than $3,500.

The only objection that the writer can see to employing the methods described is that the chord and end-post members were under partial stress when the reinforcing plates were added to the section. The old metal was therefore of necessity stressed higher per unit of section than was the new metal when the work was completed and under full live and dead loads. This is not believed to be a serious objection, as stresses at the time that repairs were made were not more than 20 per cent of the stresses under full loads. The difference in unit stress between old and new metal was anticipated and provided for in the form of an increase in the section of new plates, so that the maximum stress in the old metal would not exceed a reasonable limit. The increase in new section to take care of the inequality of unit stresses was a small item in comparison with the saving effected by the elimination of centering.

The principle of supporting trusses without falsework has been adopted in several other cases, the details being changed when necessary to adapt it to different types of truss. In one instance several diagonals of a light country bridge were removed and replaced entirely by the aid of ballast loading.

It is hardly necessary to say that the methods described require a careful analysis of stresses and strength of members, a careful detail of supporting members and the constant attention of a competent bridge engineer.

Special Tile Holds Reinforcing in Storage Building

U-Shaped Grooves in Tile for Reinforcing Rods —Cost of Construction with Tile and Concrete Is Exceedingly Low

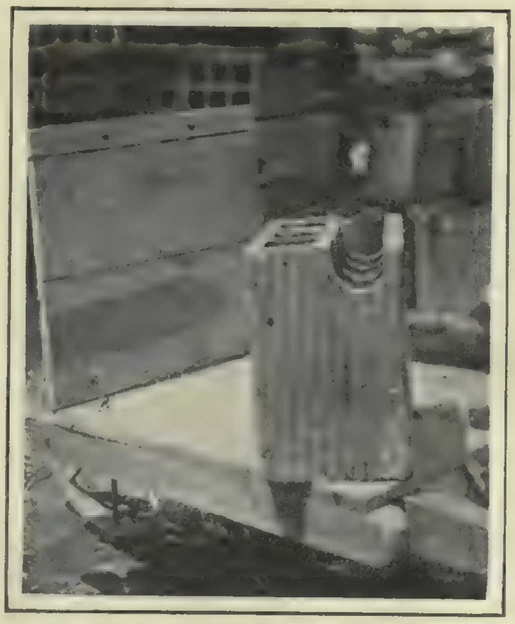
NEW construction methods have been used to reduce the cost of cottonseed storage buildings in the South. By using tile in which there is a U-shaped groove for holding reinforcing rods, the boiler plate originally specified was replaced at a saving in steel which reduced the construction cost to $3.50 per ton of material stored.

The two buildings are each 75 ft. in diameter and 60 ft. high, having a total capacity of 7000 tons. The floor is of concrete. The foundation extends about 3 ft. below the surface, resting on heavy clay. The special construction of the tile is shown in the illustration. Corrugated steel bars placed in the U-groove are held in place with concrete. Wet, heavy cinders are placed in the tile

BUILDINGS ARE 75 FEET IN DIAMETER AND 60 FEET HIGH

to keep the concrete around the rods. In the first 25 ft. of tile two ½-in. bars are placed in the grooves; in the next 25 ft. a ⅝-in. bar is used. In the top 10 ft., ½-in. bars form the reinforcing. The bottom 10 ft. of wall has two thicknesses of tile, and above that point one thickness is used.

The cottonseed is put into the buildings at the center of the top, thus making a cone-shaped pile, tending to decrease the danger of the walls bulging out. An A-frame steel tunnel runs through the center on the bot-



SPECIAL TILE HOLDS REINFORCING IN U-SHAPED GROOVE

tom of each building, in which a conveyor will be placed to remove the seed.

W. W. Griffin, of the Griffin Construction Company, Atlanta, Ga., the designer, is constructing two of this type of cottonseed storage buildings in Atlanta for the Buckeye Cotton Oil Company. Eight buildings of almost similar construction are being built for the Swift & Company's mill at Augusta.

Railway Income Continues Upward Climb in April

Gross operating revenues for April on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were $1,223 per mile, showing an increase of $210 or 20.8 per cent as compared with April, 1915. Operating expenses were $827, an increase of $103 or 14.3 per cent. Net operating revenue, therefore, was $396—an increase of $107 or 37.0 per cent, and operating income was $342—an increase of $102 or 42.3 per cent.

Brick Pavement Carries 4492 Vehicles a Day

Driveways at Pennsylvania Terminal in New York City Show Little Effect of Wear After Seven Years in Service

A TRAFFIC census taken over a seven-day period, from May 22 to 29, at the two driveways to the Pennsylvania Railroad terminal in New York City shows that an average of 4492 vehicles a day pass over the pavement at the Thirty-third Street entrance and 3384 over that at the Thirty-first Street entrance. The pavement was laid in 1910 and at the present time shows very little effect of wear.

OBSERVATIONS CONTINUOUS

The observations were taken under the direction of D. O. McComb for the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, and were continuous throughout the period between midnight May 22 and midnight May 29.

Attention was paid to the possible effect of special events on the accuracy of the traffic count as a true daily average. It was found, however, that in a city the size of New York the special event is the rule rather than the exception, and has much less effect on a traffic census of the kind than would be the case in a smaller city.

A feature of the census was the large proportion of taxicabs using the pavements. At Thirty-third Street 75 per cent of the vehicles were taxicabs.

All kinds of motor traffic spread out evenly over the driveways, while horse-drawn traffic kept close to the sides. The effect of the latter on the surface is noticeable at the curb, where a groove from ⅜ to ½ in. deep and about 2½ in. wide is worn into the pavement, caused by the locked wheels of the wagons going down the incline.

The traffic on the Thirty-first Street side is more diverse in character than that entering the Thirty-third Street entrance, the latter being principally taxicabs and the former carrying all the incoming baggage, express and only a small proportion of the passenger traffic.

167 TAXICABS IN AN HOUR

In one three-hour period, May 27, a total of 501 taxicabs entered the station—an average of 167 an hour. The average number of taxicabs a day reached 886, each passing twice over the pavement.

The count was taken of the vehicles going in. As these had to pass over the same road going out, the number was doubled to obtain the actual vehicular traffic passing over the roadway. The total daily vehicular traffic at the Thirty-first Street entrance was 3384 and that at the Thirty-third Street entrance 4492. The traffic at the Thirty-first Street entrance was constituted as follows: 42 rubber-tired carriages, 16 rubber-tired wagons, 700 steel-tired wagons, 1772 taxicabs, 617 automobiles and 236 motor trucks. That at Thirty-third Street was made up of 51 rubber-tired carriages, 417 steel-tired wagons, 3391 taxicabs, 496 automobiles and 135 motor trucks.

The pavement was laid in 1910, the bricks being bedded in cement mortar mixed 1:3. They are of fireclay made at Clearfield, Pa. On the inclines they are 7¼ x 2¼ and 2⅜ in., with beveled edges and no lugs. They were carefully laid and separated so that the mortar or grout could readily be placed in the joints.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

How Engineers Can Best Serve in the Mexican Emergency

SIR: I have been in receipt of numerous inquiries from engineers as to how their services could best be utilized in the present emergency along our southern border, and I have generally answered that the best service engineers can render at the present time is to join one of the engineer regiments of the National Guard, of which a large number must be raised to complete the engineer quota of the twelve infantry divisions of the National Guard.

I send this information to you thinking that it may be of interest to your readers.

W. M. BLACK,
Chief of Engineers, U. S. Army.
Washington, D. C.

Unprecedented Demand for Men

SIR: During the past winter and spring the demand for young men trained in technical schools has been unprecedented. Even during the winter months the call continued unabated, which is very unusual, because as a rule the demand is great only in the spring and summer months.

The civil engineering department of Lehigh University reports that between the dates of Sept. 1, 1915, and June 15, 1916, 119 companies or individuals asked for young men to fill either permanent positions or positions during the summer vacation of 1916. In all, these 119 applicants sent in requests for 392 men.

The accompanying table shows the principal branches of industry from which the applications came. For example, from twenty-one contractors and builders and others engaged in similar constructive work came applications for thirty-seven men at various times during the period under discussion. The young men wanted in this group were for the construction of buildings, both of the ordinary type and of concrete or steel, or they were wanted for the construction of various engineering works.

The table also shows that twenty-two manufacturing companies made requests for ninety-nine men, some of whom were desired for permanent positions and some for temporary work during the students' summer vacation. Under this class of companies are included those manufacturing steel, cement, castings, chemicals, machinery for handling materials, ventilating machinery and ammunition.

SUMMARY OF APPLICANTS FOR MEN

Types of industry	Number of companies applying for men	Number of men wanted
Machine shops	6	60
Manufacturing	22	99
Construction, including contracting and building	21	37
Valuation	7	81
Surveying	10	21
Engineering with railroads and other corporations	30	68
Engineering with consulting engineers	10	10
Teaching; high schools and colleges	8	8
Sales engineering	5	8
Total	119	392

Reference to the table shows that seven companies sought eighty-one men for making valuations and appraisals. Among these are included several railroad and telephone companies. The demand from railroads for assistants has been and is very great, and as the initial salaries paid by these corporations are generally small it is difficult at the present time to get young men to enter railroad service. Some of the applications shown in the table under the headings of surveying and valuation, as well as under engineering with railroads and other corporations, are from railroad companies.

A few of the larger railroad companies, finding it difficult and even impossible to secure assistants at the low salaries they were offering only a few months ago, have, in common with most other employers, increased the initial salaries for men just leaving college.

It appears that the present demand for young engineers may continue for a long period of time for three reasons:

1. Because of the prosperity in the United States.

2. Because many engineers trained in Europe and working in this country before the war started have left the United States, South America and Africa to enter military service in Europe. Moreover, the technical schools of Europe are not now in session, and have not been for about two years, and hence cannot supply young engineers for several years to come. American engineers will be called upon to do most of the engineering work of the Western Hemisphere without competition from men trained in the technical schools of Europe, as was the case before the present war.

3. Because about the years 1909 and 1910, when the supply of young engineers exceeded the demand, there was in general a material diminution in students entering civil engineering courses, in consequence of which classes graduating now are very small. This movement has probably gone too far, thus creating a shortage in the supply. The writer believes that as a result of the present scarcity of young engineers there will be a marked increase in the number of students entering civil-engineering courses during the next few years.

The average salary of the men graduating from the civil engineering department of Lehigh University in June, 1916, was between $75 and $80 per month at graduation. Among the employers of these men are to be found the New York State Highway Department, three bridge companies, several contractors, a company building coke plants, two railroad companies and several manufacturing plants. Most of the members of this class of 1916, possibly 90 per cent, desired to enter work on construction.

FRANK P. MCKIBBEN,
Professor of Civil Engineering, Lehigh University.
South Bethlehem, Pa.

Concrete Pavement 18 Feet Wide Has Inverted Crown

SIR: I am inclosing a photograph of street-paving work at Vernon Heights, Cedar Rapids, Iowa. The specifications on this work call for a 6-in. one-course concrete, mixed 1:2½:4.

INVERTED CROWN FOUND EFFECTIVE FOR CONCRETE PAVEMENT WITH NO CURB

The pavement has an inverted crown, is 18 ft. wide and is designed to carry the water in the center of the pavement. Inverted pavements of this type do not seem to be advocated very strongly, but the completed picture shows the advantage of an inverted pavement where no curb is used.

F. W. GREENE,
Resident Engineer, The Anderson Land Company.
Cedar Rapids, Iowa.

Proper Basis for Allocation of Maintenance Expenses

SIR: I have been very much interested in the article of Paul M. LaBach in your issue of May 13, 1916, page 639, regarding the proper basis for allocating railroad maintenance-of-way expenses. In these analyses he has called attention to two important points that I would like to emphasize:

1. The necessity for an accounting system that is so arranged with the analysis in mind that the necessary allocations may be reduced to a minimum. There are some accounts that from their nature have to be allocated. There are other accounts that under present conditions have to be allocated simply because the expenses applying to the two classes of service have not been

kept separate. One of the fundamental reasons for a classification of accounts is that it will make possible a suitable analysis of the cost of service. Therefore the requirements of the analysis should be kept clearly in mind in the arrangement of the classification, and suitable accounts should be provided to take care of expenses that are substantially different in their nature.

2. Mr. LaBach has not at all exaggerated the costs of maintaining the track and roadway that have nothing to do with the traffic carried. The smaller the road the greater is the proportion of the expenses that do not vary with the traffic handled.

The division of the maintenance-of-way expenses that do not vary with the traffic presents the greatest difficulty in the whole problem of the division between passenger and freight service. It does not seem logical to divide the expense equally between the two classes of service just because there are two kinds of service. In the case of a road where only one-tenth of the traffic is passenger and nine-tenths freight, a method that would charge half of these expenses to passenger and half to freight could surely not be justified.

To all intents and purposes these expenses are similar in their nature to the expenses due to the investment. The method that is suitable to assigning the investment and the expenses due to that investment, such as depreciation, taxes, renewals, etc., is best suited to the allocation of the maintenance-of-way expenses that do not vary with the traffic.

Having made this assumption as a starting point, the next step will be to determine the best method of assigning the investment in the track and roadway. I do not imagine that Mr. LaBach would be satisfied to assign the investment equally between the passenger and freight just because there are two classes of service. In the case referred to previously, where one-tenth of the traffic is passenger and nine-tenths freight, such a loading of the passenger traffic by assigning to each kind of service half of the investment in roadway and track would make impossible any payment of the costs by the passenger business, and would be unreasonable.

In order properly to assign investment or expense, the cause for that investment or expense must be found. When the cause is determined, then the assignment can be made intelligently. The promoters of a new railroad make detailed studies of the traffic that may be secured in the territory under contemplation. They make estimates of the amount of freight traffic and the amount of passenger traffic likely to develop. If the amount of the two combined traffics justifies the building of the railroad, the investment is made in the railroad in order to get the traffic. The traffic is the reason for the investment. Therefore the traffic in the two classes of service must be compared.

A common unit for the comparison of passenger and freight traffic involves the considerations not only of the physical units by which the traffic is handled, but also the income from the traffic, after the direct expenses of handling the traffic have been deducted from the gross earnings on that traffic.

The ton-mile is not altogether satisfactory as a unit for comparison of freight and passenger traffic, because in the passenger business it does not measure the service rendered. The train-mile is unsatisfactory because of the great difference in the relative values per unit.

In a recent analysis of an interurban electric property I made a study of the relative earnings per car-mile for passenger and for freight. In this special case the gross earnings per car-mile were found to be slightly more for freight than for passenger. But when the expense pertaining to each class of traffic was deducted from the gross earnings of that class, the amount remaining which can apply to the payment of the common expenses of maintenance-of-way, to the payment of taxes, fixed charges, etc., was found to be almost exactly the same per car-mile for passenger traffic as for freight traffic.

Under these conditions, then, there is no question that the car-mile is the best unit for the division of the investment in track and roadway between passenger and freight, of the expenses due to that investment and of the joint maintenance-of-way expenses not directly due to traffic.

Mr. LaBach's suggestion as to maximum loads or stresses being a better measure of the use of the railroad structure might very well apply to a certain part of the railroad structure, but its use would be limited to certain parts of the structure which are a comparatively small part of the total. For instance, if certain bridges had to be designed for high-speed passenger trains, the passenger traffic ought to be weighted with the difference between the cost of the structures as built and what the cost would be for slow-moving freight. But a refinement of this kind applies to such a small proportion of the total that there is danger of over-emphasizing the importance of it compared with the main question of the assignment of the property and expenses common to both classes.

JOHN A. ROCKWOOD.

Portland, Ore.

Present-Day College Education

SIR: Having read editorial contributions published in your paper of late on "Present-Day College Education," and having differed with some most decidedly—particularly the ten summary paragraphs of Professor Swain's reply to Professor Mead's criticism in the issue of May 6 and the communication of T. Chalkley Hatton in the issue of June 10—it is my motive to take issue with Mr. Hatton in his efforts to discredit college training of young engineers.

In a desire "to test the applicant's ability to interpret specifications in a common-sense and accurate manner" the examiner of candidates for positions as paving inspectors asked them to define the word "pacificist" and also to name the states bordering Mexico. Because one or two of these men happened to answer ridiculously Mr. Hatton concludes in his third paragraph that "certainly these young men had not attained that thoroughness and accuracy in their college education which fitted them to fill satisfactorily the simplest engineering positions. They were not taught to think straight."

"Not having a set of specifications at hand," it is stated, "the examiner, in order to test the applicant's ability to interpret specifications in a common-sense and accurate manner," asked such questions as the meaning of words and questions on geography. Who is the more ridiculous—the examiner or the examined? Was the examiner not testing the strength of their grammar-school training, and is it not illogical to conclude that this lack of knowledge was due to a deficiency to be laid at the door of the college? The examiner must have been very limited indeed if, for lack of specifications, he should be forced to ask such questions. Would not a few original problems in mathematics or mechanics, or a few questions as to the method of procedure they would adopt, given certain imaginary conditions arising in the field, or the like, have really tested the probability of their fitness "to interpret specifications in a common-sense and accurate manner"? It is not contended that the answers were pardonable, but those answers in no way affect a man's fitness as a paving inspector.

Another feature of Mr. Hatton's citing this incident is that he is willing and eager to attempt to drag a multitude of young engineers down to the level of one whose grammar-school education was found to be lacking.

Mr. Hatton says "they were not taught to think straight." Should a candidate answer a great number of that type of questions correctly, does that not indicate accuracy of *memory* rather than accuracy of *thought?*

Summit, N. J. AUSTIN H. REEVES.

Pump Delivered Quickly for Camp Whitman Water Supply

SIR: It has occurred to us that it probably would be of interest to your readers to learn of the facility with which we were able to furnish the necessary pumping equipment for providing the soldiers at Camp Whitman, N. Y., with the necessary water supply.

On June 23 one of the officers of the Twenty-second Corps of Engineers telephoned our New York office requesting that one of our representatives come to Camp Whitman and confer with them regarding the pumping equipment which would be required.

The writer spent Saturday, June 24, at the camp, and, after going over the situation thoroughly, it was decided that a centrifugal pump, to deliver 325 gal. per minute against a total head of 230 ft. would meet their requirements in all respects.

I telephoned our shop, the American Well Works, Aurora, Ill., at about 2:30 or 3 p. m. on Saturday and arranged with them for the shipment of one of our No. 3½ type I belt-driven, two-stage, solid shell, open-impeller, centrifugal pumps. This pump was delivered to the camp officials at Poughkeepsie at about 9 p. m. Sunday, June 25, and, according to the newspaper report, reached Camp Whitman at Green Haven, N. Y., before daylight on Monday, June 26.

S. B. WHINERY,

Eastern Sales Agent American Well Works, New York City.

[This letter adds an interesting detail to the article, "With the 22d Corps of Engineers at Camp Whitman," published in the Engineering Record last week. From the information it contains it is apparent that the wells upon which reliance was placed for the camp supply did not meet expectations as to flow, and that the alternative source, noted in last week's article, Fishkill Creek, is being utilized. The water from this creek is being sterilized with liquid chlorine.—EDITOR.]

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Put Mixer on Roof to Add Eleventh Story

TO AVOID confusion on the street and in the basement of the ten-story department store of Rothschild & Co., in Chicago, the concrete for a portion of an additional story was mixed on the adjacent roof. The spectacle of a mixer far above ground grinding out concrete, with the Auditorium tower and the top of the Blackstone Hotel as a background, was more or less of a novelty. In getting the aggregate from the street to the mixer advantage was taken of portions of the coal-handling equipment and the freight elevator service.

The building was constructed several years ago and the modern steel frame was designed to carry additional stories when expansion became necessary. The additional story is at the south end, 176 ft. on State Street and 144 ft. on Van Buren Street. As the street walls extend a considerable distance above the existing roof it was only necessary to construct a new roof and floor, which required 14 columns, 95 beams and 22 girders, all of concrete. This work and the new roof were built before attempting to replace the old roof with a concrete floor.

The equipment of the building, in addition to an extensive passenger-elevator service, includes two large high-speed freight elevators, which travel from the third basement to the tenth floor. One of these elevators has a capacity of 10 tons. In the third basement are several elevator hoppers connected by chutes with the ground surface in the rear alley. The gates discharge coal for the furnaces into a traveling bucket. It was decided to use several of these hoppers for handling the sand and stone in the new construction work. Material was delivered in 6-ton auto trucks and dumped down the chutes into the hoppers, from which it was gated into wheelbarrows. The large elevator carried nine loaded wheelbarrows and the smaller one five to the tenth floor at each load. An inclined runway was built from the tenth floor to the roof, and all material used in the concrete and the new construction work was transported from the tenth floor up this runway.

On account of its light weight and portability the contractors used a motor-driven 8-ft. Standard low-charging mixer, which was taken up the large elevator to the tenth floor and then transported up the material runway to the roof.

The work was carried out by the Clark-Bisbee Company, of Chicago.

Accounting for the Contractor: Equipment Account

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company, Scranton, Pa.

A LEDGER account may be kept for the portable equipment of each job, but ordinarily a more convenient method is to run only one account, which for the sake of brevity we will call "Plant." Portable plant, being shipped about from job to job, is rather difficult to keep track of unless some definite, easily operated system is employed. A card record supplies the simplest solution. Cards measuring 3 x 5 in. are the standard size, fitting the box files or drawer units handled by most dealers in office supplies. If economy demand that for a time such records be kept in a pigeonhole of the desk, or even in a pasteboard box, at least be sure a start is made with the proper-sized card, so that all the matter will not have to be rewritten later. Index cards can be procured with ¼-in. tabs.

To demonstrate, let us list the equipment of our fictitious friends Messrs. Arnold, Brown & Co. On the first tab will be written "Bridge No. 4," to indicate that the following cards serve to list the equipment on that job. Following out here the alphabetical idea, the first cards after the index card will read somewhat as shown in the accompanying samples. Others will follow till the list of equipment at Bridge No. 4 is complete.

Then on the tab of another index card will be written "Corfu," and following that will come the cards descriptive of the Corfu plant, and so on till the entire plant is recorded and indexed. When additional equipment is purchased, the invoice or bill of sale will be approved, entered and filed as suggested in a previous article of this series, and charged to "Plant"; at the same time a descriptive card will be prepared and placed in the index. Now, when the Bridge No. 4 mixer is moved to the job at Leeds the card is moved along, too, after noting thereon the date on which the change was made.

The plant account should be kept at cost, until such time as a complete revaluation becomes necessary. In the meantime annual depreciation should be balanced by en-

BUCKET
1 Special No. 10—cost $90.00
Bought Aug. 1, 1914 of
Dayton Supply Co.
for Acton work
Transferred Jan. 5, 1915 to Portland
" Sept. 10, 1915 to Bridge No. 4

DERRICK
1 Stiff-leg, 22' mast 38' boom
Bought Sept. 1, 1915, second hand, of
Smith & Co. for $120.00
for Bridge No. 4

MIXER
1 Burke Gasoline Concrete Mixer
Bought Feb. 12, 1915, of D. E. Francis
for $800.00
for Portland work
Transferred Sept. 10, 1915 to Bridge No. 4

MIXER ON ADJOINING ROOF ADDS ELEVENTH STORY TO CHICAGO DEPARTMENT STORE WITHOUT INTERRUPTING BUSINESS ON FLOORS BELOW

tries to the credit of "Reserve for Depreciation," as will be explained in a subsequent article.

Small tools, such as shovels, picks, crowbars, hand drills, etc., should not be carried in the plant account, but charged to the expense incident to each contract. Should there be any salvage at the conclusion of the job, the job can be given credit at an appraised valuation and a corresponding expense charge made against the next contract on which such tools or left-over supplies may be used.

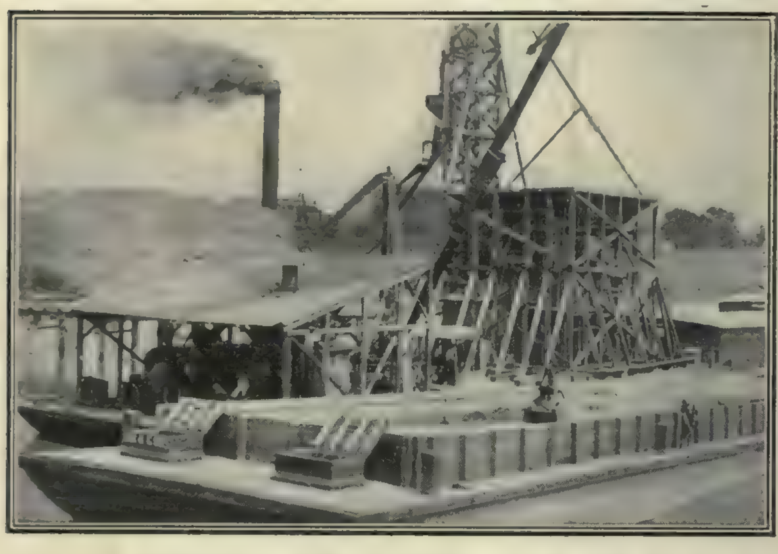
Tower and Derrick on Same Boat in Concrete Plant for Bridge

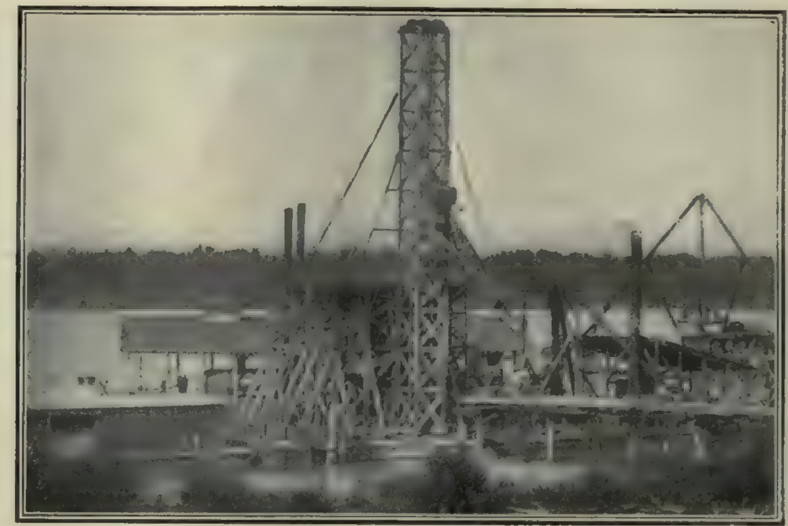
By A. FREDERICKSON
Metropolis, Ill.

THE FLOATING mixing plant used to place concrete in the piers for the Paducah & Illinois bridge is fed by a derrick mounted on the same barge with the bins and distributing tower. The bins and 1-yd. mixer are set lengthwise on the barge, and the tower is located at one side of the deck at the center of the bins, instead of on the center line of the boat. The barge on which the plant is mounted is 36 x 110 ft., 5 ft. deep. The boat mounts a 75-ft. tower, and the swinging of a $1\frac{1}{4}$-yd. clamshell bucket loaded with gravel did not tip it enough to cause spilling in spouting concrete through the 2-ft. door of an air lock in sealing the caissons, although no hopper was used on the lock.

A 60-hp. boiler furnishes steam for the mixer, the two drum tower hoist, a dynamo engine, water pump and heating coils in the gravel hopper and water tank. One drum of the tower hoist is lagged with 3-in. hardwood for the bucket line, and the other drum is used for raising and lowering the tower hopper and boom. The shaft of the top drum is extended to the center of the barge, where a spool is mounted for pulling a self-dumping cement car to the charging platform from the cement barge. This car runs up an inclined track which has a removable extension into the cement barge. An independent three-drum hoist, boiler and swinging gear are used to operate the derrick. The photographs show the plant at pier 1 before the tower was equipped with a boom, and with only two chutes in use. The plant has placed more than 700 cu. yd. in a 12-hr. run.

The plant was built for the work and was designed by H. K. Seltzer, chief engineer of the Union Bridge & Construction Co., contractor for the substructure of the bridge. G. F. Wilhelm and T. T. Newman are respectively engineer and superintendent for the contractor, while C. R. Fickes is resident engineer for the Paducah & Illinois Railroad Company, for which the bridge is being constructed.





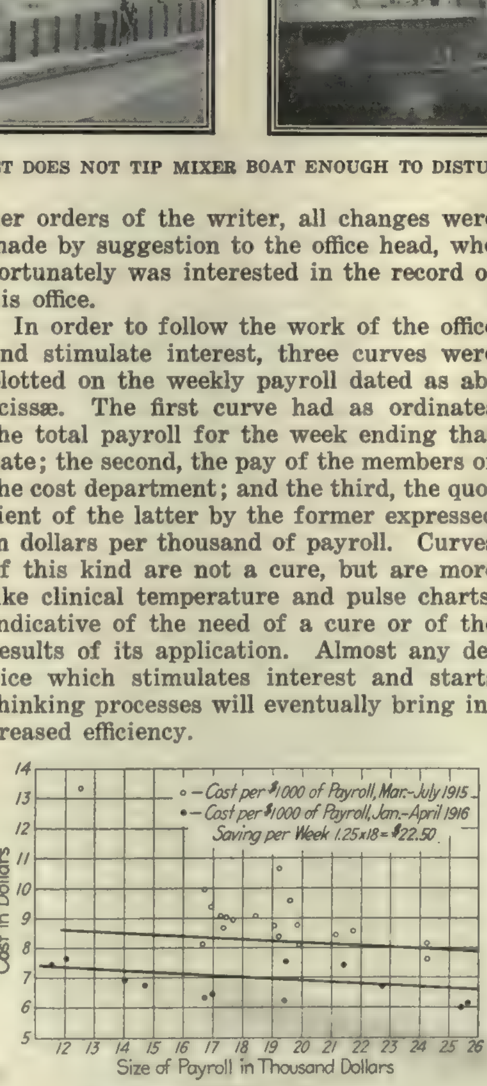
SWINGING OF LOADED CLAMSHELL BUCKET DOES NOT TIP MIXER BOAT ENOUGH TO DISTURB CHUTES EVEN WITH 75-FOOT TOWER

Cost of Cost-Keeping Cut by Study of Office Force

By DAN PATCH
Aberthaw Construction Company, Boston

THE COST of making up payrolls and keeping construction costs in a common field office for several large jobs with which the writer was connected was greatly reduced during the last year. Most efficiency work is applied by the office or overhead force to the direct labor, or working force; but in the present interesting instance the work of a cost-keeping office itself was under observation. As the office was not under orders of the writer, all changes were made by suggestion to the office head, who fortunately was interested in the record of his office.

In order to follow the work of the office and stimulate interest, three curves were plotted on the weekly payroll dated as abscissæ. The first curve had as ordinates the total payroll for the week ending that date; the second, the pay of the members of the cost department; and the third, the quotient of the latter by the former expressed in dollars per thousand of payroll. Curves of this kind are not a cure, but are more like clinical temperature and pulse charts, indicative of the need of a cure or of the results of its application. Almost any device which stimulates interest and starts thinking processes will eventually bring increased efficiency.



INCREASING OFFICE EFFICIENCY

So it came about that men of the cost department were found to have training which fitted them for vacancies in the organization where the work was of more importance and more nearly commensurate with their pay. They were transferred and their places taken by younger and less broadly trained men. It also developed that by a slight change in arrangements considerable overtime on payrolls could be eliminated. All unncessary subdivisions of costs were excluded. It had been customary to enter all costs daily in the cost books. Thereafter only such costs as could be set against quantities of work and expressed in units were used daily. Each week a summary of the costs, checking with the payroll, was made up to send to the home office, and the method of making entries in the cost book was changed so that only those items on which the superintendents wished daily costs were entered daily, the others being entered weekly from the summary, as a bookkeeper would enter from his cash book to his ledger.

These changes may seem trivial, and because no stopwatch is mentioned may not seem to ring true to the gospel of scientific management; but the results were gratifying, as will be seen from the accompanying curves. In order to make the comparison shown in the diagram a fair one, two periods in which the payrolls fluctuated through about the same limits were taken from the clinical curve and the ordinates of cost per thousand of payroll plotted on abscissæ of thousands of payroll. A conservative estimate of the saving as shown by these points is $1.25 per thousand, and as the payroll was about $18,000, this meant about $22.50 per week. As the period through which the saving was made with this average payroll was thirty weeks, there was an aggregate saving of $675. It so happens that the concern for which the writer works does largely percentage work, and accordingly this saving actually reduced the company's earnings by $67 and netted the owners $742. This saving was accompanied by a reduction of one-half hour in the length of working day of the office force.

People sometimes wonder at the altruistic way in which doctors preach prevention as against cure, but here is a cold-blooded contractor following the example of the doctor. The answer is that profits made through waste are not normal, and that conservation eventually brings healthier conditions in business as well as in other things.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Testing Society Sends Standard Cement Specifications to Letter Ballot

Acceptance of Many Years' Conference Work by Committee C1 Marks Annual Meeting—Year Book to Be Replaced by Biennial Publication

The most animated of all the sessions at the annual meeting of the American Society for Testing Materials at Atlantic City last week was the Thursday morning discussion on cement and concrete. The report of Committee C1 recommending that the standard specifications for Portland cement, developed as a result of numerous conferences with committees of the American Society of Civil Engineers and the United States Government, should be accepted at once and submitted to letter ballot (to become effective Jan. 1, 1917, if adopted) was finally accepted. The recommendation that these standards be given the special name of "American Specifications and Methods of Tests for Portland Cement" was defeated.

Important action was taken on the recommendation of the executive committee when it was agreed to vote to replace the "Year Book" by a biennial publication to be called the "A. S. T. M. Standards." All tentative specifications are to be printed in the "Proceedings." This was ordered to be submitted to letter ballot.

Abstracts of the more important papers presented at the meeting will be found on pages 48 to 50 of this issue.

Report of Executive Committee

The executive committee reported that arrangements had been made with the U. S. Department of Commerce by which the standards of the society which bear upon export trade will be translated into foreign languages. All the 31 standards of Group 1 and 12 standards of Group 2 had been translated into Spanish by the middle of June.

The total membership of the society, including 210 junior members, is now 2071. This shows a greater increase than for any previous yearly period, even though the dues were increased 50 per cent at the beginning of the current fiscal year.

On the financial situation the report contained the following paragraph:

"From present indications it is to be anticipated that, barring expenditures in unexpected directions, the deficit of $6,407.03 at the beginning of the fiscal year will not only be extinguished, but will be converted into a moderate surplus by the end of the year, and that the financial affairs of the society will thereafter be on a thoroughly sound business basis for the first time in the history of the organization. The cash balance in the treasury June 1, 1916, was $15,666.86 with no unpaid bills, as compared with a cash balance of $6,480.79 at the corresponding period last year."

Specifications on Design

In connection with the question, submitted last year, whether engineering design and construction should form a part of any specifications, a new paragraph has been added to the regulations governing standing committees, as follows: "In the preparation of proposed standards, the consideration of matters of engineering design or construction shall not in general be regarded as falling within the province of the society. If, however, it should appear to a given committee that the consideration of such matters is, for special reasons, indispensable in specifications designed to cover the customary relations between the producers and consumers of a given product, then reference to such matter in proposed specifications for that product shall be permitted within the scope necessary for the particular purpose above stated."

To avoid danger of centered control a motion was passed instructing the executive committee to submit next year such changes in the by-laws as will make the appointed members of the nominating committee and of the executive committee ineligible for membership on the nominating committee for the next succeeding year.

Report of Committee on Steel

The recommendations of Committee A1, on steel, that certain requirements as to permissible variations in weight and thickness of structural steel in various standard specifications be changed, were approved and submitted to letter ballot. Six proposed tentative specifications for track spikes, screw spikes, tie plates, bars, etc., were adopted as tentative specifications.

Moving pictures of the methods used in the laboratory of the Pennsylvania Railroad for finding the yield point of steel specimens as obtained by the sudden change in the speed of the indicator of the Ames dial on the strain gage were shown. The total time required for one test obtaining yield point, ultimate strength and percentages of elongation and of contraction was given as 2½ min.

Committee A5, on corrosion of iron and steel, reported progress and also announced the enlargement of its field by the appointment of a subcommittee to investigate preservative metallic coatings for metals.

The following resolution was introduced by Dr. Henry M. Howe and was carried:

"Recognizing the confusion, inconvenience and loss of time and efficiency occasioned by the lack of uniformity in recording temperatures in this country; and recognizing further that the Centigrade scale is much simpler and more convenient than the Fahrenheit scale, and is the present standard in all countries except Great Britain, and is also in general use among scientific men throughout the world, be it

"Resolved, That it is the sense of this meeting that the efforts being made to obtain legislation requiring the use of the Centigrade scale in all future government publications should be heartily approved."

Yield Point and Elastic Limit

The report of Committee E1, on methods of testing, recommending the insertion of the proposed definitions of elastic limit, proportional limit and yield point, submitted last year, at the beginning of the methods for tension and compression tests, was approved and sent to letter ballot. The change recommended last year involving the determination of the modulus of elasticity was not recommended for adoption at this time. It will be further considered by subcommittees.

The topical discussion on the relation between yield point and proportional limit for various grades of steel was one of the most animated of the meeting. Following the formal papers by T. D. Lynch and H. F. Moore, both written and oral discussions were presented. In the oral discussion C. D. Young pointed out the difference between the relation

(Continued on page 60, column 2)

Plan Organization for Engineer Officers' Reserve

William Barclay Parsons, in Interview with Engineering Record Representative, Explains Tentative Scheme Based on Army Reorganization Act

In making definite provision for an engineer section of the Officers' Reserve Corps the Army Reorganization Act, which became effective July 1, furnishes a foundation upon which the War Department is preparing to build up a military organization of the nation's technically trained men. The new legislation deals with the engineer reserve corps only in general terms. Its main stipulations are that the engineer reserve corps shall be created, that its members shall be exempt from the age limits prescribed for officers in certain other branches of the active and reserve service (thus admitting to the rank of major men more than 45 years old), that commissions shall be issued by the President and be valid for a five-year term, that in time of war reserve officers may be called by the President to active service, with pay, and that in time of peace, if sums are appropriated, a fifteen-day period of field instruction each year may be prescribed. Beyond major provisions of this sort the act does not go. To the War Department, working in co-operation with a joint committee of civilian engineers, representing five of the national engineering societies, has been left the task of working out the details of the scheme. Although no final plan of organization has yet been adopted, William Barclay Parsons, chairman of the national joint committee, on which he represents the American Society of Civil Engineers, outlined to a representative of the Engineering Record this week the tentative scheme which the War Department now has under consideration.

Board Will Examine Candidates

At an early date the War Department will issue an invitation to the engineers of the country to apply for commissions in the reserve corps of engineers. To determine the qualifications of applicants there will be appointed a general examining board, consisting of officers from the Corps of Engineers of the Army and, probably, representatives of the five national engineering societies—civil, mining, mechanical, electrical and consulting—which co-operated with the War Department in the legislation affecting the Officers' Reserve Corps. The intention is to hold oral examinations at many places throughout the country where engineer officers are stationed, the civilian engineer members of the board aiding the army officers in reaching a correct estimate of the rank to which a candidate for a commission should be assigned.

Commissions are to be given for the grades of major, captain and lieutenant. It is likely that the requirements for major will be somewhat similar to those for "member" of the American Society of Civil Engineers, although actual membership in the American Society of Civil Engineers, or in any of the other national engineering organizations, will not be a requisite for a commission. The constitution of the American Society of Civil Engineers stipulates that a member shall be not less than 30 years of age, shall have been in active practice for 10 years, shall have had responsible charge of work for 5 years and shall be qualified to design as well as direct engineering work. Graduation from a school of engi-

neering of recognized reputation is considered as equivalent to 2 years' active practice. With some slight revision—possibly an increase in the minimum age limit—these requirements, together with others based on military knowledge, may be the basis for the selection of majors in the reserve corps.

Technical Qualifications

As indicating what will be expected of a captain, the requirements of the American Society of Civil Engineers for an "associate member" will be followed in a general way. In the American Society an associate member must be 25 years old, have been in active practice for at least 6 years and have had responsible charge of work for at least 1 year.

A captain will need to be familiar also with drill regulations, field service regulations, etc.

Lieutenants will be recruited from the members of the profession who have qualifications somewhere between those of "junior" and "associate member" of the American Society.

The qualifications for major, captain and lieutenant, as outlined above, merely indicate in a general way what the War Department is considering. It is probable that some revision will be made in the age limits above referred to and that for its commissioned officers in the engineer section of the reserves the War Department will require men slightly older than those called for by the minimum in the several grades of the American Society of Civil Engineers. A man who combines technical with military experience will have this fact taken into consideration in his rating.

As to the size of the reserve corps no accurate prediction can be made. The Army Reorganization Act merely stipulates that the proportion of officers in the Officers' Reserve Corps shall not exceed the proportion for the same grade in the corresponding branch of the regular army, except that the number of commissioned officers in the lowest authorized grade shall not be limited.

The uniform of officers in the engineer section of the reserves will probably be the same as that in the regular army, except that the initials R. C. (Reserve Corps) will be superimposed upon the insignia of the castle which is the designation for engineer troops. The government will not furnish the officers' uniforms.

Mr. Parsons brought out the point that a commission in the Officers' Reserve Corps opens the way for those who wish to join the regular army. The new army act states that vacancies in the grade of second lieutenant are to be filled in the following order: (1) graduates of the U. S. Military Academy; (2) enlisted men whose fitness for promotion shall have been determined by competitive examinations; (3) members of the Officers' Reserve Corps between the ages of 21 and 27; (4) commissioned officers of the National Guard; (5) honor graduates of distinguished colleges entitled to preference by general orders of the War Department, and (6) candidates from civil life. It is thus seen that members of the Officers' Reserve Corps have the third preference for commissions in the regular army.

An Enlisted Reserve

The Army Reorganization Act also makes provision for an Enlisted Reserve Corps, and in the engineer section of this organization a particular effort is to be made to secure the enrollment of men qualified for the grade of "master engineer," which ranks somewhat higher than that of sergeant of infantry. This grade is designed to attract technically trained men to whom a sergeant's pay would not be an inducement. In this grade it is hoped to secure young men with National Guard experience, contractors' superintendents and foremen, expert draftsmen, etc.

The foregoing paragraphs give merely a sketch of the organization contemplated. The provisions outlined are subject to change. It is expected that the War Department will soon issue definite instructions regarding the formation of the Officers' Reserve Corps and the qualifications for admission.

Testing Society Sends Standard Cement Specifications to Letter Ballot

(Continued from page 59)

in question for the designer, who must fix working stresses, and for the testing engineer, who requires a rapid method of commercial testing for acceptance of material. It was also pointed out that a temperature test might be found useful in determining whether the strain is beyond the proportional limit or not.

Papers were presented by A. T. Goldbeck and E. B. Smith on an apparatus for determining soil pressures and by D. J. McAdam, Jr., on endurance and impact tests. These are abstracted on pages 48 and 49 of this issue.

Report of Committee C1 on Cement

The most animated session of the meeting occurred when the report of Committee C1, on cement, was presented. A new cement specification, which the committee desired to call the "American" specification, was proposed. Several changes from the form appearing in the preprint were reported. After prolonged debate the meeting refused to sanction the proposed title and referred the matter of titling to the executive committee. The specification was then passed to letter ballot, with the understanding that, if approved, it is to become effective Jan. 1, 1917.

Written discussions objecting to parts of the proposed standards were submitted by Benjamin A. Howes and by J. A. Kitts. It was pointed out, however, that some of the points to which objection was made had already been changed in the final draft.

The recommended tentative compression tests for mortar were ordered printed after some discussion of the change in test specimen from a cube to a 2-in. cylinder 4 in. long.

The committee has elected the following new officers: Chairman, R. S. Greenman; vice-chairmen, H. B. McFarland and John B. Lober; secretary, P. H. Bates.

Owing to the prolonged debate on the cement report, little time was available for the presentation of the papers on concrete. The more important points made in several of the papers will be found in the abstracts on another page of this issue. Discussing the paper by D. A. Abrams on rattler tests of concrete pavement specimens, G. P. Hemstreet outlined the results of more than a ten years' use of the rattler in testing asphalt paving blocks.

Ceramics

Committee C4, on clay and cement sewer pipes, presented again its "Schedule of Analytical Data for Sewer Pipe" and its tentative standards, entitled "Recommended Practice for the Laying of Sewer Pipe," with the request that, as amplified and expanded, these be again printed among the tentative standards. The meeting supported the recommendations of the committee.

Committee C6, on drain tile, reported proposed revised standard specifications, which differ from the present standards principally in the inclusion of absorption and freezing and thawing tests. The committee urged that these revisions be incorporated at once and that instead of printing the revised specifications as tentative for two years they be passed at once to letter ballot. The committee's recommendation was approved.

Road Materials and Timber

Committee D4, on road materials, proposed nine new standards or revisions of present standards, which were acted on as follows:

To Be Printed as Tentative Specifications for Two Years.—Tests for specific gravity, form of specifications for commercial grades of broken stone, method of determining softening point of bituminous materials other than tar products.

To Be Sent to Letter Ballot.—Method of making mechanical analysis of broken stone or broken slag; method for making mechanical analysis of mixtures of sand or other fine material with broken stone or broken slag; revised standard tests for loss on heating of oil and asphaltic compounds; revised standard method for making mechanical analysis of sand or other fine highway materials, except for fine aggregates used in cement concrete; method of test for distillation of bituminous materials suitable for road treatment.

The meeting concurred in the committee's recommendation that certain new definitions be published as tentative.

Committee C11, gypsum and gypsum products, withdrew the major part of its report, containing specifications. Definitions presented by the committee, however, were ordered printed as tentative.

Committee D7, on timber, presented specifications for Douglas fir and for sampling and analysis of creosote oil, which were ordered printed as tentative specifications. A specification was offered for wooden paving blocks, but was withdrawn by the committee.

At the closing session the secretary announced that the total registration for the meeting was 643; the men numbered 513 and the women 130. The registration at the 1915 meeting was 592—489 men and 103 women.

Kansas Engineering Committee Reports on Flood Prevention

The engineering committee of the Kansas Flood and Water Congress at a recent meeting at Topeka submitted a report in which it was stated that government aid will be necessary in effecting a satisfactory system for flood abatement in Kansas. The committee was also of the opinion that a permanent state flood commission should be appointed as the official body representing the state. The re-establishment of stream-gaging stations formerly maintained by the federal government and an exhaustive study of Kansas flood conditions were also recommended.

T. J. Strickler, state public utilities engineer and chairman of the committee, estimates the loss in Kansas during the past thirteen years due to floods at $52,000,000. He suggests state control to prevent plans for one drainage district from interfering with those of others.

New Jersey Water Commission Becomes Inoperative

Because of efficiency and economy legislation of last year the duties of the State Water Supply Commission of New Jersey have been assumed by the State Department of Conservation and Development. The geological bureau of the conservation department, which will hereafter handle the commission's work, proposes to make investigations of underground-water conditions in New Jersey and also determine what increase, if any, there has been in water-power development in that state during the past twenty-six years. Surveys will also be made to determine the safety of all dams in New Jersey.

Work on Twin Peaks Tunnel Progresses

That the Twin Peaks tunnel in San Francisco will be completed by June 1, 1917, is indicated by the progress of the work at the rate of 450 ft. a month. Concrete work has been practically completed at Laguna Honda Station, as well as from the west portal to that point.

A shaft has been sunk from the surface on the center line and considerably in advance of the heading, from the bottom of which drainage tunnels are being driven in both directions. As much as 300,000 gal. of water a day was pumped from this shaft at one time, although the flow is now about 160,000 gal. in twenty-four hours. To reduce the difficulties arising from excess water it is intended to advance the drainage headings until a junction is made with the main headings being driven from both directions.

Stuart Leaves Baltimore & Ohio; Begien Succeeds Him

General Superintendent of Southwestern Takes Place of Chief Engineer, Who Will Enter Private Practice

F. L. Stuart, chief engineer of the Baltimore & Ohio Railroad for the last five years, has resigned effective July 10, to engage in private engineering practice in New York City. R. N. Begien, general superintendent of the Baltimore & Ohio Southwestern, will succeed him.

Francis Lee Stuart was born Dec. 6, 1866, at Camden, S. C., and was graduated from Emerson Institute, Washington, in 1884. That year he began railroad work with the Baltimore & Ohio. In 1887 he went to Alabama for the Cahaba Coal Mining Company, and from then until 1892 was engaged in various engineering work in the South. In the latter year he returned to the Baltimore & Ohio as resident engineer on construction work in Pennsylvania and West Virginia. He was engineer and contractor on various railways from 1895 to 1897, when he went to Nicaragua as assistant engineer of the Nicaragua Canal Commission, later being made division engineer of the Isthmian Canal Commission. In 1899 he returned to the Baltimore & Ohio as assistant engineer and in 1903 was advanced to district engineer, in charge of the development of grade reductions. The following year he was made engineer of surveys for the entire system. A year later he resigned to become chief engineer of the Erie and in 1911 again became connected with the Baltimore & Ohio as chief engineer, succeeding A. W. Thompson.

During these last five years, under Mr. Stuart's direction, the Baltimore & Ohio has undergone one of the most extensive programs of grade reduction ever put through by an American railroad. Two of the most noteworthy features were the Sand Patch tunnel and the Magnolia cutoff. A work that is at present attracting considerable attention is the low coal pier being built at Curtis Bay, near Baltimore—of a type quite different from anything now on the Atlantic seaboard. It is Mr. Stuart's intention to promote patents which he holds for conveying machinery to be used on this pier.

Ralph N. Begien was born in Boston in 1875 and was graduated from Harvard University in 1897. He also was with the Nicaragua Canal Commission for three years, after which he spent a year on railway work in Ecuador. In 1902 he began what has been a continuous service with the Baltimore & Ohio. Starting as assistant engineer, he was promoted to division engineer of the Philadelphia division in 1908. Early in 1910 he was made assistant to A. W. Thompson, then chief engineer. He remained as Mr. Thompson's assistant when at the end of that year Mr. Thompson was promoted to general manager, and again in May, 1912, when he was advanced to third vice-president. In December of the latter year, however, Mr. Begien was made assistant general superintendent of the main-line system, and a few months later was made general superintendent of the Baltimore & Ohio Southwestern.

Mr. Begien is a member and past chairman of the committee on economics of railway location of the American Railway Engineering Association, and has made some noteworthy investigations of train resistances and economic tonnages. He is also a director of the association.

Chief Engineer of Baltimore & Ohio Railroad Resigns—Succeeded by General Superintendent

FRANCIS L. STUART

RALPH N. BEGIEN

California Road Commission Wants $15,000,000

The bond issue of $18,000,000 which the state of California voted for highway improvement in 1909 having been expended, the state highway commission has asked for a bond issue of $15,000,000 to be voted on next November. Of this amount $12,000,000 is wanted for the completion of the original system of trunk roads and county laterals; the remaining $3,000,000 is to be applied on a county-aid co-operative basis in building approved extensions which have been applied for by various counties.

The July issue of the *California Highway Bulletin* contains a map showing 1490 miles of road already constructed and indicating present conditions on the remainder of the 2900 miles which the highway commission has taken under consideration.

$16,119,583 Already Spent

The arrangement of the map is such that the importance of those sections of the proposed system which have been surveyed but for which funds are not available is apparent. It is pointed out that ex-Governor Gillett, under whose administration the original $18,000,000 issue was passed, has said: "I suggested that the first state good-roads bonds issue should be for only $18,000,000, not because I supposed for a moment that that amount would build all the roads or even all the state highways needed. I believed that if the sum of $18,000,000 was judiciously used the result would be to convince the people of the wisdom of good roads, and that whatever money was needed in the future the people would gladly give. I said that I thought it would take more than $5,000,000 to build the main trunk lines the state requires."

The commission's balance sheet shows that 87½ cents out of every dollar expended went directly into the roads. The other 12½ cents include all other expenditures, such as preliminary studies of mountain laterals and aid given to many counties.

The expenditure of $16,119,583 includes $14,468,082 for highways under construction, $181,400 for construction of plants and equipment, $745,044 for surveys and $725,057 for headquarters and division offices' general expense.

The remainder of $1,900,000 will be needed to complete roads already under contract and to build sections which the commission is obligated to construct.

Engineers to Make New York Depot Battalion Representative

Those New York engineers who have shown interest in the defense of this country from an engineering standpoint have, it is announced, an excellent opportunity to form a battalion representative of the profession in New York City by joining the depot organization being recruited by Major J. F. Fairchild at the armory of the 22d Regiment of Engineers, New York National Guard. Its depot battalion will consist of six companies recruited to 100 men or more each. Instruction in tactics and military engineering will be given. Each company will drill on a different night of the week, so that the men joining the battalion can practically select their drill night. The organization will be completely outfitted as engineer troops at the expense of the state and will serve for three years as state troops, or until the return of the regiment, when the members of the depot battalion will be mustered out, with the option of joining the 1st Regiment of Engineers, as the 22d is now designated by the War Department.

It is stated that enlistment will not interfere with attendance at Plattsburg camps or with the possibility of volunteering for federal service. Transfers to other state or federal military organizations can be arranged at any time.

More than 100 men of the Civilian Engineers' Training Battalion organized last March have already signified their intention of joining this organization, and it is expected that many of these men have had sufficient training already to enable them to qualify as noncommissioned officers. The executive committee of the Civilian Engineers' Training Battalion has expressed a wish that all of its members who are free to do so might join the depot organization because of the unusual opportunity to form the nucleus of a military engineering organization representative of the engineering profession in New York City.

An effort is being made both by this committee and by the recruiting authorities to enlist as many riggers, mechanics, foremen and construction men of all classes as possible in this organization in order to make it a standing example of the economy of giving military training to men with construction and engineering ability as against giving military engineering training to men without experience in either field.

Lima, Ohio, to Have Sewage Plant

Reinsch-Wurl screens and the activated-sludge treatments of sewage have been recommended for use at Lima, Ohio, by George W. Fuller, consulting engineer, of New York City. The screens are to be used during the entire year. The activated-sludge plant will be in operation seven months out of twelve at times when the flow of the Ottawa River is comparatively small.

Flood Deep Unbraced Coffer on Finishing Work

Completion of Excavation and Masonry for Forty-Sixth Street Pier, New York City. Occasion for Celebration

On the afternoon of July 1, after appropriate speeches by R. A. C. Smith, commissioner of docks and ferries, and John Purroy Mitchel, Mayor of New York City, the south flooding gate in the deep steel cofferdam for the shore section of the new Forty-sixth Street pier being constructed by the city was opened, flooding the slips cut out of rock 44 ft. below low tide. The cofferdam, inclosing an area 5½ acres, was described on page 68 of the Engineering Record of July 18, 1914, and on page 654 of the issue of May 22, 1915. Two leaks, one under the single row of sheeting at the north end and one under one of the large pockets at the lower end of the river arm, kept a 12-in. electric centrifugal pump running to half capacity. This dam is by far the driest one of its area built with one or more long sides against open water. The top of the cofferdam is said to have moved in 4 ft. since unwatering.

Handling of Construction

The 81,000 cu. yd. of rock excavated from the slips on either side of the pier were loaded by six locomotive cranes, on trestles at right angles to the river arm, into skips on cars, which, by means of steam dinkeys, were hauled along the river arm and out on to the end of the old Forty-fifth Street pile pier. Here the skips were dumped by locomotive cranes into scows. Concrete was mixed at a plant set on the river arm, described in the Engineering Record of Sept. 25, 1915, page 395. Much of it was spouted to place from the river arm of the coffer, while some was carried to the steel forms in buckets by the cranes and stiffleg derricks. The remainder was dumped into elevated hoppers, from which it was spouted to place. This last method is illustrated in the construction views shown on the opposite page.

A feature of the rock excavation was the method of shooting down a full-depth section of face, described on page 614 of the Engineering Record of Nov. 13, 1915. The most difficult part of this work was cleaning up the small shoulder of rock left under the banking along the river arm. When some of this banking was removed, a section of the coffer showed signs of instability, but the rock ledge was nevertheless excavated without accident. Heavy ice hampered the work of cleaning up the bottom for some weeks after the main excavation was well advanced and delayed the entire work. This ice, shown in one of the photographs, was as expensive to excavate as the rock and could not be thawed by any practicable means long enough to permit resumption of work.

Personnel

The design of the pier and the supervision of its construction have been carried out by the Department of Docks and Ferries of New York City, of which R. A. C. Smith is commissioner and C. W. Staniford chief engineer. The contractor for the work is the Holbrook, Cabot & Rollins Corporation, for which Thomas D. Bryson has been in general charge.

Pennsylvania Highway Forces Work on Roads Near Camp Brumbaugh

To assist the military forces of Pennsylvania in putting the roads around Camp Brumbaugh in good condition the State Highway Department has begun that work under the direction of W. D. Uhler, chief engineer of the department. Work was started June 30 with scrapers, rollers and other equipment. Caretakers in charge of drags will be stationed at the camp to keep the roads in the best possible condition.

Baltimore & Ohio Railroad Changes Its Districts

The Baltimore & Ohio Railroad June 28 made several important changes in the arrangement of its lines and in the jurisdiction of its executive officers. The system will hereafter be divided into three territories, to be known as the Eastern, Western and New York Terminal lines. The Eastern lines will embrace the main line and branches of the road east of Wheeling, W. Va., and Chicago Junction, Ohio. That part of the road west of Parkersburg, Wheeling and Chicago Junction will comprise the Western lines.

Among the changes in officers is included A. W. Thompson's promotion from third vice-president in charge of operation to vice-president in charge of traffic and commercial development, as announced elsewhere in this issue. The numerical order of designating vice-presidents has been discontinued.

$515,000 for Kansas City Levee Work Passed by City Council

The ordinance creating a district for flood protection in the East Bottoms in Kansas City became a law several months ago. Another bill providing for levee construction was passed by the city council last month and will be approved by the mayor.

The present plan favored by big property owners and manufacturers was drawn by Curtis Hill, city engineer. It withdraws all protection back on the shore line, is purely a flood-protection scheme and eliminates that part of a previous plan providing for the construction of dikes and revetment extending about 600 ft. out into the river.

In view of the change in plans eliminating the extension of the right bank of the Missouri River to the U. S. Harbor line, the federal government will not aid in the work. Flood district 1 has a total river frontage of 3.71 miles and covers about 2219 acres, of which 2092 are taxable for construction at the rate of $243 per acre.

Engineering Society Activities

The Connecticut State Association of Sanitary Engineers held its annual meeting recently at New Haven at which E. E. Thomas was elected president and O. T. Thomas, secretary and treasurer.

The Engineers Club of Seattle at the regular weekly meeting June 28 was entertained with the latest war news by "The Fighting Parson," Major John Pringle, D.S.O., Canadian Overseas Contingent. Major Pringle, who has just completed 10 months' continuous service, is on a short furlough.

The Providence Engineering Society, at its recent annual meeting, elected officers and took a trip over the site of the big $12,000,000 project under way at Kent. A dinner at the University Club completed the program. Thirty-five automobiles took 125 members of the society to Scituate. The business meeting was held in the Engineering Building of Brown University. Prof. J. Ansel Brooks, of Brown, was elected president. The other officers elected are: Vice-presidents, Ralph W. Adams, G. A. Carpenter, W. T. Robertson; corresponding secretary, A. E. Thornley; recording secretary, W. C. Kennedy; treasurer, A. E. Whatley; executive committee for three years, F. E. Winsor, Robert L. Brunet, W. C. Pickersgill and L. Earle Rowe.

The Detroit Engineering Society will hold its annual excursion and picnic to-day. The steamer Pleasure has been chartered and many kinds of entertainment have been arranged.

The Second National Exposition of Chemical Industries will be held in the Grand Central Palace, New York City, during the week of Sept. 25.

What Engineers and Contractors Are Doing

JUDSON R. WEST, chief engineer of the Seattle Port Commission since January, 1915, has resigned, effective July 31. Mr. West has accepted the chair of railroad engineering at the University of Pei Yang, Tientsin, China. Mr. West is a graduate of the University of Colorado and of the civil engineering department of the University of California. As the Port of Seattle's scheme of harbor development is practically completed and nearly all the engineering problems disposed of, Mr. West had expected to sever connections with the port during the summer. As professor of railroad engineering Mr. West will have one of the largest departments in the University of Pei Yang.

ROY WELSH, of Centralia, Wash., has been appointed city engineer of that city to succeed Caleb Berry, who resigned recently.

FRANK B. BLACK, member of the State Commission of Agriculture, has been made highway commissioner for Pennsylvania to succeed R. J. Cunningham, who died recently. Mr. Blake is a business man. His first public office was with the agricultural commission.

H. C. SMITH has resigned as engineering instructor at the University of Oklahoma to become associated with D. W. Patton, consulting civil engineer, of Poteau, Okla. Mr. Smith is a graduate of the University of Michigan. He and Mr. Patton will devote their time to highway, railroad and waterworks engineering.

WILEY RODMAN has been promoted from chief bridge engineer in the Kentucky department of roads to state commissioner of roads, succeeding R. C. Terrell. Mr. Rodman was graduated from the State College of Kentucky in 1906, and from June to October of that year was employed by H. L. Cooper as draftsman on preliminary work on the hydroelectric development at Keokuk, Iowa. He left that work to become assistant engineer for Viele, Blackwell & Buck, consulting engineers, of New York City, on the hydroelectric development at Oroville, Cal. In 1909 he was made engineer and superintendent of construction for the Livermore (Cal.) Water & Power Company and a year later went to the Hydraulic Engineering Company of Maine on work at Keokuk. He went to Mexico in 1912 in charge of shaft driving and tunnel work for the Mexican Light & Power Company and later in that year was made tunnel superintendent for that company under Jacobs & Davies, consulting engineers, of New York City. He has been with the Kentucky roads department since 1914.

A. R. MURPHY, of Knoxville, Tenn., has become associated with the engineering department of Wallace & Tiernan Company, New York City. Mr. Murphy was graduated from the University of Tennessee in 1907 and immediately became connected with the C. W. Hunt Company, New York City. In 1908 he was made draftsman and engineer in the Bureau of Municipal Research, New York City. He returned to his alma mater in 1909 to become fellow and instructor in civil engineering. He later became connected with the engineering department, Pitometer Company, New York City.

W. H. FRANKLIN has left the valuation department of the Chicago, Milwaukee & St. Paul Railway to join the construction forces of the James Black Masonry & Construction Company at Seattle, Wash.

CHARLES P. LIGHT, field secretary of the American Highway Association and a prominent figure at highway conventions for many years, has resigned in order to form the firm of Graham & Light, which has been appointed district agent for the Fidelity Mutual Life Insurance Company, of Philadelphia. The

COMPLETING THE OUTER PILE SECTION

Deepest Unbraced Coffer, Built for New York Pier, Is Flooded After Serving with Great Success

RAISING GATE TO FLOOD COFFER

LARGER OF THE ONLY TWO LEAKS

TAKING OUT PUMP AS WATER ENTERS

WHILE ICE DELAYED CLEANING UP SLIP FLOORS, WALLS WERE CONCRETED—LESS THAN 4 INCHES OF WATER ON LEVEL SLIP FLOOR BEFORE FLOODING

headquarters of the firm are in Washington, D. C., and its territory covers the greater part of West Virginia, western Maryland and the District of Columbia.

JEROME NEWMAN, chief engineer of the California State Board of Harbor Commissioners since 1912, has resigned, to take effect as soon as a successor can be named. Mr. Newman is a graduate of the University of California, class of 1883. He spent three years at the Royal Polytechnic School, Charlottenburg, Prussia, doing post-graduate work, after which he entered the engineering department of the Southern Pacific Railway. He left the employ of that company in 1888 to take up land surveys, but again entered the railroad field in 1890 as resident engineer for the Northern Pacific Railroad. From June to October, 1894, he was topographer on the Overhead Pacific Railroad, which was never built. He became connected with the engineering department of the San Francisco & San Joaquin Valley Railway in 1895, where he was employed until 1900, when he was made office assistant to the chief engineer of the Southern Pacific. In 1904 he was appointed office engineer for the San Pedro, Los Angeles & Salt Lake Railroad and a year later returned to the Southern Pacific as assistant engineer, where he remained, with the exception of a few months, until his appointment to the board of harbor commissioners in 1912.

M. A. HOWE has resigned as professor of civil engineering at the Rose Polytechnic Institute and will make his home in Vermont. Professor Howe has been a member of the faculty of the Rose Polytechnic Institute for twenty-nine years. At the farewell dinner given recently in his honor by the members of the board of direction and the faculty of the institute Professor Howe was made professor emeritus in civil engineering for life.

F. F. HANLY, formerly assistant engineer for the Baltimore & Ohio Railroad at Baltimore, has been made division engineer, with headquarters at Cumberland, Md.

J. S. JONES was recently elected president of the Wisconsin & Northern Railroad. His headquarters are in the Steger Building, Chicago.

E. V. SMITH has been promoted from district engineer maintenance of way of the Baltimore & Ohio Railroad to assistant superintendent at Newcastle, Pa.

MAJOR GEORGE R. SPALDING, Corps of Engineers, U. S. A., has been transferred from Cincinnati to Louisville. Major Spalding's work at Cincinnati consisted of the general improvement of the Ohio River. At Louisville he succeeds Major Oakes, whose transfer to Philadelphia was noted in the June 17 issue.

MAJOR ROBERT R. RALSTON, Corps of Engineers, U. S. A., who has been in charge of the second Cincinnati district, will succeed Major Spalding in charge of the first Cincinnati district. Due to a change in plans, he will not be transferred to Louisville, as announced in the June 17 issue.

ERNEST STENGER has resigned as general manager of the St. Joseph & Grand Island Railway to become general superintendent of the Union Pacific Railroad. Mr. Stenger was graduated from the University of Michigan in 1886. He entered railway service that year as rodman for the Burlington & Missouri River Railroad and in 1888 was made draftsman for the Atchison, Topeka & Santa Fé Railway. He remained with that road for two years, but in 1890 was appointed assistant engineer of the Missouri Pacific Railway. In 1900 he became division engineer of the Union Pacific Railroad and during his seven years' service with that company rose to the position of superintendent. He was made general superintendent of the Rio Grande Western Railway in 1907 and four years later became general manager of the St. Joseph & Grand Island Railway.

L. E. MCDOUGAL has closed his engineering offices in Imperial, Cal., to become connected with the engineering department of the Standard Oil Company at El Segundo, Cal.

RICHARD K. MEADE, consulting engineer, of Baltimore, has removed his offices to the Law Building.

P. D. FITZPATRICK has been made general roadmaster of the Central Vermont Railway, with headquarters at St. Albans, Vt. The new work is in addition to his duties as valuation engineer for that railroad.

C. R. KNOWLES has been promoted from general foreman of waterworks of the Illinois Central and the Yazoo & Mississippi Valley railroads to superintendent of water service, with headquarters at Chicago.

JAMES E. JENKINS has resigned as superintendent for Willard Case & Company, New York City, to take a position as superintendent on the construction of a concrete warehouse for the John W. Cowper Company, of Buffalo. Mr. Jenkins was graduated from the Rensselaer Polytechnic Institute in 1904. Previous to entering college he had seven years' experience on hydroelectric and deep-water surveys. After graduation he became connected with the Pennsylvania Railroad on the tunnel work under the East River at New York City. Early in 1907 he was made engineer for the Naughton Company and Arthur McMullen, contractors on sections A and B of the tunnels mentioned. He was appointed engineer for the Thomas Crimmins Contracting Company in 1908 in charge of work on the New York State Barge Canal. Three years later he took a similar position with Smith, Hauser & Company & Locher on a contract with the Board of Water Supply, New York City. In 1914 he was made chief engineer for the Union (S. C.) Manufacturing & Power Company and a year later took charge of the work on the Montreal aqueduct enlargement for the Cook Construction Company. He was later made superintendent for Willard Case & Company.

R. W. REED, formerly with the engineering firm of Reed & Reed, Michigan City and East Chicago, Ind., is now superintendent for the Great Lakes Dredge & Dock Company at Buffalo.

GILBERT G. HALL, city and consulting engineer of South Bend, Wash., has been made a member of the Washington subcommittee of the Naval Advisory Board to obtain data on Washington industries

WILLIAM TRAPNELL, formerly division engineer maintenance of way of the Baltimore & Ohio Railroad at Cumberland, has been made district engineer maintenance of way at Wheeling, W. Va.

W. W. PETERSON has just been graduated from the civil engineering department of the University of Minnesota and is now employed in the engineering department of the city of Minot, N. D.

W. R. SAUTER, formerly reinforced-concrete engineer for the Department of Wharves, Docks and Ferries of Philadelphia, has been made concrete engineer for Cramp & Company, contractors of that city.

H. HUDSON has resigned as assistant city engineer of La Porte, Ind., to become connected with the Indiana Concrete Road Association, with headquarters at Indianapolis.

D. N. SHOWALTER, formerly resident engineer on the reconstruction of the Stony River Dams in West Virginia, has purchased the planing mill at West Chester, Pa., formerly owned by S. C. Black. Mr. Showalter is a graduate of Lehigh University and has been engaged in construction engineering for the past ten years.

GEORGE W. FULLER, consulting engineer, of New York City, will give lectures on sanitary engineering during 1916-17 at Yale University. Mr. Fuller has also been made supervising engineer of the operation of the sewage-disposal tank at York, Pa.

G. L. MARICK has been appointed assistant office engineer for the Gulf, Colorado & Santa Fé Railway, with headquarters at Galveston, Tex.

M. P. MELLON, formerly chief field engineer for the Tennessee Coal, Iron & Railroad Company, is now connected with R. G. Hill & Company, contractors, Birmingham, Ala. He is at present engaged in making a survey for 32 miles of road for which his company has the contract.

H. R. HERSHEY, who has been with the Pennsylvania Highway Department for the past ten years, has been made road superintendent of Lehigh and Northampton counties. Mr. Hershey entered the highway department as rodman and was successively transitman, chief of party and chief of construction. He succeeds W. H. Pascoe, resigned.

ARTHUR A. PRENDERGAST, who has been employed for the past six months as assistant engineer in the department of public utilities on the design of the new coagulation basins and covered high-service reservoir for the city of St. Paul, has resigned to become superintendent of construction for the W. J. Hay Company of that city. The Hay company was recently awarded the contract for the construction of the coagulation basins. Mr. Prendergast is a graduate of the department of civil engineering of the University of Minnesota and for the five years previous to his employment by the city of St. Paul was superintendent of construction for the U. S. Reclamation Service. Previous to that he was connected with the Great Northern Railroad on construction and location and was superintendent of construction for Donald Grant & Company.

Obituary Notes

FRANK J. CONLON, assistant engineer in the Bureau of Sewers, Brooklyn, N. Y., died June 28 at the age of 45. He has been connected with the bureau since 1895, previous to which he worked for his father on building erection for seven years. He started as draftsman in the sewer department and rose to be chief draftsman in 1900. He was made assistant engineer in 1905. Mr. Conlon has drawn plans for and superintended sewer work involving the expenditure of more than $10,000,000. Among his important works are the design of the sanitary sewer system for Coney Island and the contract plan and specifications for a number of branches of the Classon Avenue relief system.

S. H. BERRY, county engineer for Kitsap County, Washington, died recently at Bremerton, Wash. He had lived in that city for about twenty years and for a long time was city engineer.

Civil Service Examinations

United States.—Examinations will be held Aug. 1 at the usual places for topographer with International Boundary Commission at $2,100 a year. Applicants should ask for Form 1312.

Illinois.—Examinations will be held Aug. 5 for assistant sanitary engineer at $100 to $225 a month. Candidates will not assemble for first examination, which will be written; those passing will then be assembled for oral review.

Examinations Previously Announced

Date		See Eng. Record
July 15	New York. Bridge designer, superintendent of construction and junior assistant engineer	July 1
Aug. 21-25	Second Lieutenant, civilian candidates	April 1

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Economize Labor on Repaving Work

A STRIKING example of the tendency to economize human labor in construction work is presented in the repaving under way in Brooklyn, N. Y., described on page 51 last week. From the ripping up of the old wood blocks and the concrete foundation to the mixing of the joint filler the effort to minimize labor is manifest. The only features of the work monopolized by men are the finishing of the subgrade, the spreading of the sand cushion, the actual laying of the blocks and the pouring of the joints—this despite the fact that the work is carried on within very restricted limits and under conditions that at first sight would seem to discourage the use of large machinery. The bulk of the excavation, and the hardest part, is done by a steam shovel, which also loads the spoil on to the trucks. The subgrade is tamped by a steam roller and the concrete foundation is mixed and placed by machine. In mixing the joint filler the labor of five men is saved by the use of a hand-operated mixer, which, though crude, has effected economies. Such examples indicate that the labor shortage due to the European War has not been without some recompense. It is directing the contractors' attention still more forcibly to labor-saving machinery. Cheaper and better construction will be the result.

Changes in Cement Specification

KNOWING that all engineers and contractors would be anxiously awaiting details as to the character of the changes proposed in the new cement specification, sent to letter ballot by the American Society for Testing Materials week before last, the Engineering Record asked R. J. Wig, who is a member of both the Joint Conference and the A. S. T. M. cement committees, to present these changes briefly and give the reasons why the committees recommended them. The article appears on page 71 of this issue. It will be noted that while Mr. Wig, in his closing paragraph, commends the new specification, giving clearly the reasons for his commendation, he also voices the opinion that the specification "is still far from satisfactory as a basis for the purchase of cementing materials." He predicts further and important improvements during the next few years. In this position Mr. Wig is supported generally by engineers who have closely followed the subject. To conclude that the new specification is a resting point is to ignore much of the discussion of recent years and, too, the difficulties that have been met in concrete work. Fortunately the cement committee of the American Society for Testing Materials seems to be working now with great harmony. The dissensions of the past have been forgotten. With the many investigations under way and the submission of the resulting data to a committee which realizes that the unsolved problems in cement manufacture are many and important, Mr. Wig's prediction of further changes in the next few years gives promise of fulfillment.

Expensive Ambiguity

A TIMELY FOOTNOTE to the discussion of ambiguity in specifications (Engineering Record, June 24) is provided by a suit instituted in Philadelphia to recover $50,000 from the city on the ground that the contractor concerned suffered loss to this amount owing to false and misleading specifications for the building of a relief sewer. On behalf of the contractor it is alleged that the city's plans indicated that the sewer was to be built through rock that would not require shoring. It need not be accepted without reservation that "the misleading representations showing the presence of hard rock throughout the greater length of the sewer tunnel were either knowingly or recklessly made for the purpose of influencing the bidding"—this is merely an allegation; but it is easy to agree with the further assertion that the city knew, or should have known, and had means of ascertaining, what was the character of the subsoil. Apparently a serious mistake was made, and the city's plans upon which bids were taken did not represent fairly the conditions under which the work was to be done. These plans indicated that only 225 ft. of a 1900-ft. sewer would go through subsoil that required timbering. According to the contractor it would have been more exact to say that there were only 225 ft. that did not require shoring. Lawyers say that the contractor has a very good case, this conclusion being based on precedents established in suits involving a similar set of facts. However this may be, the incident certainly provides another argument against ambiguity in specifications, whether they be for steelwork or sewers.

The Allies' Economic Conference

THE BRITISH BOARD OF TRADE has published the recommendations for the regulation of the trade of the Allies made at the Paris conference held from the 14th to the 17th of last month. Rumors have been in existence that the post-bellum trade plans of the Allies would be directed not only against the Central Powers but also against neutrals. While the recommendations, as published, do not include any scheme expressly aimed at the trade of neutrals, there will naturally be an effect on the latter because of the plans for bringing about trade co-operation among England, France and Russia. Primarily the recommendations are directed toward preventing trade inroads by the Central Powers. While neutrals cannot object to the arrangement, since it is natural for allies in the tremendous struggle to desire to remain allies during the period of recuperation, the United States must look to her own interests. The very apparent danger is not from the Allies but from Germany. Cut off as she will be, if the recommendations of the Paris conference are adopted, from trade with her powerful neighbors, the fairest game for her will be the United States and those neutral countries to the south of us with whom our merchants have developed new relations since August, 1914. The situation is one warranting the most careful attention by our government departments and our manufacturers. It is obviously most dangerous to adopt measures out of hand. Protection during Europe's time of recuperation must be considered side by side with the long trade pull of subsequent years. A policy that might, from our standpoint, be eminently satisfactory during the recuperative period might merely pile up a toll of retribution for the time when economic conditions are once more normal.

A. S. T. M. Procedure

AS A RESULT of years of experience the American Society for Testing Materials has developed a procedure which seems well suited to the adoption of specifications having so important a bearing on engineering practice and industry as the standards it puts forth. This procedure requires that all proposed standards be printed for one year as tentative before coming up for final consideration and reference to letter ballot. That the plan is good is evidenced by the lack of criticism of it. In order that under exceptional circumstances a specification may be referred to letter ballot at once, without prior printing as tentative, the rules require that there shall be a nine-tenths majority of those voting. The rule indicates that the doctrine that should prevail here is the same as is applied in ejectment proceedings involving land titles —that the decision to eject must depend not on the weakness of the defendant's case but on the strength of the plaintiff's. In other words the proponents of a motion to pass a specification at once to letter ballot must bring the most weighty reasons forward in justification of the course they suggest. There was evidence at the recent meeting of the society in Atlantic City that one committee at least—that on road materials—does not appreciate fully the spirit of the procedure. It asked that quite a number of specifications not hitherto printed as tentative, and some containing amendments

which were new, though the specifications themselves were old, be passed at once to letter ballot. While as to some of the specifications the committee on being quizzed from the floor justified its request that there was reason for immediate passage to letter ballot, it was quite apparent that the seriousness of a wholesale violation of the regular procedure had never dawned upon the committee, or at least upon the representatives present on the floor. Quite rightfully there was opposition. While it is but right, when the circumstances are weighty, to waive the regular procedure and invoke the nine-tenths majority rule, only circumstances such as those under which the new cement specification was at once passed to letter ballot should justify the extraordinary procedure.

The Fight Against Efficiency

REFERENCE has already been made in this journal to the bills and riders on various measures now before Congress which would prohibit time studies and other investigations making for higher efficiency in the government service. Fortunately there has been considerable agitation on the subject. There should be far more—in fact, must be far more if these pernicious measures are to be kept off the statute books. One of the best discussions of the subject that this journal has seen is a brief letter written by J. G. White, head of the well-known corporation bearing his name, addressed to several senators and congressmen.

He points out that the only hope which we can entertain for getting any share whatsoever of foreign trade lies in developing an efficiency exceeding that of other nations. Our present industrial activity is due solely to the fact that the nations at war must come to us for supplies and, also, that they are now unable to compete for foreign business on account of their preoccupation in Europe. After the war, he predicts, the situation will be vastly changed and we shall be put to a most severe test by Europe's efforts to take care of its huge debts and rehabilitate its financial systems. If when the country faces such a situation its government, acting quite contrary to that of Germany, for example, which has always tried to set the highest standards in governmental affairs as an example for its industries, should declare that it will prevent studies to increase efficiency, it will give public encouragement and backing to misguided labor leaders who are trying to prevent the introduction of more efficient industrial methods.

As a striking example of what can be done where the restriction-of-output policy does not obtain, it is interesting to know that Sir William Beardmore in his presidential address before the Iron and Steel Institute of England, in May, said that in his factory, making munitions, girls with only three weeks' training and under exactly the same conditions, had turned out double the number of shell bodies as had the trained mechanics. In the boring of shells the output also was double, while in the curving, waving and finishing of shell bases the output was 120 per cent more than that of experienced men. That the women were not overworked, Lloyd-George's well-known ideas on social justice give assurance. This case shows not only the possibility of securing greater industrial efficiency, but indicates that pressed by circumstances the European nations have developed an efficiency in production during the last two years that they never dreamed of before.

It is imperative for the future of this country that we likewise aspire to and attain a higher industrial efficiency. That this may be done the government of the United States should set the example. The passage of the anti-time-study and anti-efficiency measures by Congress will not only discourage efficiency but will impel labor to wage an unceasing fight, even in private plants, against methods for obtaining the greatest possible output for a given expenditure of effort. With labor's determination not to be exploited, whether under the name of efficiency or otherwise, all right-minded men agree. But more efficient methods do not necessarily mean exploitation. In fact, true efficiency, which includes contented and properly remunerated labor, and exploitation are incompatible.

A Sensational Submarine Feat

THE ARRIVAL in Baltimore the other day of the submersible liner "Deutschland" is from an engineering as well as from a strategic standpoint one of the very notable feats of the many which the present war has produced. There have been long voyages of the submarines before, even across the Atlantic from Halifax to the English Coast, and from some point in Germany round through the Mediterranean. In the former instance, however, the craft did not have to run submerged, and in the latter a friendly or at least a neutral shore was never very distant.

It is a long step from ordinary submarine cruising to a cargo-carrying passage across the Atlantic. A submersible blockade runner, such as the "Deutschland" should properly be called, involves some problems quite different from the construction of a fighting submarine. The latter must be extremely quick in maneuvering, must carry armament besides her torpedoes, and must be able to submerge with great speed. On the other hand, the fighting submarine does not have to be very large, for ordinarily she never need operate far from her base. Of course, the larger the fuel capacity the better, yet experience has shown that it is not difficult to pick up gasoline tanks off a secluded spot on a neutral shore or even to have a fairly convenient base of supplies there. It is comparatively easy to get good speed under these circumstances, for all the capacity can be utilized for munitions and fuel.

The cargo-carrying submersible is a different problem. In order to make it possible to carry an amount of goods which would justify a transatlantic voyage she must be big and have a large storage capacity for fuel as well as for cargo. Reports indicate that the "Deutschland" is somewhat in excess of 300 ft. in length and of perhaps 30-ft. beam. Such a boat evidently cannot be overloaded with storage battery for submerged running, yet must be able to make fairly good headway when operating on the surface. It is no mean feat to design a craft of this sort able comfortably to weather the transatlantic voyage when heavily loaded and nearly awash, while yet retaining ability for prompt submergence and a fair speed under water without leaving a telltale wake behind. It implies greater structural strength than in case of a fighting boat, both on account of the strains encountered in running through a sea and for the power to maintain the deep submergence necessary to avoid traces of her progress being visible from the surface.

Apparently all these requirements have been well fulfilled in the "Deutschland," which seems to have made some two-thirds of the distance on the surface, although she had to make long under-water runs in dodging the British blockading fleet. Congratulations are certainly due on this feat of under-seamanship. That she got through the rather loose patrol which had to extend far along our Atlantic Coast is not remarkable, but getting out of the Chesapeake will be a considerably more difficult feat than getting in. Chesapeake Bay is shallow and while the returning "Deutschland" will be safe within the three-mile limit she cannot well pass out through the Capes untrailed. Then it will be a game of hide-and-seek and the safety of the returning freighter will be dependent on her ability to work submerged with never a bubble or an oil drop to disclose her path. If she departs successfully it is quite safe to say that there will be plenty of other visits of the same character and another entirely new feature will be added to the intricacies of naval warfare. What the end of this submarine engineering will be is hard to say, but one can easily imagine much larger craft built with the "Deutschland's" experience in view, and quite able to carry enough cargo to make blockade running well worth the while.

Scathing Arraignment of Reclamation Service Agitation

LAST winter, after a careful inquiry into conditions on the projects of the U. S. Reclamation Service, the Engineering Record expressed itself most emphatically on the reasons for the present conditions. It stated that other factors than the alleged high cost of the irrigation works were chiefly responsible for the unsatisfactory conditions, characterized as disgraceful the hearings before some of the boards of cost review, and laid the bulk of the agitation to the door of the speculators and not of the farmers. The first issued report of the Central Board of Review not only supports these contentions as to the Carlsbad project, but is far more severe than was this journal. In other words, there is now official sanction of the position taken by the Engineering Record.

While the Central Board's report is on only the Carlsbad project, its comments on the speculator are general. As to the hearings and the difficulties, the Engineering

Record takes full responsibility for saying that, while not so noisome, the hearings on some of the other projects have followed in the main the disgraceful spirit shown at Carlsbad, and that elsewhere, also, other things than the cost of the works are responsible for the failures.

The Central Board of Review, it will be remembered, was appointed by Secretary Lane to pass on the reports of the local boards which reviewed the costs on individual projects. It consisted of Dr. Elwood Mead, chairman, Brig.-Gen. William L. Marshall and I. D. O'Donnell. Dr. Mead is a recognized authority on reclamation matters and was formerly chairman of the State Rivers and Water Supply Commission of the State of Victoria, Australia. General Marshall, formerly Chief of Engineers of the U. S. Army, has for years been consulting engineer for the Secretary of the Interior. Mr. O'Donnell is supervisor of irrigation of the Reclamation Service and is generally conceded to be one of the most successful irrigators in the West. The Board, therefore, is thoroughly competent to discuss irrigation matters, while the eminence of its members warrants more than usual consideration of its utterances.

The Central Board's review, published in the July number of the "Reclamation Record," opens with a scathing condemnation of the majority report of the local board. Not only was that report published before it was submitted to the Secretary of the Interior, and even before the minority report was written—a most irregular and unwarranted procedure—but it contains lurid and unfounded comments that did the government a gross injustice. Then in the fullness of the malign spirit that actuates the speculative element, this report and these lurid comments, unfounded and irregularly released, were sent to the water users on each project. The remissions of legitimate charges against the project recommended by the majority report, so the Central Board states, "encouraged water users elsewhere to ask for similar and equal reductions. An impression was created in widely separated localities that the purpose of these boards was to reduce project costs rather than determine them."

A quotation will serve to show the mental state of the two signers of the majority report of the local board. It is part of the comment prepared by the chairman and issued with the report:

"The water user had no voice or vote in the selection of either [engineers and watchmen employed by the Reclamation Service] and had neither the right to hire or fire, and yet he is absolutely compelled to agree to another increased construction cost per acre or let his land go back to the wilderness.

"He has only the right to pray and pay. . . .

"And now realizing the total costs, with all reverence and with a full realization of the present conditions obtained by careful research, I utter the prayer:

"God pity the water user on the Carlsbad project."

The impression which comments of this sort will make can well be imagined. As to the justice of the first statement the Central Board finds that the water users, voluntarily in November, 1911, asked for a further appropriation and agreed to pay the full cost. In other words, they fully accepted the stipulated cost and were not forced "to agree to another increased construction cost per acre," as the chairman of the local board states.

Being of such a mind it is not surprising that the majority recommended that the government reduce the cost of the project to the settlers by $514,021.29—more than half of the total of $933,840.96 which the government had spent on it. With this recommendation the Central Board disagrees, though there are certain items which it recommends be investigated and an adjustment made if the facts warrant it. The board also recommends that the administrative expenses of the Washington office and the cost of making and installing certain wooden gates be not charged against the water users.

Of course, the majority members did not take their ideas from their imaginations. The review of the Central Board leaves no doubt whatsoever as to the source of the misconceptions, and it is to this feature of the report that the Engineering Record directs special attention. The speculative landholder is to blame, and in so declaring the Central Board bears out the contentions made in this journal in the issue of January 1 this year. Though lengthy the board's comment puts so forcibly and well the crux of the situation that it deserves quotation in full. Moreover, having quoted it there will be little need for comment. It carries full conviction. Says the Central Board:

"The speculative landholder on our irrigation projects and his allies, the usurer and the real estate commission dealer, as a rule invest no money in improving or cultivating land. They produce nothing and have no intention to produce anything from the soil. They rely for their profit on the necessities of the settlers and farmers and on the unearned increment due to rise in land values from the mere fact that they were irrigable; from the settlement and increase in value of the neighboring lands, due to the sweat of their neighbor's brow, and from the increase in population and local business and trade. They, unfortunately, may always be found at the head and front of every movement to repudiate under any and every flimsy pretext, and to cut down the actual and proper cost of irrigation works that alone give value to their own and neighbor's lands and are the only basis of prosperity. They constitute not only no use or value to the project, but are the greatest possible nuisance, handicap, and hindrance to development and progress. This blemish of the reclamation act must be eliminated, controlled or abated before any successful system of land settlement in the arid states can be carried out by the states or general government.

"We can not conceive how it was possible for the local board to overlook this situation, and especially how those who prepared the comments above mentioned regarding the plight of the water user could ignore the fact that the main difficulty of the water user is not high project costs, but inflated land prices and usurious interest rates on borrowed money and deferred payments. . . . Those who are urging that the project costs be reduced because they allege that $30 an acre is all that can be paid for a water right are neither improving nor cultivating farm units, in great areas of idle land held in the names of dummy owners, but are asking the real developer to pay from $50 to $150 an acre for the privilege of doing this. In our judgment, if there is to be any reduction, it should not be at the expense of the reclamation fund, but should come in the form of reduced prices for excess lands. It is the government's investment that has created whatever values exist there, and this investment does not justify the prices that are asked. When one considers the nature of the ownership of the excess lands, one realizes that a reduction in project costs will not benefit the water user or any purchaser of these lands one iota; that reduction will simply go into the pockets of the present speculative owners or increase the value of any mortgage on these lands, or both."

Comment is unnecessary, other than to indicate a hearty concurrence in the board's opinion that the speculative element must be eliminated from the projects. It is a difficult problem, but it must be solved before success can be attained.

It must not be thought, however, that the Central Board absolves the government from all blame. The history of the Carlsbad project, which the board details, shows that the government took up a scheme entirely under private control which had repeatedly demonstrated its capacity to consume the money of investors. What influences there were that resulted in the adoption of a tottering project by the government the Central Board does not say. It makes it very clear, however, that in its judgment the reclamation act did not contemplate the taking over by the government of projects either wholly or almost entirely under private ownership. The Carlsbad project, of course, is not the only private enterprise taken over. Where the government has taken projects of that class the owners at the time the government came have done well. The actual farmer, whose energies and struggles have helped to build up new domains on barren wastes, has paid dearly to the land owners for the increased value created by the government's expenditures.

It is well for the country that the Central Board has spoken so plainly and forcibly on some of the evils that beset the reclamation projects. There has been much misunderstanding of them, particularly in the East. There is no one who would not be most generous in dealing with the projects if conditions were as they are represented—due solely or almost entirely to government mismanagement—and if what were done would redound to the benefit of those who are actually developing the land. The truth being known, however, distinctions will be made, and the sympathy which the hard-working settlers have earned will be tempered by the determination that nothing should be done which will further help the speculators. The Central Board's report should secure the widest publicity.

SINKING 62 x 140-FOOT CAISSON FOR PUMPING STATION IN CENTER OF NARROW 6-MILE CAUSEWAY ACROSS NORTH END OF BEAR LAKE

Pumping Station Will Make Deep Idaho Lake Available as Equalizer for Bear River

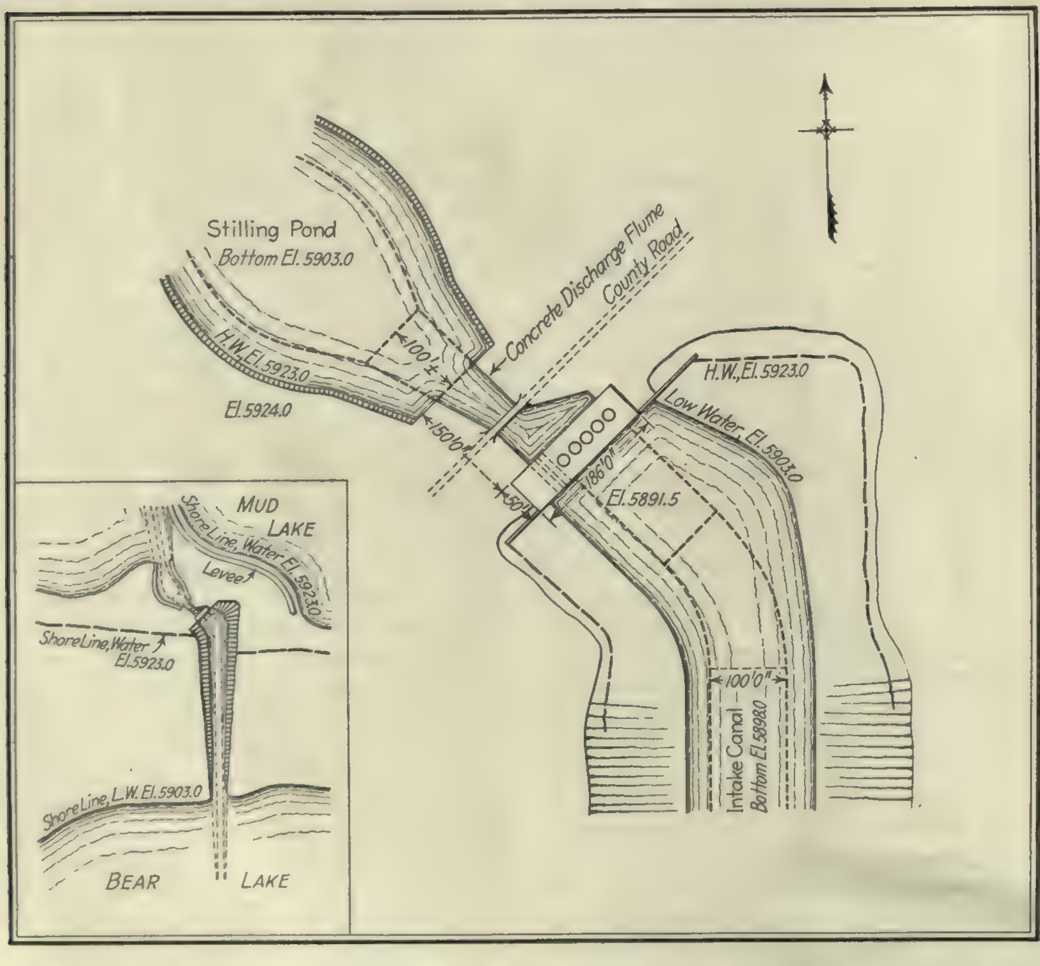
Continuous Flow Sufficient for Irrigation and Power Developments Will Be Provided Over Any Probable Succession of Dry Years by Drawing Down Big Natural Reservoir

BEAR LAKE, in the Wasatch Mountains on the Utah-Idaho line, with an available storage capacity of 1,300,000 acre-feet, is to be utilized, by the construction of a pumping station rated at 1500 sec.-ft. capacity, as a huge equalizing reservoir which will be filled in periods of heavy rainfall and drawn down during dry years to bring under complete control the flow in Bear River. The flow to be regulated by this station, located at a point called Lifton on a narrow causeway crossing the north end of the lake, will operate four large hydroelectric developments on the river below and will furnish water for extensive irrigation use. Both in point of employing as a reservoir a lake with very large storage capacity in comparison with the annual flow of the river, and of using to draw it down a pumping station driven by power developed from the water pumped, this project is believed to be unique.

Topography Key to Project

A glance at the map is necessary to make plain the reasons for this development. Bear River, flowing north, emerges from the mountains east of Bear Lake, traverses on a slope of barely a foot to the mile the flat mountain valley in which lies the lake, turns west and breaks through the Wasatch Mountains. From this point it runs south to Great Salt Lake on a steeper gradient in which a fall of 865 ft. is utilized by three plants now in operation and one under construction. Thirty miles beyond Bear Lake the river is but 40 ft. below normal lake level, and even to reach this far with a canal a succession of several miles of rocky ridges in the valley floor would have to be cut through. The junction with the river of the outlet canal now under construction, though 16 miles above the lake and as far downstream as a canal can be dug by dredging, is but 11 ft. below the lake level. It was evident that a pumping station would be required if any considerable flow was to be maintained from the lake at stages 4 ft. or more below its normal level. The Utah Power & Light Company, which supplies electric power for lighting, traction, irrigation pumping and mining and industrial plants throughout this territory, and the chief units of whose generating system are on Bear River, therefore decided to add the pumping station to the inlet and outlet canals already built and building to connect the river with the lake.

A 12-ft. drawdown would equalize the flow of the river over any succession of dry years recorded, but a maximum drawdown of 21 ft. is provided for to cover any inaccuracies in the records and to make it possible to equalize the power output from streams other than Bear River itself.



PUMPING STATION SET AT ANGLE WITH INTAKE CANAL TO AVOID DAMAGE FROM DRIFT ICE

Development Valuable for Irrigation

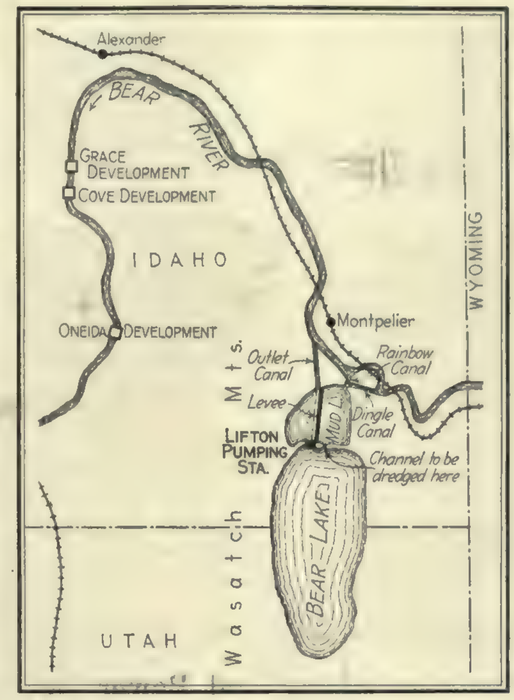
Bear River drains an area of 6500 square miles, made up of portions of southwestern Wyoming, southeastern Idaho and northern Utah. The drainage area of Bear River above the lake is approximately 3000 square miles, and the drainage area of Bear Lake itself is about 400 square miles. The capacity of the inlet canals constructed is 5000 sec.-ft., so that practically all flood waters can be diverted into the lake. The four hydroelectric stations located on the river below the lake develop at maximum capacity 67,500 kw.

Irrigation is extensively carried on in the Bear River drainage area, the water being diverted from the main river and from a great many of its smaller tributaries. The regulation of the river for power purposes automatically regulates the flow for irrigation also, and will prevent

a shortage of water in dry years and provide water for irrigating large additional areas both by gravity and electric pumping distribution. The depth to which it will be possible to draw down the lake will make more water available for irrigation in the summer months than could be secured by a system designed merely to equalize the flow of the river throughout the year.

Lake Steepsided

Bear Lake is a deep body of water approximately 21 miles long and 8 miles wide. At the north end there are a large swamp and a shallow lake called Mud Lake, which is 6 miles long and 5 miles wide. The inlet canals through which water is diverted from Bear River discharge in the north end of Mud Lake, and the water then runs 6 miles through this lake into Bear Lake. When Bear Lake has been pumped down 5 ft., practically the entire bottom of Mud Lake will be exposed. In Bear Lake itself the shores are steep and there is little difference in area between the high and low water levels. One foot of drawdown of the lake equals 68,000 acre-feet.

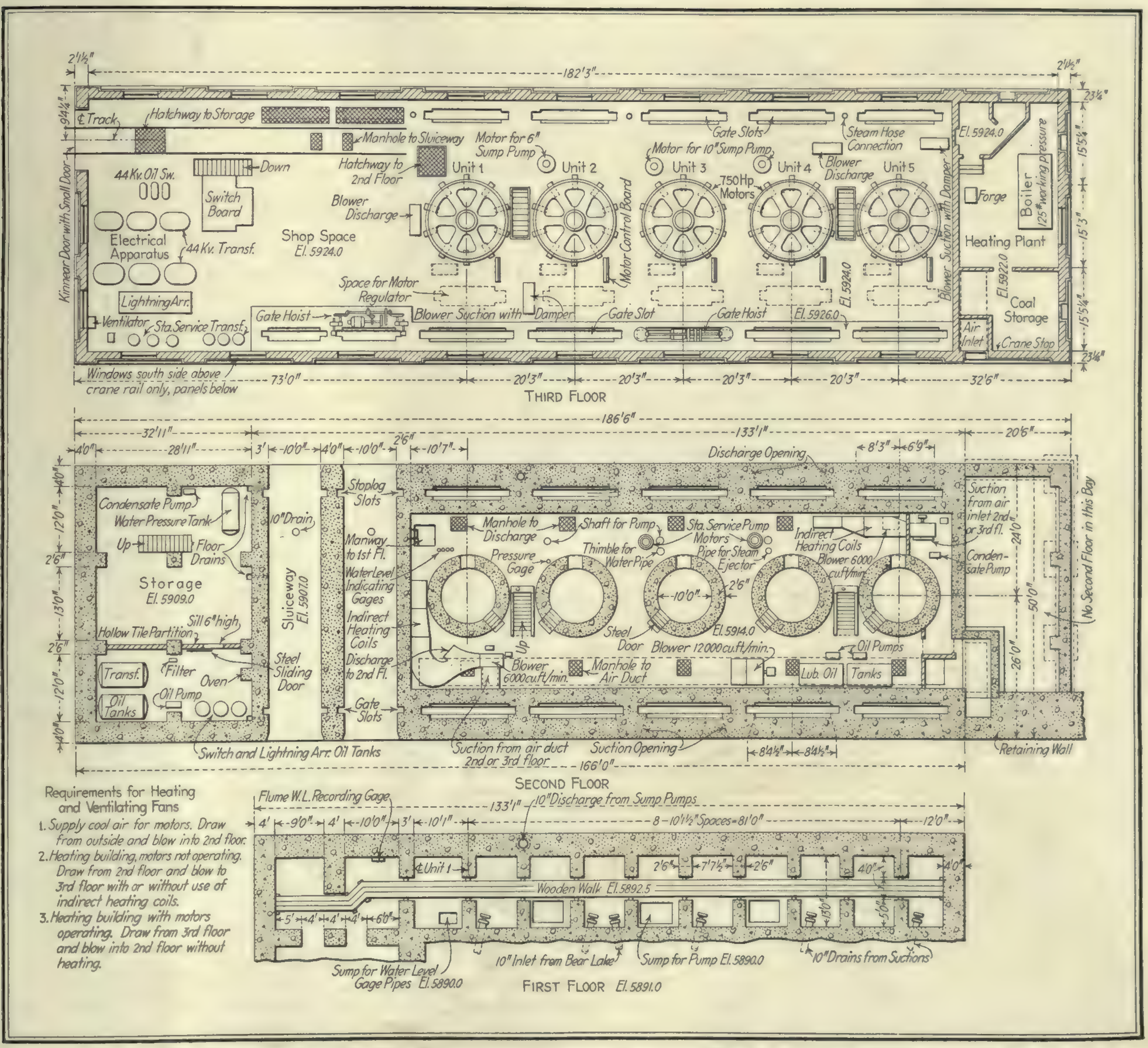


WORKS TO CONVERT LAKE INTO RESERVOIR

There was formerly a natural outlet from the lake to the river, which extended over a very flat swamp and was 20 miles long. It had very small capacity and such a flat grade that during the spring, when the river was at high stages, it is said that water sometimes flowed from the river back into the lake.

Outlet Canal Has Flat Grade

A canal has been dredged across this swamp from Lifton on the north end of Bear Lake 14 miles north to the river at a point called Junction. When the lake is full the surface of the river at Junction is approximately 11 ft. below the surface of the lake. Practically all of this fall is necessary for the canal to pass the maximum flow required. It is possible to draw the lake down by gravity to a depth of 4 ft. by means of this outlet canal, but the rate of flow through the canal is greatly reduced as the lake level drops. The pumping plant, however, will make available the desired storage capacity and at the same time secure the full discharge capacity of the canal at all stages of the lake. The



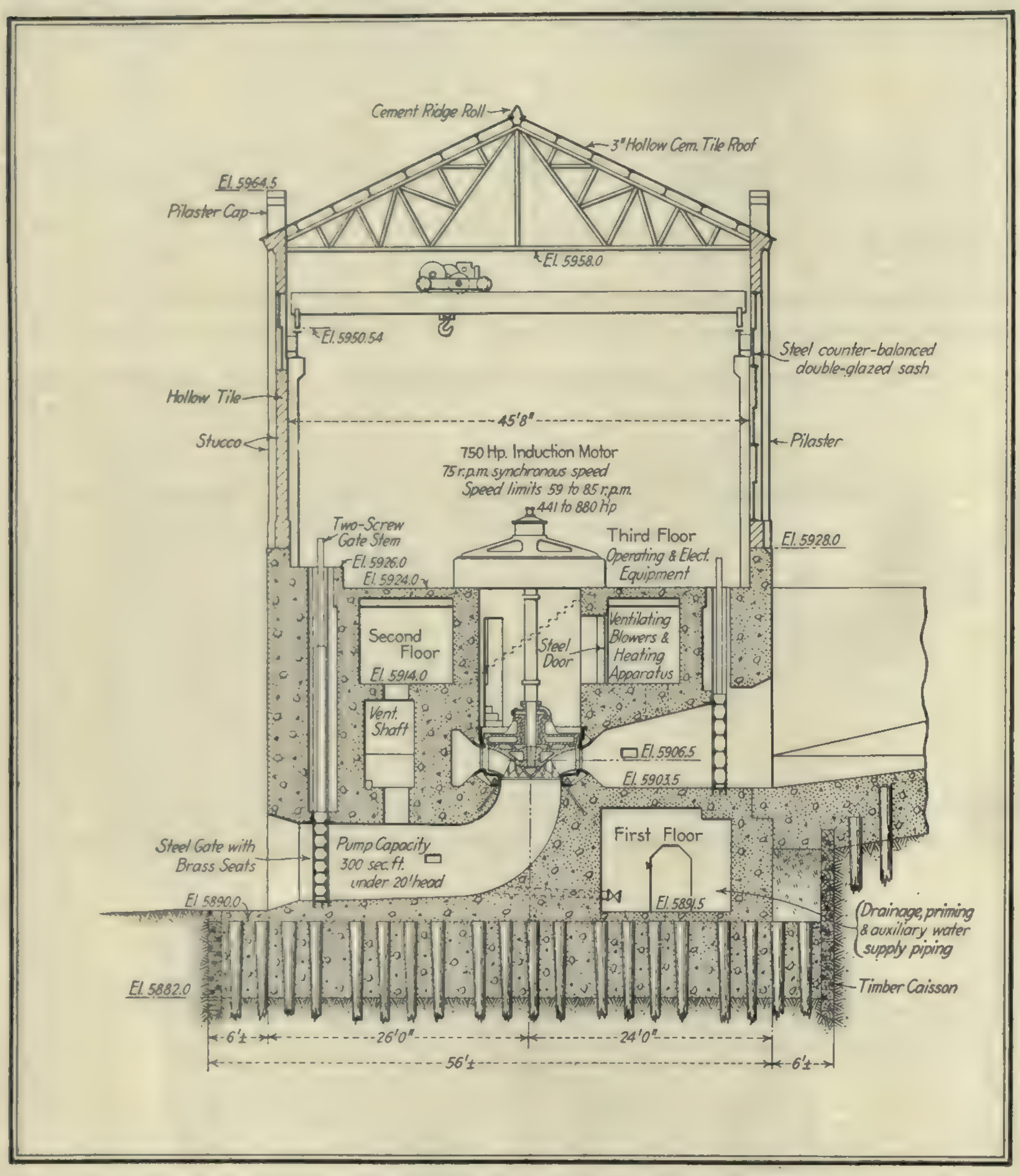
FLOW OF 1500 SECOND-FEET MAINTAINED BY FIVE HUGE PUMPS—LIFTED 20 FEET HERE, THIS FLOW DEVELOPS TOTAL HEAD OF 865 FEET BELOW

plant is located on the upper edge of the lake, at the head of the outlet canal, and will develop the maximum capacity mentioned of 1500 sec.-ft. at 20-ft. head, although to equalize the flow in Bear River below the lake over an average year it will be necessary to use only three of the units and to lower the lake level only 3½ ft.

Five vertical-shaft units with a nominal capacity of 300 sec.-ft. each will be contained in the pumping station. As the head will vary from nothing to 20 ft., variable-speed motors and two types of impellers have been provided for better operation at low heads. The arrangement of the principal and auxiliary apparatus in the station and the heating and ventilating system required by the cold winter climate are clearly shown in the accompanying drawings.

It was necessary to locate this station on a sand bar called the Causeway, which extends entirely across the north end of Bear Lake and separates it from Mud Lake and the swamp. All the material about this locality is very fine sand mixed with clay, which extends to unknown depth. The only variation is in the percentage of sand and clay. This material flows readily in water, and the wave action against the Causeway has flattened it out so that the bottom of the lake at the contour line 20 ft. below its normal surface is approximately 2000 ft. from the normal shore line along the Causeway. Heavy wind storms sometimes break up the ice on the lake and pile it up on the Causeway to a height of 10 or 12 ft. For this reason the pumping plant has been located on the north side of the bar, at the head of the outlet channel, and has been set at an angle with the intake channel, so that if ice is forced into the latter it will pass the station and pile up where there are no structures.

On account of the peculiar foundation conditions, the building is being constructed on a concrete mat supported on piles. In order to place and unwater this mat an open wooden caisson 140 x 62 ft. was sunk to a depth of 44 ft. The construction of this caisson, which is one of the largest ever sunk by open dredging, will be described in a future article.



SEVERE CLIMATE AND COST OF COAL REQUIRED CAREFUL INSULATION OF BUILDING

A large intake channel will be dredged through the beach south of the Causeway to the pumping plant. While it is possible that wave action may gradually fill this channel with sand and make its maintenance a difficult problem, the cost of a permanent intake channel would have been so great that it was not considered expedient to build one. The channel will be dredged very large at first and will be maintained by such additional dredging as may be necessary in the future.

The pumping station is now being completed by the Jarrett-Chambers Company for the Utah Power & Light Company, a subsidiary of the Electric Bond & Share Company, the work being under the direction of the engineering department of the latter company.

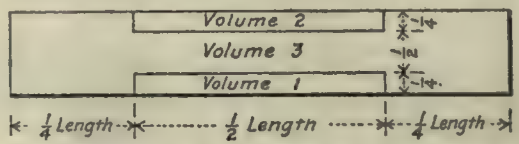
Specification for Fir Bridge Timbers Proposed

Rings Clause and Branding Suggested by Timber Committee of American Society for Testing Materials

FOLLOWING the step taken last year, when a Southern yellow-pine density specification was brought in, the American Society for Testing Materials at its recent annual meeting received from its timber committee a tentative specification for "selected structural Douglas fir" bridge and trestle timbers. The chief features of the specification are the provision of a ring clause for determining density and of a branding clause. The yellow-pine specification is followed in localizing the permissible defects in certain volumes. The specification will be printed among the tentative group and come up for final consideration with a view to adoption two years hence. Except for the omission of certain specifications, it is given here complete.

DENSE AND SOUND GRADES

Dense and Sound Douglas Fir—Under this heading two classes of timber are designated—(1) dense Douglas fir and (2) sound Douglas fir. It is understood that



VOLUMES FOR RESTRICTING DEFECTS

these two terms are descriptive of the quality of the clear wood.

Dense Douglas Fir—Dense Douglas fir shall show on either one end or the other an average of at least 6 annual rings per inch or 18 rings in 3 in. and at least 33 1/3 per cent summerwood, as measured over the third, fourth and fifth inches on a radial line from the pith, for girders not exceeding 20 in. in height and for columns 16 in. square or less. For larger timbers the inspection shall be made over the central 3 in. on the longest radial line from the pith to the corner of the piece. Wide-ring material excluded by the foregoing will be accepted provided the amount of summerwood as above measured shall be at least 50 per cent.

In cases where timbers do not contain the pith, and it is impossible to locate it with any degree of accuracy, the same inspection shall be made over 3 in. on an approximate radial line beginning at the edge nearest the pith.

The radial line chosen shall be representative. In case of disagreement between purchaser and seller as to what is a representative radial line, the average summerwood and number of rings shall be the average of the two radial lines chosen.

Sound Douglas Fir—Sound Douglas fir shall include pieces of Douglas fir without any ring or summerwood requirement.

GENERAL REQUIREMENTS

(*a*) The timber shall be only "dense Douglas fir."

(*b*) The timber shall be well manufactured, square edge and sawed standard size; solid and free from defects such as ring shakes and injurious diagonal grain, loose or rotten knots, knots in groups, decay, pitch pockets over 6 in. long or ⅜ in. wide, or other defects that will materially impair its strength.

(*c*) Occasional variation in sawing, not to exceed ¼ in. scant at the time of manufacture, will be allowed.

(*d*) When timbers 4 x 4 in. and larger are ordered sized, they shall be ½ in. less than rough size, either S1S1E or S4S, unless otherwise specified.

SPECIFIC REQUIREMENTS

Stringers, Girders and Deep Joists—The timber shall show not less than 85 per cent of heart on each of the four sides, measured across the sides anywhere in the length of the piece. It shall not have in volumes 1 and 2 (see drawing) knots greater in diameter than one-fourth the width of the face in which they occur with a maximum of 1½ in. in diameter. It shall not have in volume 3 (see drawing) knots larger than one-third the width of the face in which they occur, with a maximum of 3 in. in diameter. Knots within the center half of the span shall not exceed in the aggregate the width of the face in which they occur. Diagonal grain in volumes 1 or 2 with a slope greater than 1 in 20 will not be permitted. When stringers are of two-span length they shall be considered as two separate pieces and the foregoing restrictions applied to each half. The inspector shall place his stamp on the edge of the stringer to be placed "up" in service.

Caps and Sills—The timber shall show 85 per cent of heart on each of the four sides, measured across the sides anywhere in the length of the piece, and shall be free from knots larger than one-fourth the width of the face in which they occur, with a maximum of 3 in. in diameter. Knots shall not be in groups.

Posts—The timber shall show not less than 85 per cent of heart on each of the four sides, measured across the face anywhere in the length of the piece, and shall be free from knots larger than one-fourth the width of the face in which they occur, with a maximum of 3 in. in diameter. Knots shall not be in groups.

Longitudinal Struts or Girts—The timber shall show all heart on one face; the other face and two sides shall show not less than 85 per cent of heart, measured across the face or side anywhere in the length of the piece, and shall be free from knots over 2 in. in diameter.

Longitudinal X-Braces, Sash Braces and Sway Braces—The timber shall show not less than 85 per cent of heart on two faces and shall be free from knots larger than one-third the width of the face in which they occur, with a maximum of 2 in. in diameter.

Branding—The inspector shall brand each timber which conforms to the foregoing requirements "Selected Structural Douglas Fir."

The New Cement Specifications—The Changes Made and the Reasons Therefor

Explanation of the Requirements Which Are Expected to Receive General Approval and Become the Single Standard for This Country

By R. J. WIG

Member of the Joint Conference and A. S. T. M. Cement Committees, Washington, D. C.

THOSE who have not been closely identified with the preparation of the new specification for Portland cement, passed to letter ballot by the American Society for Testing Materials last week, may question the advisability of some of the changes and may desire an explanation of the committee's intent and purpose.

The writer, who has been intimately identified with this revision and is acquainted with the work of all the committees which gave it consideration, presents the following comments as his personal understanding of the committee's purpose.

Every requirement of the old specification has been changed in some respect and perhaps no other specification of the society has ever received such careful and thorough consideration.

HISTORY OF REVISION

There were two nationally recognized specifications for Portland cement in the United States in 1912—that of the American Society for Testing Materials, with methods of tests prepared by the American Society of Civil Engineers, and the United States Government specification.

At the suggestion of the cement committee of the American Society for Testing Materials a joint conference of nine members was organized, composed of three representatives from each interest—the government, the testing materials and the civil engineers' societies.

The Joint Conference convened in October, 1912, held numerous meetings and made various investigations. In April, 1915, it submitted its first report, which included a recommended uniform specification. This specification was given consideration by the cement committees of the U. S. Government and of the American Society for Testing Materials. The society's committee appointed numerous sub-committees that gave careful study to each recommendation of the conference, holding many meetings and making numerous investigations and tests.

The A. S. T. M. committee held a session of two days and two nights in April of this year, giving consideration to their subcommittee reports and also to the changes suggested by the government committee, which had held a meeting previously. As a result of this study, the cement committee of the A. S. T. M., on April 28, 1916, tentatively agreed upon a specification which modified in many particulars the specification recommended by the Joint Conference in its report of April, 1915.

This tentative specification of the A. S. T. M. was transmitted to the Joint Conference and the U. S. Government committee for further consideration.

On June 1, 1916, the Joint Conference issued its second report, including a revised uniform specification. This specification embodied many of the changes recommended by the A. S. T. M. and the government committees. On June 28, 1916, the A. S. T. M. committee considered this revised uniform specification and, with some few exceptions, approved it.

The cement manufacturers had no voice in the proceedings of any of the committees excepting that of the A. S. T. M. All changes made were agreed to by at least a majority of the engineers, representing consuming interests, upon the A. S. T. M. committee, excepting one item in the methods of tests—the tolerance clause on the fineness determination. The majority of the consumers desired to have this clause eliminated. With this exception the specification may be understood in one sense as a consumers' specification agreed to by the producers or manufacturing interests.

For the convenience of the reader, the old and new versions of each requirement will be given preceding the comment thereon. Additions or new matter is given in small type italics. Old matter omitted or changed is shown in small roman type.

DEFINITION

(Old) This term is applied to the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3 per cent has been made subsequent to calcination.

(New) Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and properly proportioned mixture of argillaceous and calcareous materials, with no additions subsequent to calcination excepting water and calcined or uncalcined gypsum.

The old definition was considered to partake of the nature of a specification and to be improper in including quantitative chemical restrictions which were specifically provided for elsewhere. Furthermore, no test is available to the consumer whereby he may determine whether the 3-per cent limitation is exceeded. The limitations under "Chemical Properties" prevent adulteration and the use of gypsum in quantities considered to be deleterious.

CHEMICAL PROPERTIES

The cement shall not contain more than 1.75 per cent of anhydrous sulphuric acid (SO_3), nor more than 4 per cent of magnesia (MgO).

The following limits shall not be exceeded:

	Per Cent
Loss on ignition	4.00
Insoluble residue	0.85
Sulphuric anhydride (SO_3)	2.00
Magnesia (MgO)	5.00

A restriction on the insoluble residue was included in the specification in order to prevent adulteration of cement by the addition of raw siliceous materials or appreciable quantities of cement rock. This requirement has been in the U. S. Government specification for several years and has been found to be useful in rejecting adulterated cements. The maximum limit for sulphuric anhydride (SO_3) was increased from 1.75 to 2.00 per cent because there was no evidence that the quality of the material was impaired by such a change. The increase in the fineness requirement and further restriction in the time of setting made such a change desirable and logical from the standpoint of the manufacturer. This permissible increase will probably be taken advantage of only by a limited number of mills, for gypsum is more expensive than cement, and it is the desire of the manufacturer to restrict its use to a minimum. The maximum content of sulphuric anhydride fixed by European practice is as follows:

	Per Cent
England	2.75
Germany	2.50
Austria	2.50
Holland	2.50

The magnesia limitation was raised from 4 per cent to 5 per cent. All data available

to the committees demonstrated that cements containing magnesia several per cent in excess of 5 per cent were equal in quality to those containing less than 4 per cent. The raising of this requirement reduces the cost of manufacture in some cases and should increase competition. This increase was first agreed to and recommended unanimously by the Joint Conference, upon which the cement manufacturers had no voice.

SPECIFIC GRAVITY

While the specific gravity requirement is still included, it was the general opinion that it furnishes little or no information. This requirement was said to be quite generally ignored in present practice. A cement meeting all other requirements was thought to be satisfactory irrespective of its specific gravity. While sufficient data were not available to warrant its complete elimination from the specification in the minds of some of the members, it is not made obligatory on the laboratory except when specifically ordered by the engineer. A lower specific gravity (3.07) is permitted for white Portland because by nature it has a very low iron content and correspondingly low specific gravity.

FINENESS

It shall leave a residue of not more than 8 per cent on No. 100 and not more than 25 per cent on No. 200 sieve.

The residue on a standard No. 200 sieve shall not exceed 22 per cent by weight.

The increase in the fineness requirement is a recognition of the value of fine grinding. The engineers were not unanimously in favor of the change. Some were of the opinion that the improvement in quality might not be commensurate with the increased cost, while others doubted whether increased fineness improved all brands.

Tests made on a rather comprehensive scale showed an average increase of 2 per cent in the compressive strength of concrete at the age of one month for each 1 per cent increase in fineness between 25 and 15 per cent residue on the No. 200 sieve. The reader is cautioned against misinterpretation of this statement. Of two brands of cement one having a residue of 25 per cent and the other a residue of 20 per cent on the 200 sieve, the latter is not necessarily the superior in quality; the reverse may be true. The fineness of two cements alone does not furnish any indication of their relative cementing values in concrete. However, it is the belief of many members of the committees that every brand of cement is improved by finer grinding, provided no change is made in the composition and method of manufacture.

The increase in fineness was limited for the present to 22 per cent residue on the No. 200 sieve, as too great an increase at this time, it was believed, would unbalance many mills and work undue hardship on some manufacturers. Since approximately 40 per cent of the cement mills are at present grinding all their product to meet this requirement, its enforcement will not affect all mills alike. Many engineers look forward to further increases in fineness, provided future data continue to show their value.

The study of available data showed that the relative fineness of that portion of cement which is retained on the No. 100 sieve is unimportant, as it has little or no cementing value; and with present methods of grinding the great majority of cements meeting the present requirements of the No. 200 sieve will of necessity meet the requirements of the No. 100 sieve. Therefore the No. 100 sieve requirements have been omitted.

SOUNDNESS

Pats of neat cement about three inches in diameter, one-half inch thick at the center and tapering to a thin edge shall be kept in moist air for a period of 24 hours.

(a) A pat is then kept in air at normal temperature and observed at intervals for at least 28 days.

(b) Another pat is kept in water maintained as near 70 deg. Fahr. as practicable, and observed at intervals for at least 28 days.

(c) A third pat is exposed in any convenient way in an atmosphere of steam above boiling water, in a loosely closed vessel for 5 hours.

A pat of neat cement shall remain firm and hard and show no signs of distortion, cracking, checking or disintegration in the steam test for soundness.

It was the generally expressed experience of members that cements meeting the other requirements of the specifications never failed to meet the soundness requirement exposed in air or water, provided they remained sound when exposed to the steam test. All available data confirmed these statements. The air and water tests were therefore considered unnecessary and were omitted. The description of the test piece and method of making the test is included under "Methods of Tests," which forms an appendix to the specification.

TIME OF SETTING

It shall not develop initial set in less than 30 min., and must develop hard set in not less than one hour nor more than 10 hours.

The cement shall not develop initial set in less than 45 min. when the Vicat needle is used or 60 min. when the Gillmore needle is used. Final set shall be attained within 10 *hours.*

While the old specification provided only for the use of the Vicat needle for determining time of setting, it was found that the majority of laboratories were using the Gillmore needles, because of their greater convenience. The new specification therefore provides for the use of either needle. Tests have shown that the Gillmore needle requires on the average about 15 min. more than the Vicat needle to indicate initial set. The increase in the time of initial set was deemed desirable by the engineers, as it is not uncommon to find that cements which meet the old specification requirements in the laboratory become quick setting on the work where the temperature is 10 deg. or more above that of the laboratory. This change was strongly recommended by a number of the engineers.

TENSILE STRENGTH

The minimum requirements for tensile strength for briquettes 1 sq. in. in cross-section shall be as follows, and the cement shall show no retrogression in strength within the periods specified:

NEAT CEMENT

Age	Strength, Lb.
24 hours in moist air	175
7 days (1 day in moist air, 6 days in water)	500
28 days (1 day in moist air, 27 days in water)	600

ONE PART CEMENT, THREE PARTS STANDARD OTTAWA SAND

Age	Strength, Lb.
7 days (1 day in moist air, 6 days in water)	200
28 days (1 day in moist air, 27 days in water)	275

The average tensile strength in pounds per square inch of not less than three standard mortar briquettes (see Par. 57) composed of one part cement to three parts standard sand, by weight, shall be equal to or higher than the following:

Age at Test, Days	*Storage of Test Pieces*	*Tensile Strength, Lb. Per Sq. In.*
7	1 *day in moist air,* 6 *days in water*	200
28	1 *day in moist air,* 27 *days in water*	300

The average tensile strength of standard mortar at 28 *days shall be higher than the strength at* 7 *days.*

The neat tests have been eliminated from the specification, it being the general opinion that they are unreliable and misleading. For example, the tests of cements ground to increased fineness showed decreased strength in the neat tests, although there were substantial increases in the mortar and concrete tests. It was not uncommon to find retrogression with age in neat tests between 7 and 28 days, although substantial increases were obtained in mortar tests.

The mortar strength requirements at 28 days were increased by 25 lb. per square inch. Tests substantiated by general experience showed that most cements gave strengths appreciably higher than the old-specification requirement. The new specification requires the use of 1 per cent more water in mixing the mortar, which gives greater uniformity in results, but on the average about 15 lb. lower strength. Therefore this is equivalent to further raising the tensile-strength requirement.

The retrogression clause was somewhat indefinite in the old specifications. In the new it is made specific as applying only to the 7 and 28-day periods. The committee gave consideration to compression tests as a substitute for the tension tests, but sufficient data were not available at present to permit its inclusion in the specification.

INSPECTION AND REJECTION

Every facility shall be provided by the contractor and a period of at least 12 days allowed for the inspection and necessary tests.

Cement failing to meet the 7-day requirements may be held awaiting the results of the 28-day tests before rejection.

All tests shall be made in accordance with the methods proposed by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented to the society Jan. 21, 1903, amended Jan. 20, 1904, and Jan. 15, 1908, with all subsequent amendments thereto.

Every facility shall be provided the purchaser for careful sampling and inspection at either the mill or at the site of the work as may be specified. At least 10 *days from the time of sampling shall be allowed for the completion of the* 7*-day tests and at least* 31 *days for the completion of the* 28*-day tests. The cement shall be tested in accordance with the methods hereinafter prescribed. The* 28*-day test shall be waived only when specifically ordered.*

The old specification did not permit sufficient time to complete the 28-day tests, except in cases where the cement failed to meet the 7-day requirements. The new specification provides time for the completion of both tests. The committee's own methods are used rather than those recommended by the American Society of Civil Engineers. A clause is added covering the acceptance of cement upon a 7-day test when specifically ordered by the engineer. Many engineers objected to the inclusion of this clause, as it was felt that with the omission of the neat tests and many other tests in the specification the 28-day mortar tests should not be omitted except under very unusual conditions.

Practically no changes were made in the rejection clauses except in grouping them under one heading, changing the diction slightly and adding a new paragraph which provides for a tolerance on the allowance variation of weight of packages.

METHODS OF TESTS

In all previous specifications for cement the methods of tests were prepared by a special committee of the American Society of Civil Engineers. Therefore a consideration and revision of methods by the cement committee of the American Society for Testing Materials may be considered a departure from precedent.

Space will not permit detailed comments on the changes in the methods, which have been completely revised. Only the more important changes will be mentioned.

The old specification was remiss in not providing a detailed description of methods for sampling cement in packages and in bulk on board cars and at the mill. The new specification is more specific, but still leaves much to the discretion of the engineer.

In the determination of specific gravity and fineness, the apparatus used is of a standardized type and described more in detail than in the old specification. A clause is included on the fineness determination which states that "a determination tolerance of 1.0 is allowed and all results in excess of the specified limit, but within this tolerance, shall be reported as 22 per cent." While it is the opinion of the writer that this clause is a very desirable one from the standpoint of the testing engineer, and will avoid many disputes, the majority of the consumers on all committees were opposed to it.

The method of mixing paste and mortars, as well as the molding of test pieces for soundness, time of setting and tensile tests are described in more detail than heretofore. The percentage of water required for standard mortars is increased by 1 per cent.

GENERAL REMARKS

As a whole the new specifications may be considered a step in advance. As compared with the old specification it is simpler, unnecessary tests being largely eliminated. It is more stringent on the manufacturer in requiring greater fineness, slower initial setting time and higher tensile strength of mortars. It should be of assistance to the manufacturer by permitting the use of a greater quantity of gypsum to control setting properties and in some cases should reduce the cost of manufacture by permitting the use of stone of higher magnesia content.

The engineer, architect and general consumer should find material satisfaction in the new specification because it requires a better and more satisfactory product.

It is the writer's personal opinion, however, that while the new specification is superior to the old and will furnish a product equal or superior to that of any foreign specification, it is still far from satisfactory as a basis for the purchase of cementing material. It includes no tests whereby the engineer or consumer can obtain specific and reliable knowledge of the relative cementing value of two or more cements, and the methods for physical tests are still quite unreliable and subject to great improvement. With the continuation of the investigations now under way more important changes may be anticipated in the next few years.

Motor Truck Lessens Cost of Maintaining Gravel Roads in Alabama

Replaces from 16 to 20 Mules for Scarifying, Makes Complete Scraping Possible After Rains and Effects Material Saving in Gravel Hauling

By THOMAS H. EDWARDS
County Engineer, Montgomery County, Alabama

MONTGOMERY COUNTY, ALABAMA, has 650 miles of public roads, 450 miles of which are of gravel. In 1914, in order properly to maintain them, the County Board of Revenue decided to motorize the maintenance work. Material economies have been effected. One truck, it has been found, takes the place of from 16 to 20 mules for pulling a scarifier. The five trucks now in use make it possible to scrape practically the entire system after each rain, each truck pulling three road machines and being able to make 30 miles a day. A great saving has been accomplished in the hauling of the gravel. Four trailers are provided for each truck for this purpose.

SCARIFYING

The use of the motor truck has made scarifying a comparatively easy matter. As previously stated, where formerly from 16 to 20 mules were required to pull the scarifier, one of the trucks now accomplishes the work with ease.

Recently there has been completed 6 miles of scarifying and reshaping at a cost of $24 per mile. This includes rebinding. The writer understands that in a neighboring county a contractor bid as much as $400 per mile for similar work. The detailed costs are given in the accompanying table:

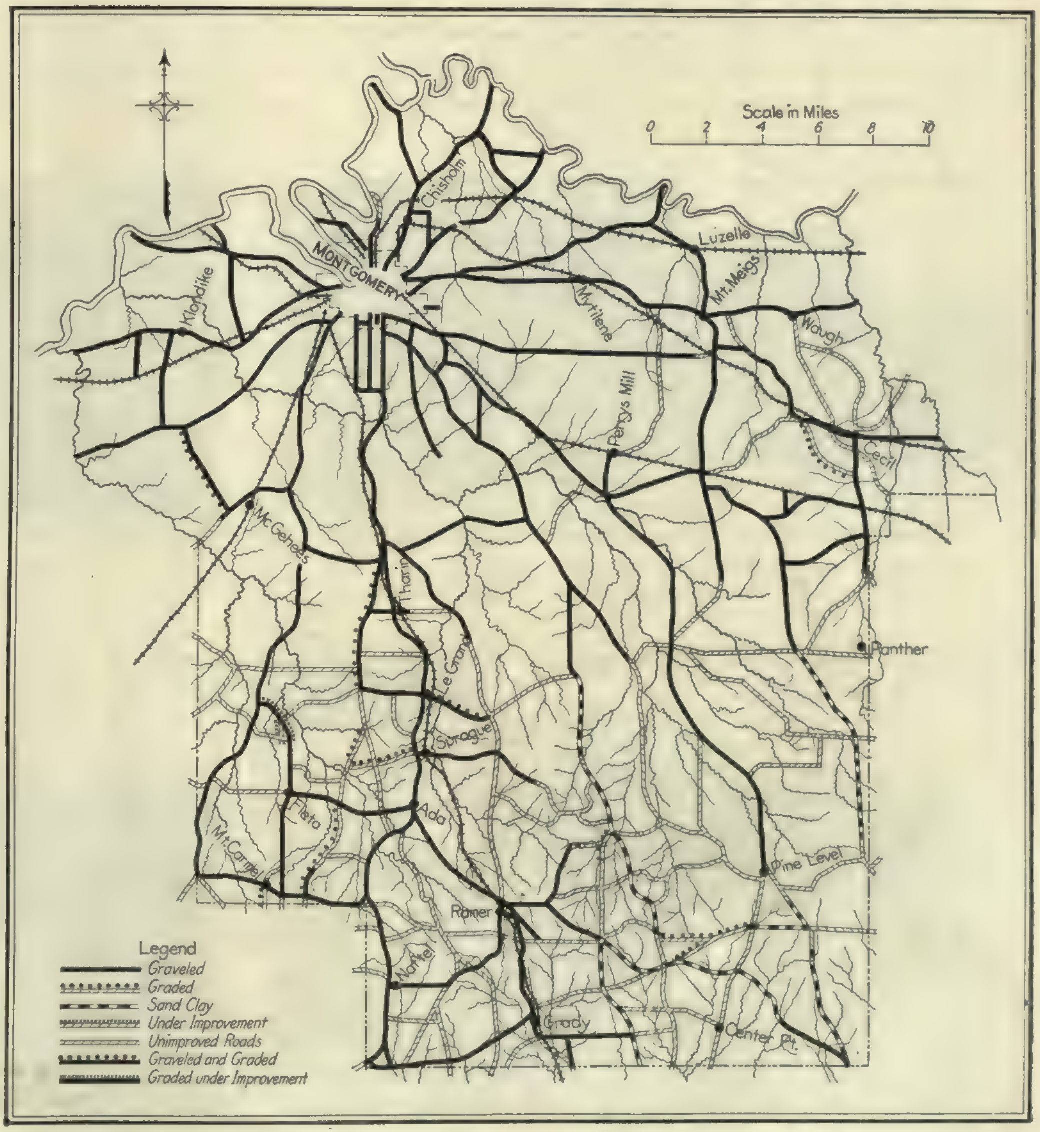
COSTS OF SCARIFYING 6-MILE ROAD

Gasoline for truck, 146 gal., at 25c	$36.50
Oil for truck, 35 gal, at 56c	19.60
Laborers' time, 31.5 days, at $1	31.50
Engineer's wages, 7 days, at $3	21.00
Foreman's wages, 7 days, at $3	21.00
Total cost of scarifying	$129.60
Cost per mile	21.60
Cost of shaping 6 miles with truck followed by road machine	14.78
Cost of shaping per mile	2.46
Total cost, per mile, of finished road	$24.06

It is very important, in the maintenance of gravel roads, to scrape them after each rain. With the five trucks now in use it is possible to cover practically the entire system before the roads become too dry to accomplish any good.

With the truck we are in position to completely scrape 30 miles of road per day. To do this there is hung to each truck a fleet of three road machines. A round trip completes the road.

The cost per mile of this class of work is about 50 cents. The cost for the 30 miles is: Driver, $3; foreman, $3; 3 la-



COUNTY'S SYSTEM HAS 650 MILES OF ROADS, 450 OF WHICH ARE OF GRAVEL

WEEKLY TRUCK REPORT

Truck No. 3 Week Ending March 11, 1916

District: 7

Hickory Grove Road Hauled from Sellers, Ala.

DATE	Len. Haul	No. Yds. Hauled	Gas Used	Oil Used	No. Men	Engineer	Foreman	Misc. Exp.	SUPPLIES RECEIVED AS FOLLOWS: GAS	OIL	GREASE	REMARKS
	Mi.		Gals.									
Monday	10.0	22.0	38.0	4.0	5	1	1					
Tuesday	10.0	22.0	36.0	4.0	5	1	1					
Wednesday	10.0	22.0	33.0	4.0	5	1	1					
Thursday	10.0	22.0	33.0	4.0	5	1	1		200.0	50.0	50.0#	
Friday	10.0	19.0	34.0	4.0	5	1	1					
Saturday	10.0	18.5	36.0	4.0	5	1	1	$1.31				
Total		125.5	210.0	24.0	30	6	6					
Cost		$	25.20	6.00	30.00	18.00	18.00	1.31				

No. Hours Scraped . . ______ Average Haul . . 10 M

No. Miles Scraped . . ______ Total Yards . . . 125.5

No. Miles Scarified . . ______ Total Cost . . $ 98.51

Cost per Yard . . $ 0.785

Cost per Yard M. I. $ 0.078

STATE BELOW FURTHER PARTICULARS OF WORK DONE, KIND AND QUALITY.

Regraveling Hickory Grove Road from Davenport to Vickers Creek.

Gravel spread 7" deep--12' wide.

C. M. Guy Foreman.

(FILL OUT AND MAIL TO ENGINEER EVERY SATURDAY NIGHT.)

FOREMAN'S WEEKLY REPORT SHOWS DETAILED COSTS OF OPERATING TRUCK

borers, $3; gasoline, $5; oil, $1—a total of $15.

The replacing of chains, repairs to trucks, etc., necessary to truck upkeep cost about $400 per year.

HAULING GRAVEL

In connection with each truck there are four Troy reversible 3-yd. trailers. While the truck and two of the trailers are at the dump the other two trailers are being loaded. Therefore only about ten minutes are lost per trip, this being consumed in loading the truck.

By this method of hauling, it has been possible to place gravel on the roads for from 7 to 11 cents per yard-mile, as against from 30 to 40 cents for mule haul, and includes spreading the material on the road.

With an increase of late in the price of gasoline from 11 to 25 cents per gallon it has been possible to keep the costs per yard-mile around 10 or 11 cents.

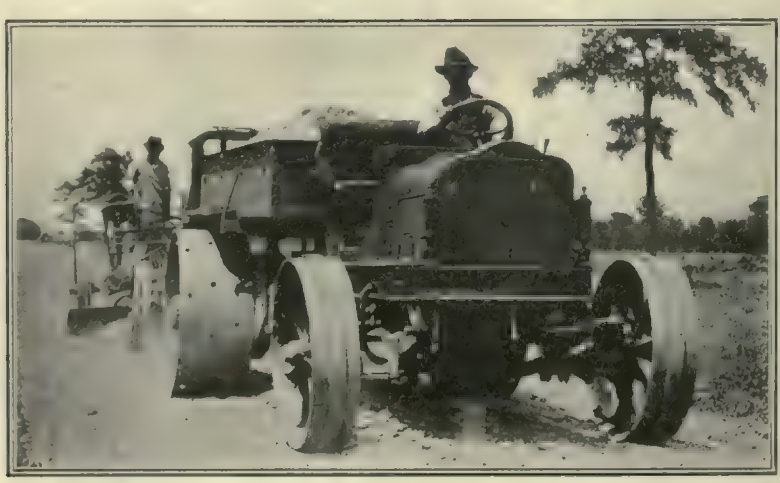
The accompanying table shows the unit costs of operating one of the trucks for hauling gravel during a week. The table shows a gasoline consumption of about 35 gal. per day. This is from 10 to 12 gal. more than the truck uses on the average haul, due to very long 12-per cent grades on the particular road traveled.

The first truck, a White 6-cylinder, latest type road truck, was purchased in the latter part of 1914. It proved such an economy to the county that four others were purchased, together with trailers and equipment. All of the trucks are of 5-ton capacity.

The Board of Revenue of Montgomery County is composed of the following members: R. H. Jones, president; H. M. Hobbie, J. T. Walker, J. L. Scogin and S. J. Guy. The work has been done under the supervision of the writer as county engineer.

EXTRA TRAILERS PROVIDED LESSEN TIME LOST IN LOADING MATERIAL

TRUCKS PULL TWO TRAILERS IN ADDITION TO CARRYING THEIR OWN LOADS



ONE TRUCK REPLACES 16 TO 20 MULES FOR PULLING ROAD MACHINERY AND COVERS 30 MILES A DAY

St. Paul Is Doing Intricate Track-Elevation Work in Chicago with Company Forces

North-Side Tracks Being Lifted for 3½ Miles on Narrow Right-of-Way Without Disrupting 4-Minute Schedule of Elevated Railway

ELEVATION of a steam railroad in a large city usually needs much maneuvering within narrow right-of-way limits to avoid interference with the frequent train service. It is not often, however, that it means upholding the schedule of a tenant elevated line, electrically operated, calling for trains on a 6-min. headway in each direction most of the day and on a 4-min. headway during the rush hours. This feat is being accomplished by the Chicago, Milwaukee & St. Paul Railway in Chicago, on the North Side line to Willamette, over which the Northwestern Elevated Railway operates. The present program of 3½ miles from Wilson Avenue, the junction with the Northwestern Elevated, to Howard Street and the city line is, like similar work of this company, being done by company forces. Features of the work are the careful timing of the operations to harmonize both with the daily fluctuations of traffic and with the various shifts in the running tracks, and the attempts to place each stick of timber and each shovelful of dirt where and so that it will do the most good with the least waste.

Heavy Traffic on the Line

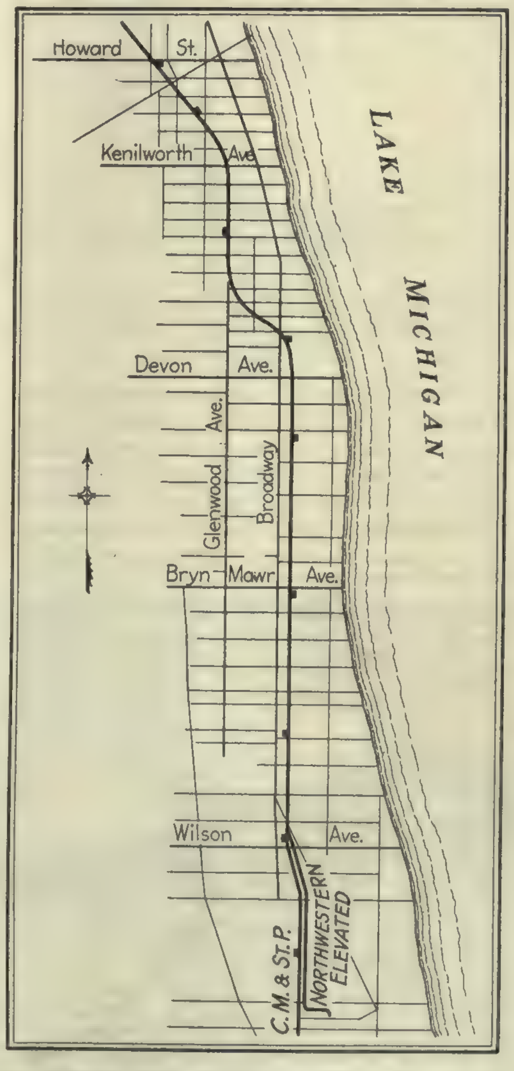
The work in question is on the Evanston branch of the Chicago, Milwaukee & St. Paul. This line, which prior to the beginning of this improvement was a three-track line, carries a twofold business—the comparatively light local freight business of the St. Paul and a heavy and rapidly increasing suburban travel on the Northwestern Elevated, which operates trains over the line from a junction at Wilson Avenue through Evanston to Willamette on a traffic agreement with the St. Paul. These trains run 6 min. apart each way during the greater part of the day and 4 min. apart during the morning and evening rush hours; and those familiar with the elevated "loop" in Chicago will realize that much interference with the schedule of any of its tributary lines would be disastrous to the entire elevated service. In addition to these trains it is of course necessary to move some material trains over the line, though the effort is made to do this mostly at night.

Before the track elevation was started the electric trains ran on the two east tracks, while the west track was used by the St. Paul for its freight business.

The present improvement is one of several, some of which have been completed, designed to elevate the entire line to the northerly limits of Evanston. The present program covers the work from the Wilson Avenue junction to the Evanston-Chicago city line at Howard Street. When the improvement is completed and the line fully developed there will be four tracks, two in the middle with island platforms for local trains and two on the outside for express service. The freight business will be handled on one of these latter tracks during the night, when no express trains are run.

The general program for prosecuting the work was determined largely by the fact that all the local industries with side-track facilities happened to be on the west side of the right-of-way. In order to keep these industrial facilities in commission the work has been prosecuted from the east side. Benefiting by the organization developed and the experience derived on the Bloomingdale Road work, which was described in the Engineering Record of Aug. 29, 1914, page 240, the work has been carried out by a regular sequence of operation, working in general from south to north. The sequence to the present time has been as follows: (1) Shifting of two main tracks to extreme west side of right-of-way, and retention of third as construction track; (2) excavation for east retaining wall; (3) placing of foundation for retaining wall; (4) carrying up of neat work; (5) replacing of construction tracks with pile trestle on line of second track from east side; (6) construction of east halves of abutments for bridges over streets; (7) filling from trestle, with material held by tie cribbing or by planks braced against the trestle until the fill was brought up high enough to support another track between trestle and wall; (8) laying of second track, and (9) shift of traffic from low to high level.

This shift was made in January, and the low-level tracks were released for construction purposes. The job will be finished by a similar sequence of operations: (1) Erection of second trestle, (2) completion of abutments and piers, (3) excavation for west retaining wall, (4) placing of wall foundations, (5) placing of neat work, (6) completion of fill from trestles, (7) removal of falsework under second and third tracks, and (8) laying of second and third tracks.



TRACK-ELEVATION PROGRAM COVERS 3½ MILES AND 35 STREETS, FROM WILSON AVENUE TO HOWARD STREET

Sequences Also for Smaller Operations

Not only has the work as a whole been carried out in regular sequence, but the individual operations have themselves been subdivided into sequences. For instance, in the construction of the trestle the pile driver went first, backing away to the north as the driving progressed, and the construction track was torn up at the same time. One gang sawed off the piles and capped them, another placed the stringers in position, another group of men followed with a pneumatic drill to make the bolt holes, another man followed dropping the bolts in place, and still others set the nuts.

In this way 132 piles were driven in one ten-hour day, and with a decking crew of fourteen men an average of 300 ft. of deck per day was placed. It was, in fact, necessary that the trestle crews do the work blocked out for them each day, because there was no room to store materials, and the day crews had each day to dispose of the materials brought in and spotted the night before by the work train. So restricted was the storage space and the opportunity to haul material by rail that considerable hauling from one part of the job to another was done by teams.

The material excavated for the retaining wall foundations was thrown under the construction track, which was jacked up as the work proceeded. The concreting was done from the special train with collapsible tower and dragline cableway described in the Engineering Record of June 21, 1913, page 701, and Nov. 15, 1913, page 544.

Cheap Cribbing

A decided saving over the use of tie cribbing to hold the fills under the trestle from the low-level tracks was accomplished by the use of planks braced against the trestle. The trestle was itself tied to the retaining wall by wires which connected to hooks set in the wall and passed around the tops of the nearest piles. The 3 x 12 planks were laid on edge one against the other against one of the center rows of piles on the far side from the wall and simply braced against other parts of the trestle clear of the fill, so that when it came time to remove them the props could be knocked out and the planks readily removed. The same planks will be used as bracing for the second trestle.

Another instance of the policy of putting timber to the maximum use is seen in one of the photographs, in the stringers carrying the tracks over the streets. These are 8 x 16 sticks unframed and skewed enough to lap.

Special Problems at Stations

At the stations, of which there are eight on the work, there was not room enough to avoid tie cribbing, for the reason that the northbound track had to be swung east to make room for a 10-ft. island platform. The cribbing used here was not of the ordinary solid type, but was laid box-shaped and tied back to hooks in the retaining

HIGH-LEVEL SOUTHBOUND STATION I S CARRIED ON SAME COLUMN AS ROOF OF LOW-LEVEL STATION

SHARP DESCENT IS TEMPORARILY REQUIRED FROM EACH TRESTLE TO YARD NORTH OF HOWARD STREET

wall. The two forms of bracing are shown in the accompanying sketch.

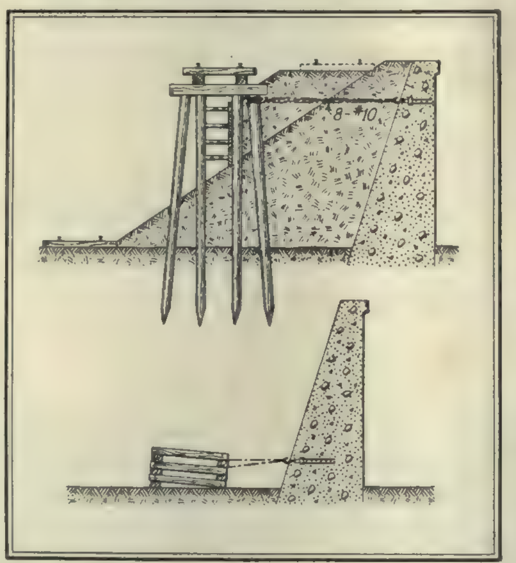
Before traffic could be shifted from the low to the high level it was necessary to provide station platforms at the high level. Outside platforms were built. On the east side an alley runs along the right-of-way for 2 miles, and at the stations it was necessary to span this alley with the platform supports, giving a clearance of 12 ft. On the west side the platforms are carried on long cross-beams spanning from the trestle to columns in the middle of the low-level island platform. When the second trestle is built the support of the west ends of the cross-beams will be transferred from the columns to the trestle. This platform is on the site of the permanent island platform of the ultimate arrangement.

One of the photographs shows clearly the construction at one of the stations. On the right is the east platform carried on the retaining wall and high columns beyond the alley. On the left is the southbound platform carried on cross-beams spanning the low-level northbound main, the roof of the low-level island platform appearing in the picture.

It will be noted that there is a gauntlet past each platform. This is necessitated by the fact that the elevated passenger cars are narrower than the freight cars, so that the former have to use the near tracks to come close enough to the platforms, while the latter have to use the far tracks to clear the platforms.

Another detail that had to be taken care of was the trolley wires. The trolley poles between the trestle and the low-level tracks adjacent were made high enough to support trolleys for either level. Ultimately it is expected to operate this line by third rail, and ducts for the cable lines have been built into the coping of the east retaining wall.

The line occupies Glenwood Avenue for six blocks, and here it was possible to



TWO METHODS FOR HOLDING FILL AWAY FROM LOW-LEVEL TRACKS

throw the temporary low-level main tracks over into the east roadway, thereby clearing all of the masonry. This necessitated bridges on sharp skews at the curves at each end to carry the high-level trestle over these low-level tracks, and it has also necessitated humping the trestle above the final profile in order to secure the necessary clearance at the crossings. Run-around trestles were built from the low-level trestle. One of the photographs shows one of the crossings in the back ground, with the high-level trestle humped up, and the low-level run-around trestle in course of construction.

Quick Shift at Howard Street

At Howard Street, the most northerly station on the work, a special problem had to be met. Here one or two cars are cut from northbound trains and either put on southbound trains or switched into a yard just north of the station. Vice versa, cars are brought from this yard and attached to southbound trains. This yard is, of course, on the low level, and when the shift was made from the low-level to the high-level tracks it was necessary to make the entire shift of switches and crossovers in one day, between morning and evening rush hours. The entire change was accomplished in five hours. The switches and yards are shown at the bottom of the steep incline in the background of one of the photographs.

The retaining walls on this work are of the so-called semi-reinforced and cellular type used by this company. The bridges are of reinforced concrete throughout, with the exception of one or two where the sharp skews and long spans necessitated steel fascia girders. In these cases the girders will be incased in concrete. The intermediate supports are arched bents on rectangular columns. They are of standardized shapes and are cast in steel forms. The

THIS FORM OF TEMPORARY STREET CROSSING IS TYPICAL—NOTE HUMP CROSSING AND LOW RUN-AROUND TRESTLE IN BACKGROUND

slabs are cast in place by constructing falsework in the struts to support the forms.

As previously pointed out, the absence of storage space and the impossibility of hauling materials in during the day necessitated the careful development of a system for getting the materials to the job. The company has a large yard at Galewood, and each afternoon a train of materials to be used next day is made up and hauled to Chicago, arriving there in the early evening. After midnight the cars are hauled to the work and spotted to be unloaded the next day. At the same time the empty cars are removed, so that there is little or no switching on the main tracks during the day. As an extra precaution double crossovers connect the main tracks every ¾ mile or so, so that if it becomes necessary a short section of either track can be cut out of service.

The entire improvement is being done by company forces, which have numbered as high as 1200. The work was started two years ago, but was suspended shortly afterward for a period of nine months. It is being carried out under the direction of the engineering department of the Chicago, Milwaukee & St. Paul Railway, of which C. F. Loweth is chief engineer, A. G. Holt, assistant chief engineer, and H. C. Lothholz, engineer of design. C. H. Buford, assistant engineer, is in immediate charge, with F. C. Loweth and J. E. Weston as assistant engineers.

Urges Education of Public to Need of Health Laws

Many Sanitary Statutes Poorly Drawn, Unnecessarily Severe and Inconsistent As Between Various Communities and States

THAT a health department should educate its public to a law before attempting to introduce it and that the nonobservance of sanitary laws is due in a large measure to their defects were contentions made by Paul Hansen, chief engineer of the Illinois State Board of Health, in the discussion following George A. Johnson's paper on the typhoid toll, presented (abstracted in the Engineering Record of June 17, page 803) at the American Waterworks Association convention, held in New York City recently. These notes are taken from Mr. Hansen's discussion.

Full-Time Health Officer Needed

Most sanitarians have a very clear idea of how an effective local health department should be organized, paid and conducted, but they also realize that it is out of the question to secure the right kind of a health organization at once. It has been the universal experience in health activities that the only manner in which results can be obtained is to concentrate on one thing at a time. The all-important step to take at the present time is to secure the employment of the full-time health officer. He will, of course, not entirely solve the problem of health administration, but he will carry it a long way in the right direction. Once he is recognized as a necessary institution those interested in the promotion of health can work for the elaboration of the health department's organization.

The nonobservance of sanitary laws is due in a large measure to the fact that many of them are poorly drawn, unnecessarily severe, inconsistent as between various communities and states, and often far in advance of what the public will stand for. Attention should be given to the modification of sanitary laws so that there may be greater uniformity of practice. In connection with certain state sanitary laws relating to the activities of engineering bureaus a tendency exists to make such laws altogether too lengthy, too drastic and to include in them too much of the unessential. Too much stress cannot be laid upon the necessity of drawing up sanitary legislation with great care, so that it will be practically enforcible and will not exceed what will have the backing of public opinion. In other words, the health department should educate its public to the need of the law before attempting to introduce it.

Work Tangibly Guaranteed

Exception is taken to the proposition of Mr. Johnson that state boards of health should not be given power to review plans for the installation of water supplies, water purification plants, sewerage systems and sewage treatment works, but should be required to approve any scheme for water purification, and, presumably, waterworks, sewerage systems and treatment works that is tangibly guaranteed. In the first place, engineers who design works of this character are not in the habit of guaranteeing that their designs will work properly, nor are clients in the habit of demanding such guarantees. In fact, it would be in general considered unprofessional.

It would seem, then, that the guarantee must be made on the part of the contractor. This would be unfair when the contractor is bidding upon an engineer's detailed plans, and in most classes of sanitary engineering work it is necessary for the engineer to prepare his plans in detail. An occasional exception to this is current practice in connection with the installation of water-purification works.

Contractors' Guarantees

Engineers frequently draw their specifications so that the filter contractors can bid on their own plans and specifications for a part or the whole of the work; but as this is not universal practice, and as water-purification works represent only one class of engineering works that must be reviewed by the state boards of health, Mr. Johnson's proposal would not be practicable.

Furthermore, allowing that it would be possible in every case to secure tangible guarantees, every engineer knows that such guarantees are often not worth the paper they are written on. In no field has this been more evident than in the water-purification field, for, as is well known, a poorly-designed, crudely-constructed filter plant can be made to furnish pure water during trial tests under skillful manipulation, though similar results cannot be expected under ordinary operating conditions.

A proper check on possible mischief on the part of the state boards of health which do not have competent engineering advice is to have the law so framed that any municipality, corporation or institution which has occasion to submit plans to it, and which may not regard the requirements of the board as correct or just, may demand a reference of the matter to a commission of expert sanitary engineers, to be appointed and employed jointly by the state board of health and the party taking exception to the board's orders. Such a plan has been adopted in the State of Ohio, and has worked well to the extent of its applicability.

Recommends Extra Right-of-Way at Sharp Curves

H. E. Bilger Declares That Public Travel on Highway Will Be Benefited Out of All Proportion to Additional Expense

THE IMPORTANCE of a clear view on sharp turns in the alignment of a highway at cross-roads and railroad crossings, of lengthening the curve radius and of ample passing room and practically level approaches at railroad crossings was emphasized by H. E. Bilger, road engineer of the Illinois State Highway Department, in a paper presented at the Conference in Highway Engineering at Kansas State Agricultural College, held at Manhattan, Kan., March 4.

Old Alignment Not Adequate for Present Traffic Conditions

The alignment that, 15 years ago, satisfactorily met the requirements of a maximum speed of 8 or 10 miles per hour cannot suffice, with any reasonable degree of safety, for the present traffic conditions that impose a speed of from 20 to 40 miles per hour upon the highway. The present conditions are such as make imperative that, in all highway improvements, this matter be given serious consideration, and in view of the increasing density of the high-speed traffic it becomes advisable that due attention be paid to probable future traffic developments.

Without in any way interfering with the economics of highway location, there can be effected, even in the details of the work, a marked improvement in the general comfort and safety of the traveling public. For example, at all abrupt angles in the right-of-way, and particularly those approaching 90 deg., an improvement can be brought about by simply procuring the necessary additional right-of-way to permit moving the inner fence corner a distance of some 75 ft. or more. By so doing the radius of the curve can be considerably lengthened and a much better view provided, to the end that public travel is benefited out of all proportion to the cost of the little triangle of land. In order that this additional right-of-way at the corner may be utilized to the utmost, it is necessary that all vegetation be kept down and that the signboards, if any, be transferred elsewhere.

Additional Land at Cross-Roads

At all cross-roads additional land should be provided by moving the fences back to include within the limits of the right-of-way the four triangles at the corners. This greatly enhances the view in all directions by bringing the control of the corners within the authority of the road officials, thereby arresting the growth of vegetation that obstructs the view of highway travel.

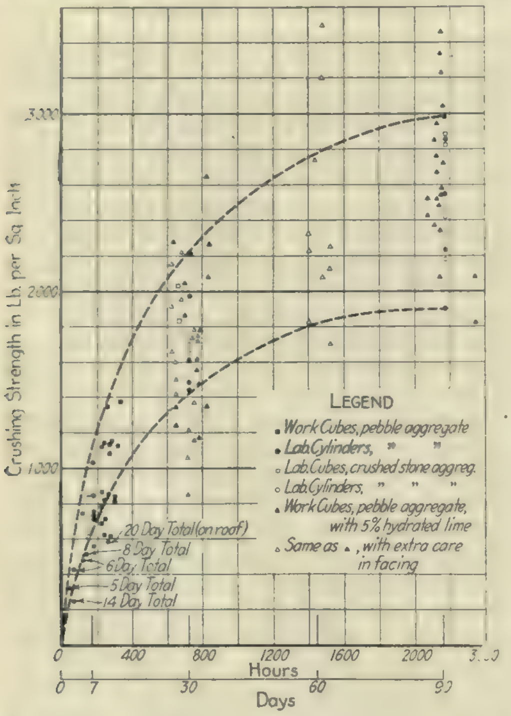
In the vicinity of railroad crossings the improvement of the highway should be such as to provide an unobstructed view along the track for at least 1000 ft. each way. This view should be enjoyed along a length of the highway extending for at least 300 ft. on each side of the crossing. At the crossings it is particularly important that sufficient accommodations be provided to permit two vehicles to pass with entire comfort and safety, requiring never less than 18 ft., and the highway for some 50 ft. or more on each side should be practically level, or should at least have a very easy grade, say not steeper than about 2 per cent.

Test Concrete Cured Under Freezing Conditions

Time for Removal of Forms in Philadelphia Electric Power House Determined by Tests of Specimens Poured on the Work

POURING of the floor slabs between steel beams in the Philadelphia Electric Power House, described in the Engineering Record of Feb. 19, page 340, had to be continued during the cold winter weather. While no concrete was poured during freezing weather, the temperature was frequently much below freezing for a long period after pouring. In fact there were times when the water froze in icicles below the slabs on the day after pouring.

Although the materials were all heated before pouring (steam coils being used for the sand and gravel), so that the concrete



COMPRESSION TESTS OF CONCRETE SHOW EFFECTS OF FREEZING TEMPERATURES

probably had some time to set before reaching the freezing temperature, it was desired to make certain that the strength was sufficient before removing the forms. For this purpose a schedule was prepared for the various parts of the work, with greater time requirements as the length of span increased. This schedule was made by counting only the hours that the concrete had cured above a temperature of 32 deg.

Test Cubes Poured on Work

In addition 6-in. test cubes were poured from the concrete going into the floor and exposed to the same temperature conditions as the slab they represented. These cubes were tested in the laboratory, and if the strength exceeded 800 to 1000 lb. per square inch the forms could be removed, provided there was not too much evidence of frost in the structure, and provided the floor was not loaded with material or by shores from above.

The accompanying diagram shows the results of tests of both laboratory and field specimens. For the latter the results are plotted in terms of number of hours above 32 deg., the actual age being noted only in a few special cases. For example, one cube 14 days old, but with only 60 hr. above 32 deg., failed at 250 lb. per square inch, and one cube 20 days old, almost half of that time at a temperature below freezing, failed at a unit load less than 600 lb. In general the results plotted on this basis of time above 32 deg. fall within the approximate curves drawn on the diagram for limits found by testing the standard laboratory cylinders kept at a temperature of 70 deg. In comparing results, however, it should be noted that cubes should give higher results than the standard cylinders. Furthermore the cubes cast on the work had the advantage of the beneficial effect of the heating of the materials and of machine mixing.

Tests of Large Aggregate

The comparison between the strength of 1:2:4 concrete made of pebbles and similar concrete made of crushed stone shows no consistent advantage either way, although the cylinders made with pebbles gave slightly better results. This was probably due to the fact that these pebbles were almost pure quartz, with some of granular quartz formation and some of dense sandstone.

The test results for the specimens cast on the work in which 5 per cent of hydrated lime had been used are seen to be variable, no noticeable effects on strength being obtained. It was thought that a careful bedding of the ends of the test cylinders in the testing machine might produce better results, but, as the plotted points show, there seems to be no definite advantage.

It may be inferred from these test results that a satisfactory and reliable method of estimating the strength of concrete cured under freezing conditions is to consider the age to be the same as the number of hours of temperature above 32 deg., or preferably above 35 deg. Fahr. Thus, knowing the approximate strength, it is possible to determine when it is safe to remove the forms.

What Is the Relation Between Yield Point and Proportional Limit for Steel?

Discussion Before A. S. T. M. Considers Definitions and Indicates Sources of Variation—Wide Disagreement Regarding Terms

FACTORS affecting the relation between yield point and proportional limit in various grades of steel were discussed by several members of the American Society for Testing Materials at the recent meeting in Atlantic City, June 27 to 30. In addition to the preprinted discussions, three written communications were presented. The effects of composition and heat treatment on the relation in question, and the relative value and meaning of elastic limit and yield point, are vital points in the discussion. Whether yield point or elastic limit should be used by the designing engineer and whether commercial testing methods accurately determine the desired quantities were also considered. Of the discussions abstracted herewith those of J. E. Howard and of H. F. Moore and F. B. Seely were printed in advance of the meeting.

Discussion by H. F. Moore and F. B. Seely

The views of H. F. Moore, assistant professor of mechanics, University of Illinois, and F. B. Seely are best given by the following quotation from their printed discussion:

"An examination of test data from various sources, actual experience with apparatus for measuring deformation and a study of the literature of the subject have led the writers to believe that no absolute limit of elasticity has been determined for any actual material, and that for materials used in engineering practice Hooke's law is an approximation—an extremely close approximation for structural materials, but still an approximation rather than a rigidly exact statement of facts. Any limit of elasticity, however determined, is regarded as a practical criterion for static elastic strength, rather than as the limit of absolutely elastic action for the material. For purposes of definition for testing engineers such a limit should be fixed at a stress for which some very small, but definite, deviation from elastic action is detected.

"The stress at which a very small but definite permanent set can be detected is probably the most nearly logical 'elastic limit,' but the process of determining such a limit is very slow, and this limit has never been recommended as suitable for commercial testing. The yield point is at present the commonest limit used in practice. The proportion limit (of stress to deformation) promises to be the most generally useful of all the proposed limits of elastic strength, if some method of determination of the proportional limit can be recognized as standard—a method which shall yield consistent results, and which shall not be too complicated nor too slow for use in commercial testing laboratories.

"Recently the writers have begun a series of tests to determine by various methods the variation of the value determined for the proportional limit, and also the variation in value determined which is caused by unevenness of gripping of test specimens. . . .

"Evenness of stress distribution is probably never completely attained even with threaded-end specimens and spherical-seated holders. With such a gripping device very carefully adjusted, appreciable variation was observed in the stresses along three gage lines. Lack of alignment of upper and lower gripping devices is only one of the possible causes of unevenness of stress distribution. Another important cause lies in the transmission of the stress from the gripping device to the specimen, unevenness in bearing of threads in a threaded-end specimen, unevenness of hold of wedge grips, etc.

"Values of the proportional limit determined from a single gage line may be far from representative for the material. The values of the proportional limit for test specimens with threaded ends and spherical-seated holders do not differ greatly from the values found with wedge grips in good alignment. This would indicate that considerable variation in evenness of gripping may take place without greatly affecting the value of the proportional limit determined."

J. E. Howard, engineer-physicist, Interstate Commerce Commission, Washington, D. C., whose discussion, like the preceding ones, was printed in advance, pointed out

that the modulus of elasticity is the fundamental feature on which it is convenient to judge of the elastic limit of steel. With a constant value for this modulus, any departure of the stress-strain curve from a straight line signifies the introduction of a permanent set and establishes the value of the elastic limit. The behavior of steel is generally such that the elastic limits and proportional limits coincide; nevertheless, it would not be inconsistent with the meaning which might attach to the latter expression were the extensions or compressions of the metal to include both elastic strains and progressive permanent sets. A restricted meaning should properly be placed on the term "proportional limit" to exclude permanent sets, without which it presents no barrier against the presence of permanent sets of any degree of magnitude.

The Term "Yield Point" Held to Be Vague and Uncertain

The influence of time, in respect to rapidity of loading, he continued, has no practical effect on the display of elastic extensions. The strains which are displayed by the steel correspond to the stresses, however rapid the applications or alternations of loads may be. This has been shown in the case of repeated alternate stresses, and there is no reason for doubting the same to be true for direct loads of tension or compression. The conditions attending ordinary testing, however, are such that very rapid extensions are difficult to follow. This limitation pertains to the testing apparatus rather than to the behavior of the metal.

The term "yield point" does not appear to have any fixed meaning, and in his opinion there seems to be no feature in the behavior of steel which calls for the use of this term, or to which it could properly apply. The term is essentially vague and uncertain, and well calculated to create confusion. It is an approximation to the elastic limit, but having been given a name it purports to have a definite meaning. The most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain.

He did not discuss the relation between yield point and proportional limit because, he stated, one of these terms is vague and without definite meaning, while the other is held to be synonymous with the expression "elastic limit," which he regards as preferable.

Discussion by R. P. Devries, Assistant Physicist, Bureau of Standards

R. P. Devries, assistant physicist, U. S. Bureau of Standards, Washington, D. C., directed his discussion to a consideration of Mr. Howard's views. He said, in part:

"The statement by J. E. Howard, in considering the effect of speed of testing, that the strains which are displayed by the steel correspond to the stresses, however rapid the application or alternation of loads may be, is important, if true. Reversal tests have been made [to which references were given] giving the conclusion that resistance in metals varies more or less in proportion to the rapidity of the reversals; other tests give opposite conclusions, and others in which no relation was found if the alternations do not exceed 2000 per minute. Mr. Howard's published tests do not seem to have reached this speed, and it is evident that the strains must lag because of hysteresis.

"It would be better not to define yield point at all if the following statement by Mr. Howard is correct: 'The most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain.' However, when yield point as defined by Committee E1 is considered, engineers do not view this matter in the same way. If certain structural steel should show no yield point, it would be of more than theoretical interest to the structural engineer. At the proportional or elastic limit, steel no longer follows the straight-line law but extends according to another more complex law. Important changes are recognized, including distinct slipping of the crystal grains, and the yield point may mark the ending of some state of flow. The yield point is not more artificial than the critical points in the slow cooling of steel."

Theoretical Discussion by G. R. Olshausen

G. R. Olshausen, engineer physicist of the U. S. Bureau of Standards, discussed the matter from the theoretical point of view. The question, he said, whether there is any difference in the magnitude of the elastic limit and the proportional limit, and under what conditions this difference occurs, may be treated by assuming the total deformation as composed of two parts—elastic strain and nonelastic or permanent strain. Thus

$$L = L_e + L_s$$

in which L is the total deformation, L_e is the elastic elongation and L_s is the permanent set. The existence of either or both of the defined limits depends on the manner in which these deformations vary with the stress S. From the definition of the elastic limit, L_s must equal zero, and from the definition of the proportional limit L must equal kS below these limits respectively. (Nine different cases are distinguished in a table not reproduced here.)

It is improbable that the case for the proportional limit greater than the elastic limit ever occurs, and the most important case is where the two limits are equal, which is the only case where both limits exist. Both terms, however, should be retained in order to indicate in what manner the determination was made.

H. S. Morse Would Abandon Term "Elastic Limit"

Major H. S. Morse, of the Watertown Arsenal, believed that the printed discussion was far from settling the serious confusion of ideas among engineers and manufacturers. He submitted the following definite suggestions: (1) That the term "elastic limit" be as far as possible abandoned as having lost its definite meaning through abuse, and that the term "proportional limit" be habitually substituted therefor; (2) that the proportional limit should be required as a portion of the acceptance test for all materials which are to be used in parts designed with low or moderate factors of safety, and (3) that the proportional limit be habitually determined by plotting a sufficient number of points and drawing a graph, the proportional limit being located where Hooke's law line intersects a second straight line drawn to the curve which represents the yield point of the metal.

Harrowing Highly Important in Gravel Roads

H. E. Bilger, of Illinois State Highway Commission, Describes Construction of Gravel Roads by Feather-Edge Method

IN CONSTRUCTING gravel roads, either in one or two courses, the importance of thorough harrowing can scarcely be overestimated, for to secure the best results it is essential that the voids in the gravel be reduced to a minimum. This point was strongly emphasized and other suggestions for gravel road construction by the feather-edge method were given by H. E. Bilger, road engineer of the Illinois State Highway Department, in a paper presented some time ago at the Conference in Highway Engineering, at the Kansas State Agricultural College, Manhattan, Kan.

Roadbed Preparation

Before any gravel is hauled onto the road its cross-section should be brought to the requirements of the plans and the entire width of the graded roadway should be thoroughly rolled until it is practically of a uniform density at all places. The portion that is to form the subgrade for the gravel should be dry, compact, almost perfectly smooth and should have such cross slope as may be necessary to shed readily any surface water that might fall thereon. The rolling should be done preferably with a three-wheel self-propelling roller weighing from 300 to 400 lb. per inch of width of tread on one rear wheel. If such a roller is not readily available, a tractor of similar design and having approximately the same weight will usually answer the purpose.

The purpose of the rolling is quite as much to detect the location of soft and yielding spots as it is to consolidate the roadbed generally. When these spots are detected additional material should be added until the yielding ceases.

Placing the Gravel

The work of placing the gravel might begin at either end of the road, but it should be carried on continuously to the other end.

During the process of construction, and before any particular section of the road is completed, the gravel might be subjected to the traffic of the vehicles used in further construction. Should such traffic rut or displace the gravel, it should be reshaped and rerolled before further work is done.

When the bonding material in the gravel is not entirely satisfactory with respect to both quality and quantity, it is usually advisable that two-course construction be adopted.

It is important that some positive and accurate method of determining the volume of gravel delivered upon the roadbed be used. Upon completion of the roadbed temporary side forms having a width equal to the depth of the loose gravel should be set on it, true to line and grade. These should be held in place by stakes at such intervals as will prevent lateral deflection greater than about 3 in. from the true alignment. Whether the gravel is to be hauled by wagons, motor trucks, industrial railways or other vehicles, it might be dumped directly upon the subgrade. After a sufficient quantity has been placed for the lower half of the road, it should be distributed to a uniform depth by the use of a blade-grader, drag scraper or otherwise.

While this course is being spread, all the larger stones should be raked or otherwise placed directly in contact with the subgrade.

Such an amount of bonding clay as may be necessary in order that the gravel will comply with the specifications should be placed on the lower course gravel, and, after it has been spread, should be thoroughly harrowed several times over until the cores formed by dumping have been entirely loosened up to a density equal to that in the other portions. The importance of this thorough harrowing can scarcely be overestimated, for in order to secure the best results it is essential that the voids in the gravel be reduced to a minimum, which means that a maximum density of material must be obtained. This density is closely approached by harrowing until the pebbles of the several sizes become so placed as to occupy the spaces between those of a large size. The cost of the harrowing, as compared with the results obtained, is practically negligible, and if necessary it would actually be more advisable to do away with the rolling and retain the harrowing than vice versa.

Harrow Should Be of Stiff-Tooth Type

The harrow should be of the stiff-tooth type, and should have metal teeth at least an inch in diameter extending about 6 in. below the frame. The spacing of the teeth should be such as will admit of the free passage of the stones between them, and yet so displace the gravel as to produce the density desired. The design of the harrow should provide a weight of from 8 to 12 lb. upon each tooth.

After the second course of gravel has been placed it should be spread until its upper surface comes flush with the top of the side forms and its cross-section conforms to that shown on the plans for loose gravel. The forms should then be removed and the gravel allowed to take its natural position. Upon the second course there should be distributed the necessary quantity of bonding clay in the same manner as in the case of the first course.

Should the gravel, with its natural or artificial mixture of bonding clay for the upper 4 in. of road, be of such a character that it will not insure a satisfactory wearing surface with a dense body and uniform texture, an inch coating of bonding gravel should be applied uniformly over the entire surface. This should be raked and rolled in until all the interstices are filled and the surface is smooth, of a uniform texture and free from waves.

One-Course Construction

When the conditions and materials are reasonably suitable, there can be built with one-course construction a gravel road that will in all respects prove as satisfactory as one built by the two-course process.

If the gravel contains naturally a sufficient quantity of satisfactory bonding material, one-course construction will generally prove the more economical.

When so employed the gravel may be dumped upon the roadbed and spread with a blade grader, drag scraper, hand rakes or otherwise until the material at the edges comes flush with the temporary forms. The forms should then be removed and the gravel thoroughly harrowed several times over until the cores formed by dumping the gravel have been entirely loosened up and the upper 4 in. has a uniform density.

Sewage-Testing Station Report Limits Processes

Cleveland Report States That Grit Drops at 30 to 60 Feet Per Minute and That Roughing Filters Will Not Work

IN THE report of the sewage-testing station in Cleveland definite answers are given to proper grit-chamber velocities, sedimentation-detention periods, washing methods for roughing filter, "greenhouse" sludge treatment, and disinfection. Most of the work was completed two years ago, but the report has just been made public. Its recommendations bearing on the solution of the sewage-treatment problem were commented on in the Engineering Record of May 13, page 631.

With but few exceptions the Cleveland sewers are of the combined type. Experiments were carried out on the easterly interceptor receiving 50 per cent of the 100,000,000 gal. received during dry weather. This sewage is mainly of domestic origin, containing an average of 250 parts per million of solid matter in suspension. The long travel resulted in a stale sewage. The following conclusions are stated:

It is possible to secure the grit in a condition which is inoffensive, nonputrescible and readily adapted for use as a filling material. Such a grit contains on the average not more than 15 per cent of volatile matter and has a specific gravity of 1.6. With an average detention period of 50 sec., during dry-weather flows there is deposited approximately 0.6 cu. yd. of grit per 1,000,000 gal. of flow, and during storm flows approximately 0.7 cu. yd. per 1,000,000 gal. of flow. Velocities ranging from 30 to 60 ft. per minute produce a grit of the proper character.

A mechanically operated screen was tested with wire fabric of 50, 80 and 120 nominal meshes per linear inch. With all three sizes the loss of head through the screen, the flow per unit area of screening surface, the clogging difficulties and the percentage removal of suspended matter were approximately constant. This indicates that the 50-mesh is as fine as it is desirable to use.

Based upon the suspended-matter determination, the average removal by the mechanically operated screen was 20 per cent; and based upon the amount of screenings produced, this removal was 25 per cent. The latter figure is undoubtedly a more exact measure of the work actually accomplished by the screen. The screen removed the larger particles of solid matter which ordinarily, by reason of floating material or sludge banks, form objectionable conditions at submerged outlets.

Screenings a Nuisance

From the standpoint of operation the most serious phase of the screening problem is the disposition of the screenings. About 650 lb. of dry material were produced per 1,000,000 gal. of sewage treated; and while the screenings drained quickly, they soon became offensive. At treatment sites located near residential districts there would have to be provided, in a screening plant, some means whereby the screenings could be disposed of without creating a nuisance.

The results obtained with the plain sedimentation tanks during the winter months were fairly good, but with the advent of warm weather it became impossible to secure satisfactory results. Active ebullition started after only a small amount of sludge had accumulated, and this greatly decreased the removal efficiency of the tanks. During the warmer part of the year it would be necessary to desludge the tanks every ten days or two weeks. On account of the nuisances in treating undigested sludge this process would be objectionable in residential districts.

In the operation of the septic tanks results similar to those obtained with the plain sedimentation tanks were secured. The characteristic tank scum never became permanently established, and the tanks decreased in efficiency as the age of the run increased.

The vertical-flow, or Dortmund, tank was operated for only a portion of two months. In view of the production of odors and the foul character of the effluent, this short period of operation was sufficient to eliminate from further consideration tanks of this type.

Imhoff Tanks Worked

The most consistent results were obtained from the operation of the Imhoff tanks. An average suspended-matter removal of 50 per cent was secured. Dissolved oxygen was present at those times when it was present in the crude sewage. The iron removal was low on account of the flocculent condition in which it was present in the sewage, and this undoubtedly decreased the removal efficiency of these tanks. In general it may be said that a detention period of 30 min. accomplished a removal of suspended matter from 40 to 45 per cent, as compared with a 50-per cent removal effected by a detention period as long as 2 hours and 15 minutes.

The roughing filters, when operated at rates ranging from 30 to 60 gal. per acre per 24 hours, removed from 25 to 40 per cent of the suspended matter in the applied sewage. The action of these filters was simply mechanical, there being no increase in the dissolved oxygen content, due to treatment. The difficulties encountered in their operation were sufficient to eliminate this process, either as a method in itself or in combination with other processes. Chief among the operation difficulties were the satisfactory treatment of the wash water and the disposal of the sludge deposited upon the surface of the filters.

The sludge investigations were made with digested sludge which was black, homogeneous, full of minute gas bubbles, and non-offensive. Only a slight tarry odor could be detected when drying beds were flooded with this sludge, and then this odor was restricted to the immediate vicinity of the beds.

A large number of analyses were made, special attention being given to the possible fertilizing constituents of the sludge. The average moisture content was about 87 per cent. Computed on a dry basis the volatile matter was 35 to 38 per cent; nitrogen, about 1.5 per cent; ether soluble matter, 6 to 14 per cent; phosphates, as P_2O_5, between 1 and 1.5 per cent; and potash, 0.3 per cent. In comparison with garbage tankage produced at the municipal garbage reduction plant, for which there is a ready market, the sewage sludge contains about one-half as much nitrogen and one-third as much phosphates. The ether soluble matter is mostly composed of light hydrocarbon oils, the presence of which might be

detrimental in a fertilizer. If extracted it would be of too poor quality for use in the manufacture of soaps; but it is not possible to say that no market could be found for this byproduct which would pay for the cost of its extraction.

Drying sludge on open sand beds gave results which depended upon the weather. During the summer months it was found possible to reduce the moisture content of the sludge to a spadable condition in seven days. These results were obtained under favorable conditions of temperature and dry weather. On the other hand, sludge applied to the open beds in October was not in a condition for removal until late in the following spring. It will probably be possible to operate beds of this type so that 1 sq. ft. of surface will dry 0.4 cu. yd. of sludge per year. The foregoing statement applies when the original sludge has a moisture content of approximately 87 per cent and the removed product 70 per cent.

DRY SLUDGE UNDER COVER

In order to obtain in sludge drying an independence from weather conditions a covered sludge bed was built, modeled after standard greenhouse construction. This type of bed can be operated throughout the entire year, provided a heating system is installed to prevent freezing during the winter months. During the summer months the period of drying is approximately the same as, or possibly a little longer than, with the open beds. Eliminating the three winter months of operation, it is possible to operate beds of this type so that 1 sq. ft. of surface will dry 0.8 cu. yd. of sludge per year.

Two types of filter presses were tested, one being operated by a high air pressure from without the filter cloth and the other by a vacuum acting on the inside of the filter cloth. The high-pressure press afforded a clean and nonoffensive method for reducing the moisture content of sludge. Reductions as low as 60 per cent were obtained with pressures between 30 and 35 lb. per square inch. During the drying period it was at times found a little better to increase the pressure to 50 lb. per square inch. This high-pressure press was of a size used in actual practice.

In order to remove the danger of pollution from disease germs at the bathing beaches along the lake front, a disinfectant must be applied to the treated sewage effluents. The tests indicate that from 5 to 7 parts per million of available chlorine will effect a bacterial removal of from 85 to 90 per cent.

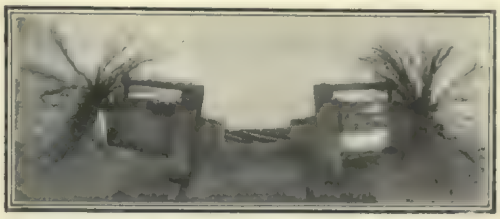
The work was carried out under the direction of R. Winthrop Pratt, consulting sanitary engineer, reporting to Robert Hoffman, Commissioner of Public Service. Harry B. Hommon, chemist, had direct charge of the testing station.

Heavy Wire Rope Tested at Bureau of Standards

New Sockets and Grip Pieces Have Been Designed to Develop the Full Capacity of Emery Testing Machine at Washington

WIRE ROPES of unusual size, for use at the Panama Canal, were submitted to the U. S. Bureau of Standards for testing, and the results for six specimens recently tested show ultimate strength values varying from 184,000 to 215,000 lb. per sq. in. of net area for 2-in. and 2¾-in. plow-steel hoisting rope respectively. The total ultimate loads varied from 293,000 lb. for 2-in. rope to 937,000 lb. for 3¼-in. rope. The details of the results of these tests and the composition of the specimens are given in Tables 1 and 2.

There is also presented herewith a detailed description of the new cable holders, or sockets, designed to develop the full capacity (1,200,000 lb.) of the Emery testing machine at Washington, including the methods used in preparing the specimens. Ordinarily, rope-testing is carried on at the Pittsburgh branch of the bureau, but steel cable of greater strength than 600,000 lb. exceeds the capacity of the machine in that laboratory. It was therefore thought advisable to provide the large Emery machine at Washington with cable holders for a wide range of heavier testing. John A. Roebling's Sons Company supplied these holders in accordance with the design furnished by the bureau.



WIRES BROOMED AND WASHED BEFORE SPELTER IS CAST AROUND THEM

APPEARANCE OF 12-FT. PLOW-STEEL-WIRE ROPE AFTER TEST

DETAILS OF SOCKET

This holder or "socket" differs from those in commercial use chiefly by its greater size. A nut is threaded to fit the end of the grip piece, and occupies the space usually taken in the jaws by the serrated portion of the grips. The holder was designed to carry a load up to the full capacity of the machine (about 1,200,000 lb. in tension), and every part of the holder, with the probable exception of the bowl proper, will be stressed nearly up to the proportional limit by such a load.

The small projecting cone frustum shown at the left of the side elevation of the socket bowl is a convenience for centering the rope, and is provided with suitable bushings for specimens of various sizes.

PLACING SPECIMEN IN MACHINE

For placing a specimen in the machine the procedure is as follows: The socket bowls, attached to the rope ends by heavy zinc castings filling their conical bowls, are laid longitudinally between the machine heads, their rectangular flanges resting on two adjustable trestles. A strut inserted below the rope counteracts the turning moment of the bowl and some 125 lb. of spelter in each. The grip pieces, with end nuts attached, are inserted in the grips. The stirrups are fitted astride the semicircular saddles of the grip pieces and their threaded ends passed through the corner holes of the sockets and secured by nuts. The initial load is then applied and the strut removed.

FASTENING CABLES IN SOCKETS

The process of fastening cables of large size in the sockets offers some difficulties, and the following practice has been adopted:

The cable is wrapped with fine wire at the ends and also at points about 15 in. from

TABLE 2—RESULTS OF CHEMICAL ANALYSES OF WIRE ROPES

Rope No.	Ultimate strength, lb.	Composition, per cent: Carbon	Sulphur	Phosphorus	Manganese	Silicon
1	866,000	0.58	0.032	0.033	0.41	0.160
3	550,000	0.68	0.030	0.016	0.58	0.130
4	937,000	0.82	0.025	0.019	0.23	0.169
5	304,000	0.90	0.034	0.024	0.48	0.172
6	694,000	0.77	0.036	0.027	0.46	0.152

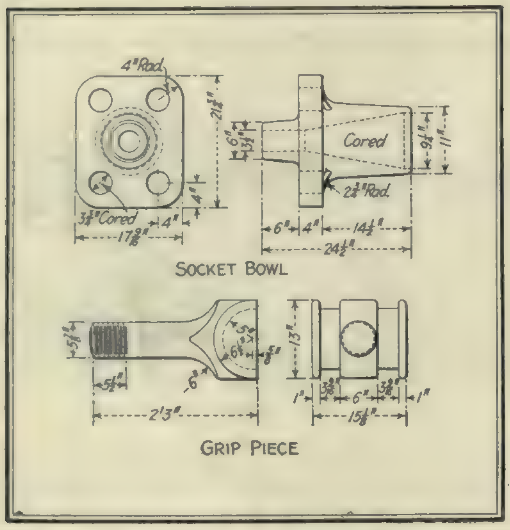
Chemical analysis for No. 2 was not made. Qualitative tests for vanadium and nickel on No. 4 gave negative results.

TABLE 1—SUMMARY OF PHYSICAL TESTS ON WIRE ROPES AT NATIONAL BUREAU OF STANDARDS

Rope No.	Diameter in.	Material	Number of strands: Large	Small	Wires in large strands: No.	Diameter, in.	Wires in small strands: No.	Diameter, in.	Total area of wires, sq. in.	First crack heard at, lb.	Ultimate strength, lb.	Ultimate strength, lb. per sq. in. of net area	Character of failure
1	3¼	Plow steel..	6	6	25 [illegible] 6	0.1540 0.1695 0.1285	9 10	0.0550 0.0935	4.61	735,000	866,000	187,900	Two strands broke in the middle
2	2	Plow steel..	6	0	19 6	0.1285 0.0520	0		1.55	280,000	293,000	189,000	One strand broke in the middle
3	2¾	Not stated..	6	0	19 6	0.1890 0.0760	0		3.36	540,000	550,000	163,400	One strand broke in the middle
4	3¼	Monitor plow steel	6	6	42 6 6 7	0.1160 0.1360 0.0995 0.1285	7 6 6	0.0860 0.0820 0.0670	4.63	720,000	937,000	202,400	One strand failed near one end
5	2	Plow steel..	6	0	19	0.1360	0		1.65	255,000	304,000	184,200	One strand failed near, but not in, the socket
6	2¾	Plow steel..	6	0	19 6	0.1850 0.0760	0		3.23	645,000	694,000	214,900	One strand failed about 1 ft. from each end

the ends. The socket bowls are then slipped on and placed, temporarily, well toward the middle of the specimen. The end windings are now removed and the wires "broomed" as uniformly as possible down to the 15-in. wrappings, as shown in one of the photographs. The iron bar seen attached to each socket is a removable lug for convenience in handling by crane. Each wire is carefully scrubbed with gasoline. The sockets are then placed at their proper positions and fixed there by means of two 4 x 4-in. pine struts placed at opposite sides and two tie rods placed at diagonally different corners of the flange plates. The proper bushings are driven in when necessary and the whole system up-ended. A platform is built up to a convenient working level and the washing process continued by spraying the "broom" with 50-per cent hydrochloric acid. The acid runs out past the bushing and is followed by a spray of rinsing water.

The spaces between strands and bowl are now carefully packed and sealed with fire-



SOCKET BOWL AND GRIP PIECE DETAILS

clay and the whole reinforced with burlap. The crucible of molten spelter is next hoisted. On account of the moisture remaining in the socket, the stream is poured small at first and is gradually increased in volume until the wires have been incased to a length roughly equal to five times the diameter of the whole cable. It is usually feasible to make the castings at both ends on the same day, though, of course, sufficient time must be allowed the first casting for hardening before the ends are reversed. No trouble has been experienced with any slippage or failure at or in the sockets.

The oxyacetylene flame is now being used to cut wire-rope specimens to a standard test length of 8½ ft., leaving about 4½ ft. exposed between the holders. After the conclusion of tests the failed cable is cut away at the sockets by the same means and the spelter plugs forced out in a 1,000,000-lb. Riehle hydraulic compression machine. One of the photographs shows a 12-ft. specimen after test.

Water Supplies in West Virginia Are Being Improved

During the last four months the division of sanitary engineering of the department of health of West Virginia has built one new sewage-disposal plant and placed three new water supplies under construction. Nine water supplies have installed liquid-chlorine apparatus. Five more supplies soon to be developed will use the chlorine treatment.

Special Details Are Used in Design of Steel Elevated Structures in Brooklyn

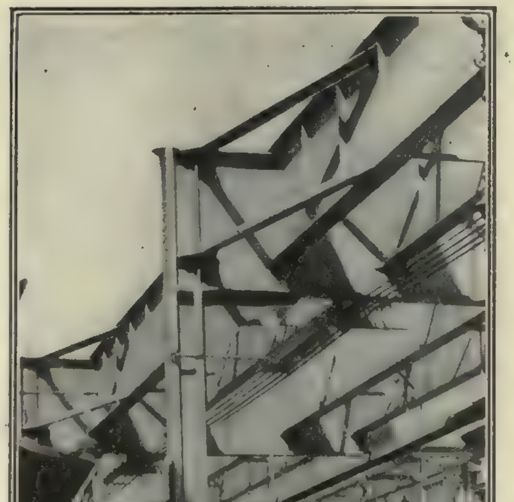
Beveled Sole Plates on All Stringers Decrease Bending at the Seats on Cross-Girders—Field Riveting Reduced in Detailing Curved-Bracket Connections

SEVERAL unusual and effective details have been developed in the design of the new steel elevated structures in Brooklyn now under construction as the part of the dual contracts being built by the New York Municipal Railway Corporation to be operated by the Brooklyn Rapid Transit Company. Section 1 of the Jamaica line, which is temporarily a two-track structure, with provision for a future third track, is now nearly completed, and the details for section 2, here described, represent the practice which has been followed from the beginning of the new construction, with a few minor modifications which have developed during the progress of the work.

Beveled sole plates on the longitudinal girders effectively decrease the bending induced at the seats on the cross-girders. These seats are detailed to support the total end shear in case the rivets in the end connection angles should work loose or drop out. Crimped lateral plates and wide gages for the end-connection rivets are used to minimize this danger. Other unusual details consist in the use of plate supports for the ties over the cross-girders and in the details for field riveting of the connections of the curved brackets.

The live load specified for each track of the Brooklyn elevated steel structures consists of a train of 60-ton cars with equal axle loads of 30,000 lb. spaced 5, 30 and 5 ft. apart, with 10 ft. between the adjacent axles of two cars. Station platforms and floors are designed for a live load of 80 lb. per square foot. Impact is added to the stresses from the electric cars by the following formula:

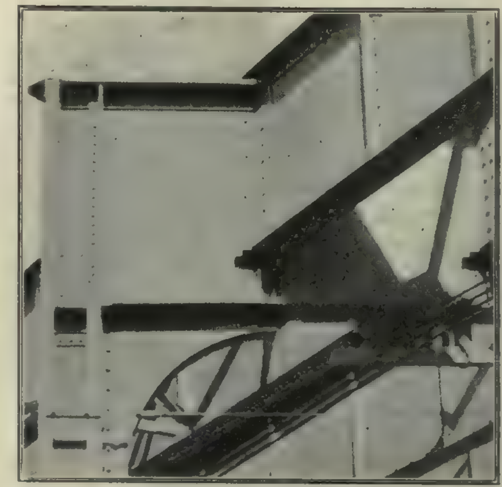
$$I = \frac{L^2}{2\,(L + D)}$$



STRUTS FROM FLANGES OF LONGITUDINAL GIRDERS STAY TOPS OF COLUMNS

in which I is the impact stress, L is the maximum live load of stress of the same kind as the dead-load stress, and D is the dead-load stress. If the live-load stress is of the opposite kind, the impact is taken as one-half of the live-load stress, D in the formula being assumed equal to zero. A lateral force of 450 lb. per linear foot of one track is specified, assumed to act at the top of the stringers. Traction force is specified as 10 per cent of the weight of a 500-ft. train assumed distributed over 1000 ft. of length if the track is on a tangent.

The allowable unit stresses conform closely to the American Railway Engineering Association standard specifications,



CABLES SUPPORTED BELOW GIRDER FLANGES—NEW SLING DETAIL SEEN AT END OF CROSS-GIRDER

with 16,000 lb. per square inch as the base unit stress.

END DETAILS OF LONGITUDINAL GIRDERS

To avoid the difficulties with loose rivets frequently experienced at the connections between the longitudinal girders and the cross-girders, seats are shop-riveted to the cross-girders to support both the fixed and the expansion ends. These seats are strong enough to carry the total loads from the stringers in case the rivets in the main connection to the web plates should become loose and have to be replaced by bolts. The main connection to the web is also sufficient to carry the loads, so that double strength is provided. Before these connection rivets in the fixed ends are driven, the stringers are fastened down to the seats. In addition, the main connection is made by wide gages in the 5-in. legs of the connection angles, to give more elastic play and decrease the tendency to loosen these rivets.

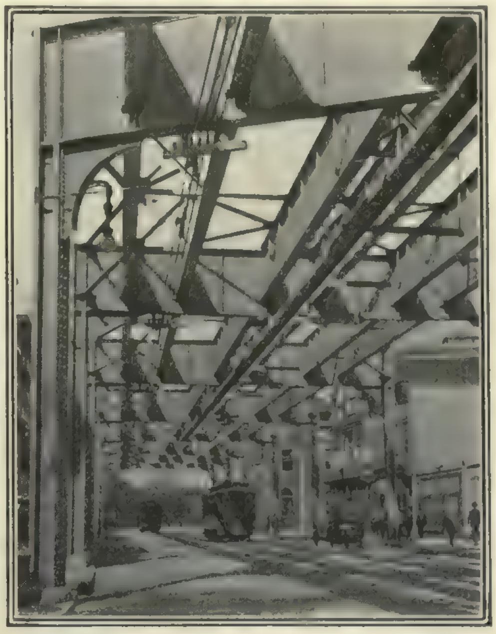
An unusual and effective detail is the beveled sole plates on all stringers, designed to decrease the bending at the cross-girders by confining the stringer load to 1 in. nearest the web of the cross-girder. The expansion joints occur about every 200 ft. At these points the bending moment is resisted by the small longitudinal brackets to the adjacent fixed stringer, as shown. The counter-sinking of the rivets connecting sole plates to girders is now avoided at the fixed ends by making the plates 7 in. long instead of 6 in., as used in earlier designs.

At the fixed-end connection between

stringers and cross-girders the top lateral plate is crimped, as noted on the drawing, in order to allow elastic deformation and prevent excessive stress in the rivets connecting to the cross-girders. This plate connects the under side of the top flange angle of the stringer with the top of the flange cover plate of the cross-girders, after being crimped.

Another unusual detail is seen in the tie-supporting plates on the cross-girders. As the ties are subject to constant renewal, it was desired to make the trackwork absolutely independent of the steel by providing a continuous steel surface to support the ties, which are not dapped, and thus allow the placing of the hook bolts at any desired position. The minimum distance of 1¾ in. specified from the top of the stringers and of the supporting plates for the ties to the top of the cross-girder is the least possible to accommodate the hook bolts under the plates.

The small plate at the end of the cross-girder, with a shelf angle support, is the latest detail devised for the purpose of carrying the telephone cables which pass along the structure. A small S-hook attached to the plate carries wire slings which support the cables.

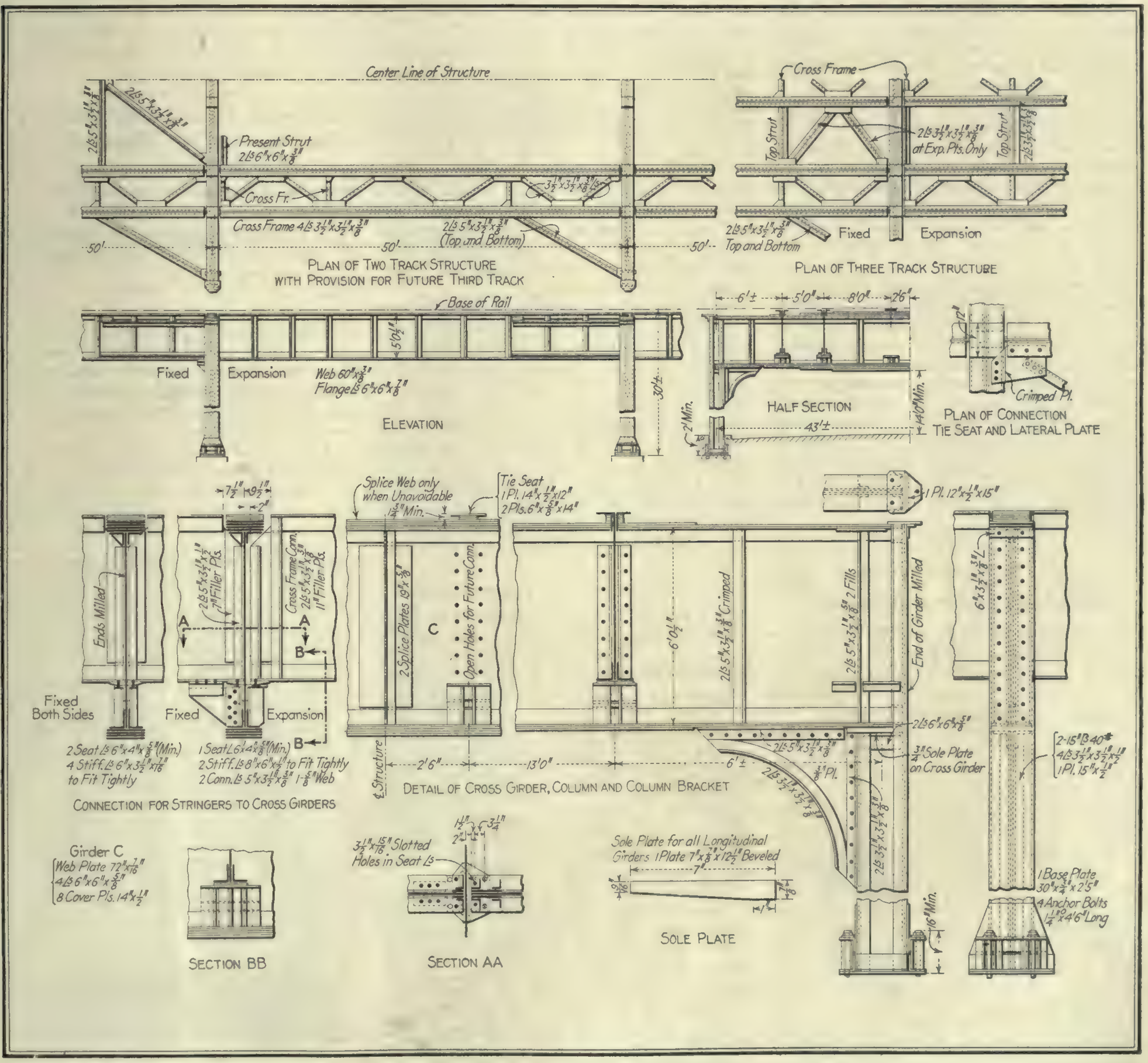


THREE-TRACK STRUCTURE IN JAMAICA, BOROUGH OF QUEENS, FOR EXTENSION OF BROOKLYN ELEVATED RAILWAY

Brackets Field-Riveted to Connection Angles

In order to decrease the number of field rivets to be driven between the curved brackets and the cross-girders and columns, which of course are duplicated hundreds of times in such a structure, the brackets are not shop-riveted with the connection angles, but the latter are shipped riveted to cross-girders and columns. In this way, only one row of rivets instead of two in each case is driven in the field. The brackets are first connected to the columns, and the cross-girders then erected by slipping the angles on the latter over the web of the brackets. The vertical-bracket connection angles are faced with the main-column section, and thus take direct bearing from the sole plate on the cross-girder.

Owing to the tonnage on this work, it has been possible to avoid nearly all web-plate splices in the girders, even though the lengths of plates exceed the usual limit fur-



TYPICAL DETAILS OF NEW BROOKLYN ELEVATED CONSTRUCTION—COLUMNS AT CURB

nished by the mills. Where webs are spliced, the splice is made strong enough to develop the bending resistance of the web plate, as this bending is counted in designing the flange section of all girders.

DESIGN OF COLUMNS

The column design is made flexible by the use of two channels and a built-up I-section, as shown. The difficulty with rolled I-beams owing to nonparallel flanges, mentioned in the article in the Engineering Record of July 17, 1915, page 76, on the Queens extension of the New York elevated, and the fact that nothing larger than ¾-in. rivets could be used in the flanges of these 15-in. I-beams, led to the adoption of this type very early in the work on the Brooklyn lines.

By using stiff struts from the top and bottom of the longitudinal girders to the columns, as shown in the plan view, it was considered permissible to regard the columns as being fixed at both ends in computing the bending effects of the tractive force, as well as the bending caused by lateral forces and wind pressure. The extreme fiber stress produced by the bending from either of the foregoing causes combined with the direct dead and live load stress was not allowed to exceed the regular specified allowable extreme fiber stress for bending by more than 25 per cent.

Traction trusses are provided in the plane of the top laterals opposite each expansion point. For the two-track structure the inside stringers are connected by the temporary diagonals and struts shown. In the final three-track structure, double diagonals between the inside stringers are used for one double panel, as indicated in one of the plans.

This work is being done under the supervision of the New York Municipal Railway Corporation, of which W. S. Menden is chief engineer and Francis P. Witner structural engineer, with Jacobs & Davies, Inc., acting as consulting engineers. The designs are subject to the approval of the New York Public Service Commission, of which Alfred Craven is chief engineer. The portion of the Jamaica line already erected was built by Post & McCord, of New York City, and the steel was fabricated by the American Bridge Company.

Technical Report Writing Required at Stevens Institute

A year ago the faculty of Stevens Institute of Technology planned for the introduction of report writing as a requirement for graduation, to be given one afternoon per week during the second half of the senior year. The present senior class is the first to complete this work. The data for these reports are obtained mostly by a search of the literature of the subject, and experimental work is neither required nor encouraged. The subject of the report is chosen by the senior himself during his first term, and is submitted for approval to the head of the department in which it falls. The students are prepared to take up this report writing by exercises which have been introduced into the junior year. The subjects of the reports which have just been submitted by the seniors not only cover branches of mechanical, civil and electrical engineering, but also chemistry, physics, economics and welfare work in industrial organizations.

Inspectors on City Work Should Be Salaried

Employment of Per Diem Men for Extra Work, Such as Opening of Streets, Not Conducive to Loyalty and Good Results

By M. Y. CROWDUS
Nashville, Tennessee

THE CRY for more streets and better ones has brought manifold problems to add to the load already carried by the city engineer of the average American city. Not the least of these is the feature of inspection.

In cities of say 200,000 the city engineering corps ordinarily carried on the payroll are swamped by the additional work which the letting of miles of street contracts puts upon them. Their ordinary duties, coupled with a weekly or semi-monthly estimate day keep their every working hour full. Hence the chances are an extra corps will be put in the field to keep up the engineering work of the new streets alone. Their salaries are not provided for in the yearly budget, and so they are paid out of the special street funds, provisions of the contracts including a lump sum charged to each street. This sum is to cover "engineering and inspection."

The work begins on the new streets, ten or fifteen are started, lines and grades given for them, and an inspector is appointed to see that the excavation, embankments, etc., are true to specifications. Work proceeds until the coming of bad fall weather, the rains, freezes and snows. Work then goes on in a desultory way on some streets, others lie torn up, muddy, half bedded, rain washed all the long winter months. The contractor gets in a day now and then, and so does the inspector. Work a day, and loaf three, or six.

Spring comes again, work starts up where it left off. New lines and grades are needed again, those previously given being destroyed, lost or effaced. The inspector again sings his lay. And then before it seems possible, at the end of the month, the discovery is made that the "engineering and inspection" fund is exhausted on Blank Street and it not half finished! And in spite of the fact that the extra field force has been "laid off" all winter, and the poor inspector has existed somewhat in the nature of Brer Bar. What then is the remedy?

REGULAR INSPECTION FORCE NEEDED

Any city with financial strength to issue bonds for the construction of a half million dollar street contract is, or should be, financially able to provide a regular force of engineers and inspectors to build these miles of streets. Having an overworked engineering corps is as bad business policy as trying to run a million dollar factory on half shift. Nothing is prettier than the workings of a well balanced engineering corps, but put a double load on them and, strive as they loyally will, their efficiency is impaired, their organization is disrupted, and the work is bound to suffer.

The inspection staff should be composed of competent, proved men, sufficient in number to take care of the ordinary year-around work of the municipality, with enough "subs" to call upon when needed. An inspector worthy of the name cannot put his soul into his work when he is continually worried as to whether he will "finish the day" or whether rain will stop him. A salaried position at $75 is more satisfying than a per diem of $3.50 or $4. For a salary of $75 or $90 men can be secured who will pay for themselves in the saving to the city which their constant supervision over works will obtain. And it is right that the taxpayer be assured of getting his money's worth on his street, without having to pay an additional cost for such assurance. Or if provision is made for engineering and inspection to be paid out of each contract, let the fee go into the city treasury to help pay for the services of the men who really pay their own salaries in the stability and durability of the work they supervise.

When a street or sewer is completed and paid for it is too late to discover that the wearing surface is only half the specified thickness, or that the sewer is choked up at a point where the grade was "accidentally" raised and the rate of fall killed.

When the inspector knows that, whether he works three days in the week or six, his check is ready for him at the end of the month, you can depend upon it that pride will insure his getting all that is coming to him in materials and workmanship; or if he is mercenary alone, he knows that he and he alone is responsible for his job; it is up to him, and if the job falls down he is the goat.

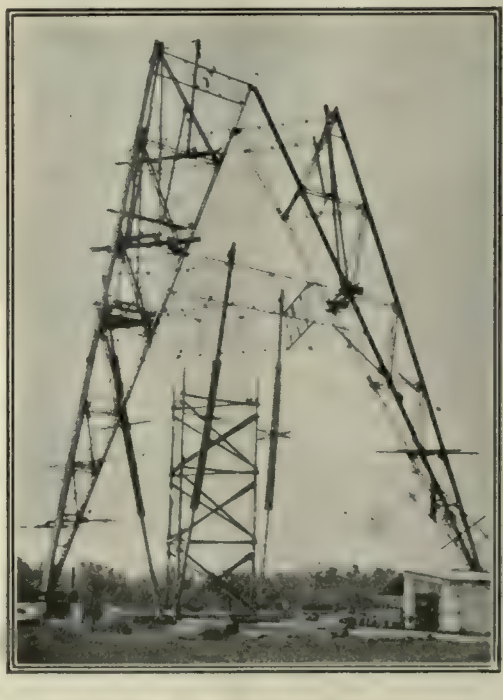
Make the inspector the keystone of the fabric, give him authority, back him up in it, and pay him his worth.

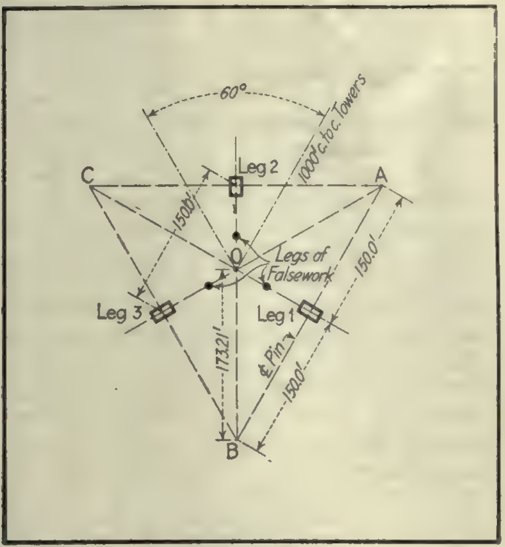
Falsework Complicates Setting of Pins for Large Wireless Tower

By P. E. MOSS WHEAT
Assistant Engineer, Bureau of Public Works, Manila

FALSEWORK already occupying the central area of the location of each tower of the wireless station for the United States Navy at Canacao, Philippine Islands, rendered impossible direct sighting for placing the center pins of the cradles. The method indicated in the sketch was therefore devised for accurately locating these cradles, on the position of which depended the connection where the three legs came together 150 ft. above.

A transit was set at the center of the tower and stakes were driven at *A*, *B* and *C*. The transit was moved to *A* and sighted on *B*, giving the center line of the pin for leg No. 1. The longitudinal center line of


FALSEWORK AND TOWER DURING ERECTION



AS LEGS OF FALSEWORK PREVENTED DIRECT ALIGNMENT OF PINS, CENTERS WERE FOUND BY MEASUREMENT ON LARGE TRIANGLE

the cradle lay midway between *A* and *B*, or 150 ft. from *A*. This distance was measured and transferred to the concrete pedestal at either end of the foundation. The cradle for leg No. 1 was then hoisted and set so that the center line of the pinhole coincided with the line *AB* and the transverse center line passed through the two points set on the foundation. Elevation was determined by direct leveling from bench marks to the top of the cribbing. The other three pins were set in the same manner.

The total height of the towers is 600 ft. They were designed by the Bureau of Yards and Docks of the United States Navy, and the steel work was fabricated in the United States, arriving at Manila on October 29 last.

Production of Manganese Ore Largest Since 1901

The production of manganese ore in the United States in 1915 was 9651 long tons, the largest since 1901, and more than three times the production in 1914, which was 2635 tons, according to figures compiled by the U. S. Geological Survey. The imports of the ore for 1915 were 313,985 tons, as compared to 283,294 tons for 1914. Of this, 268,786 tons came from Brazil—more than twice the quantity received from that country in any preceding year. The imports from India were 36,450 tons, about one-fourth the average of the preceding 10 years. No ore was received from Russia. The quantity of ferromanganese marketed in 1915 was 144,260 tons and the imports were 55,263 tons. The available supply, or 199,523 tons, was greater than that for 1914, but 15 per cent less than the average for the preceding two years. The price of ferromanganese rose to $115 a ton in December, but it is reported that during April, 1916, much higher prices were offered—$175 a ton for future delivery and $400 a ton for immediate delivery. The production of spiegeleisen in 1915 was 114,556 tons, which, with the 200 tons imported, represents an increase of 45 per cent over the available supply for the preceding year. If the increase in the production of steel is considered it becomes apparent that less manganese is now used in the manufacture of steel than formerly, a conclusion that may indicate either that the final product contains less manganese or that ferromanganese is used more efficiently.

City Engineer Defines Quality of Lumber to Use

Chicago Bureau of Engineering Prints Instructions and Bid Prices for Use of Its Designing and Construction Engineers

INSTRUCTIONS as to the kind and grade of lumber to use on different work in Chicago have recently been issued by the Bureau of Engineering for the guidance of all designing and construction engineers on the staff of John Ericson, city engineer. The following notes are abstracted from this 4 x 6-in. pamphlet of 33 pages.

Under the new rules of the Southern Pine Association the terms longleaf, shortleaf and loblolly pine have been discontinued and the terms dense and sound substituted. Following these terms the City of Chicago contracts for three grades of yellow pine lumber, viz., dense merchantable, dense No. 1 common and sound No. 1 common.

This latter class is to be used for all kinds of construction work, including concrete forms, temporary sheds, trench-bracing, shoring, driven sheeting and other work, either temporary or permanent, where maximum strength and durability under severe conditions are not required.

Dense yellow pine No. 1 common grade is to be ordered only where strength and durability are required. It may be used for posts, sills, caps and stringers, bridges and trestles, crib and harbor work, drums and bracing in deep excavations or in treacherous soil, concreting towers and derricks. The same grade is to be ordered only after careful consideration of the advantages to be gained by its use, as compared to the extra cost of sound yellow pine No. 1 common grade.

Dense yellow pine merchantable grade, which is the same as dense yellow pine No. 1 common, except for requirements as to the amount of heart, is to be ordered only where the timber is to be exposed to the weather, and where maximum durability is required.

Norway pine is particularly adapted for bridge railings, sidewalks, scaffolding, foundry flasks, posts for supporting concrete slabs, concrete forms where heavy planking is required, and many of the uses for which No. 1 sound yellow pine is specified. Price, as before, is the determining factor between the two.

White pine, owing to advance in price, may be used only for bridge gates, door jambs, outside finish that requires painting, shelving, bridge-tenders' boats, templates or any other work where ease of working and freedom from warping offset high price.

Kiln-dried white pine is to be used only for mill work, such as windows and doors.

White or burr oak is particularly adapted to uses where its high compression value perpendicular to the grain, its ability to withstand abrasion and its freedom from splintering are necessary. Bridge decking, bridge protection work, dock walings, wedges, skids and scale foundations are some of the uses for which oak may be ordered. In timbers subject to bending stresses, dense yellow pine is to be preferred, as it is approximately 20 per cent stronger in this respect than oak.

Kiln-dried red oak is to be used only for interior finish and cabinet work.

Hemlock, the cheapest lumber contracted for, is the best wood for use in mud and water, and should be used for all kinds of blocking, trench sheeting where driving is not necessary and bracing in ordinary excavation. It can be used for form lumber where the nature of the work requires it to be left in place, and is well adapted for several classes of more or less permanent construction, such as coal sheds and sand and store bins.

Caisson lagging shall be of dressed and matched maple lumber, and shall be tongued, grooved and beveled to fit snugly in the circumference of a circle whose radius will be specified in each order.

All lumber shall be of good quality, live, sound and sawed to standard sizes, full length; it shall have square corners and be straight, with such exceptions as are allowed for the various grades. It shall be free from defects such as injurious windshakes and cross grain, unsound and loose knots and other defects that impair its strength, and must be of grades fully complying with the rules for grading such materials.

Southern yellow pine shall be graded by the rules of the Southern Pine Association. White pine and Norway pine shall be graded by the rules of grading northern pine, spruce and tamarack lumber adopted by the Northern Pine Manufacturers' Association. Oak and maple shall be graded by the National Hardwood Association standard rules for measurement and inspection of hardwood lumber. Hemlock shall be graded by the rules for the inspection of hemlock lumber adopted by the Northern Hemlock and Hardwood Manufacturers' Association.

The last 22 pages of the pamphlet are devoted to bid prices on these grades of lumber.

Engineers Must Learn to Sell Their Ability

Engineering Schools Should Teach Students How to Write Convincingly and to Debate Extemporaneously and Publicly

CLOSELY connected with the current discussion on decrease in registration of engineering students and the possibility of improvements in educational methods is the contention by a prominent alumnus of a Middle Western institution that engineering is an unremunerative profession largely because engineers do not know how to sell their ability. Engineering students, he said, should be taught how to write convincingly and how to debate extemporaneously and publicly. The ethics of the profession is also a matter of vital concern to the engineering schools. Extracts from his remarks follow:

Well Trained But Poorly Paid

As an alumnus who comes in contact wtih engineers in all professions, I am satisfied that one answer to the lack of interest in engineering on the part of young men of this country is that it is proving to be an unremunerative profession. I do not believe that any other profession is graduated from the universities so well grounded in its particular art, but the engineers lack an education along certain fundamental lines which are a vital necessity to their success. All engineers must sell their idea or their product, and when they have not been trained in logic and are unable to write or tell in a convincing manner the merits of their design, or are unable to convince capitalists of their superior ability through ar-

gument or by written evidence, their engineering superiority goes for naught.

In other words, the best engineers do not rise to the top as quickly as inferior engineers, in many instances, because the inferior engineer is a born salesman. To my mind the engineering profession must have a grounding in logic and argumentation the same as the lawyer, and sell his engineering knowledge as the lawyer sells his knowledge of law. Until engineering schools teach engineers how to write convincingly and debate extemporaneously and publicly the engineering profession will continue to be unattractive to the young man.

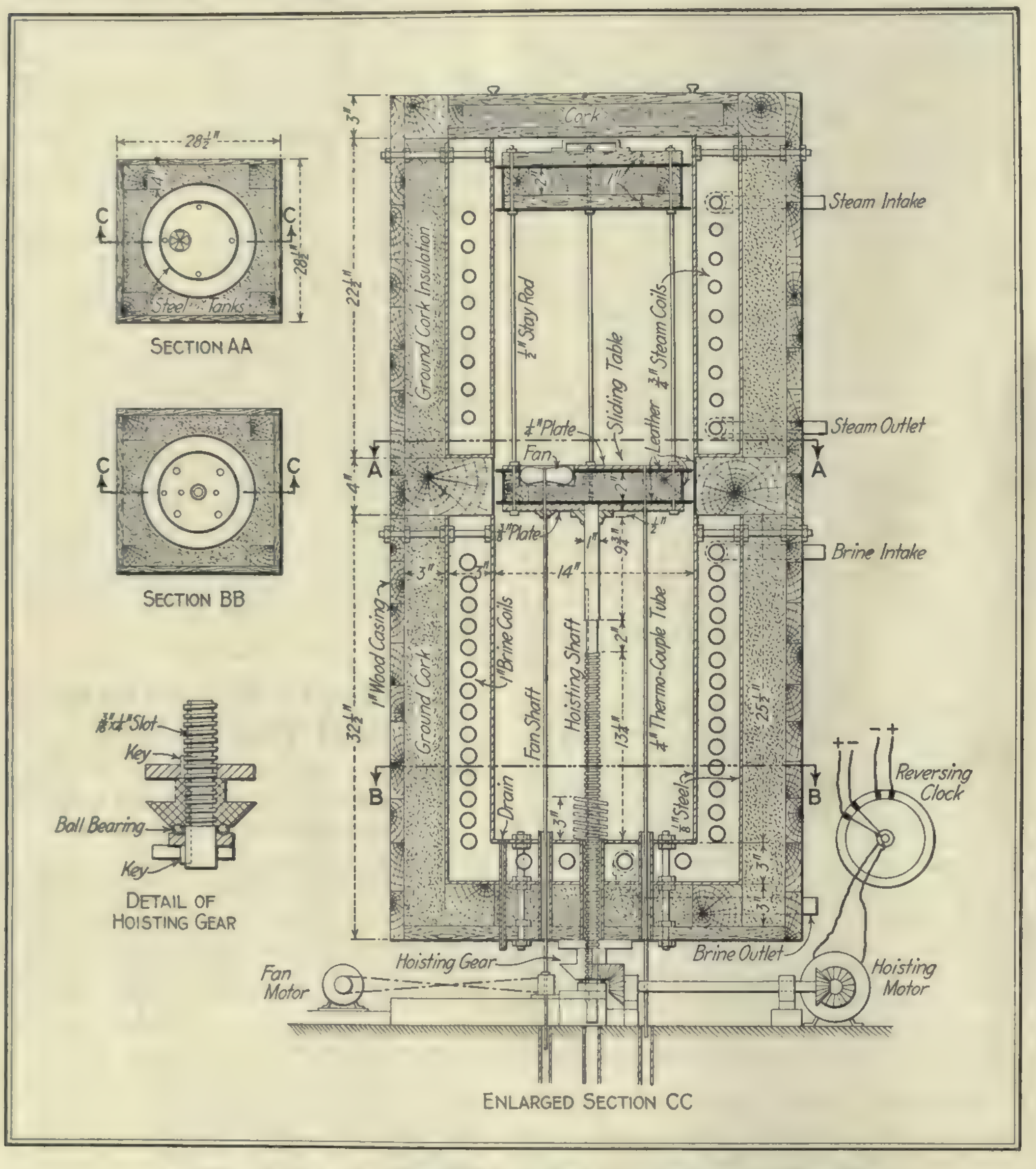
When I make the foregoing statements I am expressing not only my personal opinion, but that of a great many other engineers with whom I have talked along this line. I am so satisfied that my conclusion is correct that I will make every endeavor to keep my two sons out of the engineering profession as a lifework, unless I am first able to give them a straight collegiate course from which they will obtain a grounding which will enable them to write clearly and discuss a subject logically and convincingly.

Finally, the ethics of the profession have not received the attention that they should, and this, too, is a phase of the engineering profession which deserves the most careful attention and consideration on the part of the engineering schools. Just how this could be crowded into a four-year course is a perplexing question, but radical changes of this nature must be brought about.

New Freezing and Thawing Apparatus Is Automatic

Adjacent Insulated Chambers with Steam Coils and Brine Coils Provide Heat and Cold for Testing Stone or Concrete Specimens

FOR THE PURPOSE of testing specimens of stone or concrete to be subjected to freezing and thawing conditions the U. S. Bureau of Standards has devised an apparatus which will automatically shift the specimens from a cold chamber to a hot chamber by the use of a motor regulated by a time clock. Insulation is provided by a simple timber frame with ground-cord lining outside of the steel tanks. A small motor operates a fan to keep the air in the containing chamber in circulation.



SECTIONS OF NEW AUTOMATIC FREEZING AND THAWING APPARATUS

As indicated by the accompanying sections, the apparatus is 28½ in. square and 5 ft. 2 in. high, made up of a timber framework casing surrounding the two ⅛-in. steel tanks within which are placed the steam coils above and the brine coils below. The lower steel tanks are stayed by ¾-in. bolts, four at the lower end and four at the top, while the upper tanks have similar stays at the top. The space between the two lower tanks is to contain oil about the coils, the staybolts being fitted with gaskets to prevent leakage. The brine coils are of galvanized steel pipe, with fifteen turns and a spiral of three turns at the bottom. The steam coils are of ¾-in. galvanized steel pipe having nine turns, held in position by nuts on the threaded ends.

Ball bearings are provided below the hoisting shaft, which is operated by beveled gears from the ⅛-hp. 220-volt hoisting motor. The reduction between the hoisting gear and the driving pinion is approximately 1:3.

The purpose of the coil spring at the bottom is to enable the hoisting gear to pick up the hoisting shaft in the lower position. When the charge occupies the lower chamber the hoisting gear turns loose a few turns in the groove at the upper end of the worm on the hoisting shaft. In this position the coil spring is compressed 1 in. and the strength of the spring is such that the worm on the hoisting shaft is pressed against the lower side of the hoisting gear, so that when the motor is reversed the hoisting pinion can pick up the load. A similar groove is provided at the lower end of the worm on the hoisting shaft so the hoisting pinion can make a few turns loose at the end of the lift.

The motor is reversed by the clock at the intervals required for complete freezing and thawing of the specimens being tested. These intervals are determined by the temperatures in the two chambers, also the size and number of specimens in the test. The contact blocks on the time clock can be shifted to accommodate these intervals, so that for a given charge these blocks are set in the proper place, as indicated by the thermo-couple, to shift the specimens from one chamber to the other when they are completely frozen or thawed.

General Description of Parts

The sliding table consists of a 2-in. disk of cork, two ⅛-in. leather gaskets and two metal plates, ¼ in. above and ⅜ in. below. This is stiffened by four wooden blocks 2 in. square placed where the stay rods pass through. The circumference between the leather gaskets is girthed by a 2-in. band of leather tacked to the wooden blocks. The lower metal plate is secured to the upper end of this hoisting shaft with a ½-in. collar to give additional strength. A 5-in. circular hole in the upper plate is provided for the fan. The sliding cover is of similar construction, as shown, and is stayed to the sliding table by four ½-in. rods turned down to ¼ in. and threaded at each end through table and cover, and provided with nuts and washers. The lid consists of two ½-in. thicknesses of pine separated by 2 in. of cork and made rigid by 2 x 2-in. pine strips at the edges.

The 4-in. wood block separating the two outside chambers is of one piece 26½ in. square with the central opening cut away ¼ in. larger than the inside diameter of the tanks to receive the leather lining shown, and the four corners cut out to pass the 4 x 4-in. corner pieces. A wire basket 12 in. in diameter and 18 in. high of No. 9 steel wire is provided. This containing basket is placed between the sliding table and the sliding cover, and moved up and down from the freezing chamber to the steam chamber at certain regulated intervals.

This device has been designed by D. W. Kessler, assistant engineer physicist of the U. S. Bureau of Standards.

Hypo for Tourists

Hypochlorite tablets to treat suspected drinking water are furnished vacationists free by the Chicago Board of Health. Moline, Ill., put up small bottles of hypo in liquid form for its citizens last year.

Concrete Road Develops Three Cracks in a Year

Fostoria (Ohio) Pavement with Joints 100 Feet Apart Shows Only One Crack Directly Traceable to Contraction

IN 1914 the city of Fostoria, Ohio, laid a concrete pavement 1750 ft. in length and from 15½ to 28 ft. in width, reinforced by wire mesh against frost action, and with transverse joints spaced 100 ft. apart. Portland cement that fell well within the latest amended specifications of the American Society for Testing Materials and aggregates of excellent quality were used. The construction was carried on in a careful manner and was closely watched. After a year's service the pavement developed three cracks, only one of them clearly distinguishable as a contraction crack, and this at a spot at which the subgrade was alternately in a saturated and dry state while the concrete was setting. The other cracks occurred where attempts were made to join new concrete to that of from 12 to 36 hours of age. The following notes in regard to the pavement are abstracted from a paper presented by Charles A. Latshaw, chief engineer of the Department of Public Service of Fostoria, at the December, 1915, meeting of the engineering section of the American Association for the Advancement of Science, at Columbus, Ohio.

CONCRETE 6 IN. THICK

The Sandusky Street concrete pavement, laid in 1914, is about 1750 ft. in length and varies in width from 15½ to 28 ft. A 6-in. thickness of concrete, in the proportions of 1:2:3, was used. The Portland cement used was manufactured by the Sandusky Portland Cement Company, and, as tested by the Pittsburgh Testing Laboratories, fell well within the latest amended specifications of the American Society for Testing Materials. The aggregates were coarse Canadian sand and argillaceous dolomite. The pavement was reinforced 2 in. from the top surface by means of the American Steel & Wire Company's triangle mesh number 36. The strips of reinforcement, 50 in. in width, and overlapping 2 in. at the edges, were laid crosswise to the pavement. The length is constituted of fifteen slabs, approximately 15½ ft. wide by 100 ft. long, and three slabs varying from 15½ to 28 ft. in width and from 40 to 70 ft. in length. Tile varying in size from 4 to 6 in. in diameter was laid about 12 in. below each edge of the pavement. The trenches, around and above, were filled with ½-in. stone. The subgrade was well rolled and smooth. Expansion-contraction joints were of Carey's Elastite, ½ in. thick, armored with Baker plates.

REINFORCING TO RESIST FROST CRACKING

The reinforcing was introduced primarily to resist frost cracking. Temperature cracking was treated as of secondary concern. It was thought safe to assume that the use of the reinforcing would extend at least 10 ft., the natural spacing of contraction joints in plain concrete, as determined by observations made on about 9 miles of unreinforced concrete road in Huron County, Ohio, where natural contraction joints were made by the weather at fairly uniform distances of 90 ft., the conditions of subgrade, quality of concrete and climate being approximately the same.

An inspection of the pavement in December, 1915, revealed only three cracks, all extending the full width of the pavement. One of these was clearly distinguishable as a contraction crack without obvious signs of wear. The others occurred where attempts had been made to join new concrete to that of from 12 to 36 hours of age, situated about mid-length in the slab. Three attempts to accomplish this proved successful to the extent that the most painstaking scrutiny is involved in searching out their location, and it is doubtful if any one not familiar with the construction of the pavement could locate them.

The directions given for joining new work to old between expansion-contraction joints required that the end of the old work be trimmed with a pick or mattock to make a joint perpendicular to the surface of the pavement, that all loose materials be carefully cleaned off by means of a wire broom, that the surface of the joint be carefully washed and covered with a sprinkle of neat cement preparatory to new concrete and that the joints be made at the middle of the width of the reinforcement.

The subgrade at the location of the one contraction crack, while the concrete was setting, was frequently alternating from a saturated to a dry state, and reversely, due to leakage from a faulty catch basin adjacent thereto. A delay in repairing this allowed the full capacity of the structure to empty itself rapidly into the adjacent soil intermittently, for a period of two months after the completion of the concrete paving.

The contraction crack appeared ten days after the concrete was poured, and was probably caused by the extremely frequent and rapid fluctuation of the moisture absorption of the concrete.

The necessity of care being exercised by laborers in shoveling aggregates from soils other than those composed of sand or gravel, to guard against mixing foreign substances into the concrete, was emphasized on the Sandusky Street work. The surface of this pavement here and there displays chunks of loam or clay that were admitted into the aggregates by shovelers who scraped the materials too close to the subgrade.

Literature

For the Civil Engineer and Contractor

New Publications

PORTS OF THE UNITED STATES. Report on Terminal Facilities, Commerce, Port Charges and Administration at Sixty-eight Selected Ports. By Grosvenor M. Jones, commercial agent. Miscellaneous Series No. 33, U. S. Department of Commerce. Paper, 6 x 9 in.; 431 pages; illustrated. Washington, Government Printing Office.

PRACTICAL COST KEEPING FOR CONTRACTORS. By Frank R. Walker. Cloth, 4½ x 7 in.; 273 pages; illustrated. Chicago, published by the author, 30 North Michigan Avenue. $2.

COMMISSION ON BUILDING DISTRICTS AND RESTRICTIONS, CITY OF NEW YORK—FINAL REPORT, 1916. Paper, 7 x 10 in.; 100 pages; illustrated. New York, Board of Estimate and Apportionment, Committee on the City Plan.

EIGHTH ANNUAL REPORT OF THE HYDRO-ELECTRIC POWER COMMISSION OF THE PROVINCE OF ONTARIO, 1915. Paper, 6½ x 9½ in.; 466 pages, illustrated. Toronto, Canada, Legislative Assembly, A. T. Wilgress, printer.

THE THEORY AND PRACTICE OF MODERN FRAMED STRUCTURES. PART III—DESIGN. By the late J. B. Johnson, C. E., C. W. Bryan, C. E., chief engineer of the American Bridge Company, and F. E. Turneaure, C. E., dean of the college of mechanics and engineering, University of Wisconsin. Ninth edition, rewritten by F. E. Turneaure and W. S. Kinne, associate professor of structural engineering, University of Wisconsin. Cloth, 6 x 9 in.; 486 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.

MECHANICAL ENGINEERS HANDBOOK. Based on the Hütte, and prepared by a staff of specialists. Lionel S. Marks, professor of mechanical engineering, Harvard University and Massachusetts Institute of Technology, editor-in-chief. Limp leather, 4½ x 7¼ in.; 1836 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $5 net.

FIRST REPORT OF THE COMMITTEE ON CIVIL SERVICE OF THE SENATE OF NEW YORK STATE. Cloth, 6 x 9 in.; 933 pages. Albany, J. B. Lyon Company.

Reports, investigations and findings in relation to standardization of the public employments of the state. Tabulates salaries and salary-increase rates, and proposes constructive program of recommendations.

DATA ON THE OXIDATION OF AUTOMOBILE CYLINDER OILS. By C. E. Waters, associate chemist, U. S. Bureau of Standards. Technologic Paper No. 73, U. S. Bureau of Standards. Paper, 7 x 10 in.; 20 pages; illustrated. Washington, Government Printing Office.

AN INVESTIGATION OF THE LAWS OF PLASTIC FLOW. By Eugene C. Bingham, assistant physicist, Bureau of Standards. Scientific Paper No. 278, U. S. Bureau of Standards. Paper, 7 x 10 in.; 44 pages; illustrated. Washington, Government Printing Office.

WATER SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.

GROUND WATER IN SAN JOAQUIN VALLEY, CAL. No. 398. 310 pages.

SURFACE WATER SUPPLY OF THE UNITED STATES, 1914. PART 3, OHIO RIVER BASIN. No. 383. 125 pages.

GROUND WATER IN THE HARTFORD, STAMFORD, SALISBURY, WILLIMANTIC AND SAYBROOK AREAS, CONN. No. 374. 150 pages.

SPIRIT LEVELING IN MAINE, 1899 TO 1915. By R. B. Marshall, chief geographer. Bulletin 633, U. S. Geological Survey. Paper, 6 x 9 in.; 55 pages; illustrated. Washington, Government Printing Office.

SAND-LIME BRICK IN 1915. By Jefferson Middleton, U. S. Geological Survey. Paper, 6 x 9 in.; 8 pages. Washington, Government Printing Office.

GEOLOGY AND UNDERGROUND WATER OF LUNA COUNTY, NEW MEXICO. By N. H. Darton. Bulletin 618, U. S. Geological Survey. Paper, 6 x 9 in.; 188 pages; illustrated. Washington, Government Printing Office.

SPIRIT LEVELING IN LOUISIANA, 1903 TO 1915. By R. B. Marshall, chief geographer. Bulletin 634, U. S. Geological Survey. Paper, 6 x 9 in.; 101 pages; illustrated. Washington, Government Printing Office.

STRENGTH AND OTHER PROPERTIES OF CONCRETE AS AFFECTED BY MATERIALS AND METHODS OF PREPARATION. By R. J. Wig, engineer-physicist; G. M. Williams, assistant engineer-physicist, and E. R. Gates, assistant physicist, U. S. Bureau of Standards. Technologic Paper No. 58. Paper, 7 x 10 in.; 172 pages; illustrated. Washington, Government Printing Office.

THE PLANNING OF THE MODERN CITY. By Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City. Cloth, 6 x 9 in., 423 pages; illustrated. New York, John Wiley & Sons, Inc. $3.50 net.

Books Reviewed

The American Road

Author, James T. Tucker, professor of civil engineering, University of Oklahoma, and consulting state engineer, Oklahoma Department of Highways. Half leather, 6 x 8 in.; 235 pages; illustrated. Norman, Okla.; American Road. $1.08 postpaid.

This is a non-technical manual for practical road builders, though by the thorough manner in which he has dealt with the various subjects, the author has earned a place for his work on the library shelf of the highway engineer. The volume deals with what it styles the "cheap" roads and stops just short of the macadam road, with its modern variations. The illustrations are a striking feature, evidently very painstakingly selected and each one with its

terse caption telling a lesson. The necessity of skilled engineering control of highway work is strongly emphasized throughout. Among the subjects dealt with are: General conditions and preliminary studies, road economics, administration, convicts and road work, earth road construction and maintenance, waterways, bridges, finance, stone roads, gravel roads, sand clay roads, building with oils, and needed legislation.

Principles of Depreciation

Author, Earl A. Saliers, Ph.D., instructor in accounting and investments, Yale University. Half leather, 200 pages; tables and forms. New York, Ronald Press Company. $2.50.

REVIEWED BY C. W. STARK

Associate Editor, Engineering Record.

Being written from the accounting point of view, of which the average engineer knows all too little, this book deserves the attention of the engineering profession. Much of the book is pure exposition, clear and convincing, while other sections, which delve into the details of accounting, the reviewer, who is not an accountant, will not presume to dissect. Neither will he attempt to discuss the value of the book to other than engineers. From the engineer's point of view, however, there is one theory that colors the discussion that the reviewer cannot square with justice—namely, that it is right to require the owner of the plant to put up considerably more than $100,000 in order to come out with $100,000 of dividend-paying capital; in other words, that the forced retirement of capital by the amortization of theoretical depreciation down to a feasible condition per cent is entirely proper. Doubtless this simplifies the bookkeeping; but while the reviewer concedes that engineers should pay more attention to accounting principles, he feels that accounting is a means and not an end, and must shape itself to equity.

The book has three parts, devoted respectively to theory, practical applications and the determining of the depreciation charge. In addition there is an appendix with a chapter on logarithms and a selected bibliography that lists six books and twenty-five articles.

The character of the industrial plant is discussed first. A brief discussion of the elements of value is followed by the introduction of the author's view that depreciation should be deducted, being offset by such of the theoretical reserve as has remained in the property, either as a separate fund or as new plant. In chapter 2 the elements of a hydroelectric plant are analyzed, the proportional costs and life lengths of the elements being presented in tables. Chapter 3 shows sample ledger pages, in which the author recognizes the likelihood of estimates of life length and serviceability going wrong by showing adjusted ledger pages, which do not, however, convince the reviewer that either the car that is smashed within a year or the one which is repaired long beyond its theoretical life has been properly accounted for. The author points out in chapter 4 the difference between depreciation and sinking funds, and between funds and reserves, and then in chapter 5 he comes out squarely with the proposition that efficiency and depreciation have no connection with each other—in other words, that the fact that the plant is rendering 100 per cent service should not relieve it from the depreciation deduction.

Part 2, with chapters on regulation, the income tax, valuations and land, contains little that the engineer as such should know and does not. It is worthy of note that the author favors the unearned increment; as so many others do, he regards appreciation as the complement of depreciation.

In part 3 the author gets at the determination of the depreciation charge. Besides an introductory chapter, a short chapter is given to each of six methods. The straight-line, sinking-fund and equal-annual-payment methods are all considered, and in addition there are the reducing-balance, annuity and unit-cost methods. The author leans toward the straight-line method, but explains each briefly and presents depreciation curves obtained by the different methods. While one or two of these methods appear to have no excuse for existing, the engineer should familiarize himself with them, to do which he will likely have to read Part 3 several times, with its formulas and tables.

The book is one that valuation engineers should possess. When engineers become expert accountants they may well choose between this and other discussions of the bookkeeping side of depreciation. At present probably only a few are in a position to discriminate, and even these few are likely to find this volume not without value.

Earth Pressure, Retaining Walls and Bins

Author, William Cain, professor of mathematics, University of North Carolina. Cloth, 6 x 9 in.; 297 pages; 99 illustrations. New York, John Wiley & Sons, Inc. $2.50 net.

REVIEWED BY MELVIN L. ENGER

Assistant Professor of Mechanics and Hydraulics, University of Illinois

Many engineers have no confidence in the usual analyses for determining the thrust against retaining walls because of the assumptions upon which they rest. In particular the assumption that the material behind the wall is a granular mass devoid of cohesion has been frequently criticised as being far from the truth. The inclusion in this book of an analysis which applies to cohesive material will therefore give greater confidence in the theory, although it is probable that conservative designers will continue to neglect the effect of cohesion. One cannot help wishing that large-scale experiments were available for checking the theory and for determining constants. Until experiments are made, and they must cover a large range of conditions to be conclusive, the designer will continue to use "rule-of-thumb" methods or to use one or more of the theoretical methods.

In this book will be found many practical suggestions, graphical methods, detailed designs and tables of great value. It is divided into six chapters and two appendices, as follows: Chapter 1, laws of friction and cohesion, tables, direction and distribution of stress; chapter 2, noncohesive earth, graphical methods; chapter 3, noncohesive earth, analytical methods; chapter 4, design of retaining walls of stone or reinforced concrete; chapter 5, earth endowed with both cohesion and friction; chapter 6, theory pertaining to both deep and shallow bins; appendix 1, stresses in wedge-shaped reinforced-concrete beams; appendix 2, experiments on retaining walls.

The book is a real contribution to its field and should be in the library of every engineer having to do with the design of retaining walls.

Masonry Dam Design

Authors, Dr. Charles E. Morrison, formerly of the civil-engineering department, Columbia University, and Orrin L. Brodie, late assistant designing engineer, New York Board of Water Supply. Cloth, 6¼ x 9 in.; 285 pages; 47 illustrations. New York, John Wiley & Sons, Inc. $2.50.

REVIEWED BY A. G. HILLBERG

Civil and Hydraulic Engineer, New York City

The first edition of this book contained just 100 pages and appeared in 1910. It was entitled "High Masonry Dam Design," its cost was $1.50 and it was reviewed on page 650 of the Engineering Record of May 14, 1910. In the new edition, which comprises nearly three times the number of pages of the first edition, the authors have added chapters on overfall and arched dams and supplied an appendix illustrating the evolution of the masonry dam. Consequently the scope of the book has been extended so that it now covers almost completely the design of masonry dams, including high dams.

Chapters 1 to 5 inclusive, with the exception of minor changes, are identical with the contents of the first edition, while the remainder is new matter. Chapter 6 is a thorough treatise on the design of overfall dams or spillways, and formulas have been deduced covering all possible combinations of loadings, considering static pressure, upward pressure on base, mud pressure on back, dynamic water pressure, and water flowing over the top. The Bazin method of plotting the shape of the falling sheet of water is given, together with methods of how to extend the shape of the sheet beyond the point or points determined by Bazin.

The most interesting chapters are those dealing with the arch dam. As is well known, the stresses in such a structure depend upon a multitude of assumed actions. First, the structure might act as a gravity dam until tension begins to set in at the upstream side; then cantilever action takes place, until the resulting deformations have developed sufficient stresses in the arch to permit arching stresses to obtain. The analysis of an arched dam is by far the most difficult of any kind of dam design, and the authors deserve much credit for the clear and concise way in which this difficult problem has been presented. However, it is likely that the long and cumbersome equations can wholly or in part be replaced by graphical diagrams and charts, thus reducing materially the labor in using them.

In order to shorten as much as possible the explanation and derivation of the formulas, some of the longer derivations have been placed at the end of the book in the form of an appendix. The first of these contains the derivation of the cantilever equations and the other the movements and stresses in an arch subjected to a uniform radial load.

The authors have succeeded in producing an up-to-date treatise on masonry dam design that will be appreciated not only as a text book for students but as a reference book for designers of dams.

State Gets $2,000,000 Road Fees

The exact amount received by the automobile division of the Pennsylvania highway department from automobile license fees up to the close of business June 12 was $2,002,462. The total amount collected from that source during 1915 was $1,665,-276.50, which figures were passed April 25 of this year. It is estimated that this year's fees will exceed $2,225,000.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Program of Construction Work Shown Graphically

AFTER considerable experimenting C. H. Buford, assistant engineer of the Chicago, Milwaukee & St. Paul Railway, who is in charge of the North Side track elevation work of that road in Chicago, described on page 75, has devised a diagram for the desired progress of his work, a part of which is herewith reproduced. It will be seen that at the top and bottom of the chart are diagrammatic plans showing the streets, tracks and stations as of Feb. 1, before the season's work was started, and as proposed for May 30. In the center section the abscissas correspond to the location, and the vertical spaces are months.

This part of the diagram is self-explanatory. Each part of the work is represented by different conventions. For the trestles and the like, which are continuous, the line is also continuous. Most of the items, however, have to do with the bridges, which are only at the streets, and for these items the heavy lines across the street are connected by lighter broken ones of the proper convention.

The various lines show clearly the desired sequence of operations and the time intervals planned between them.

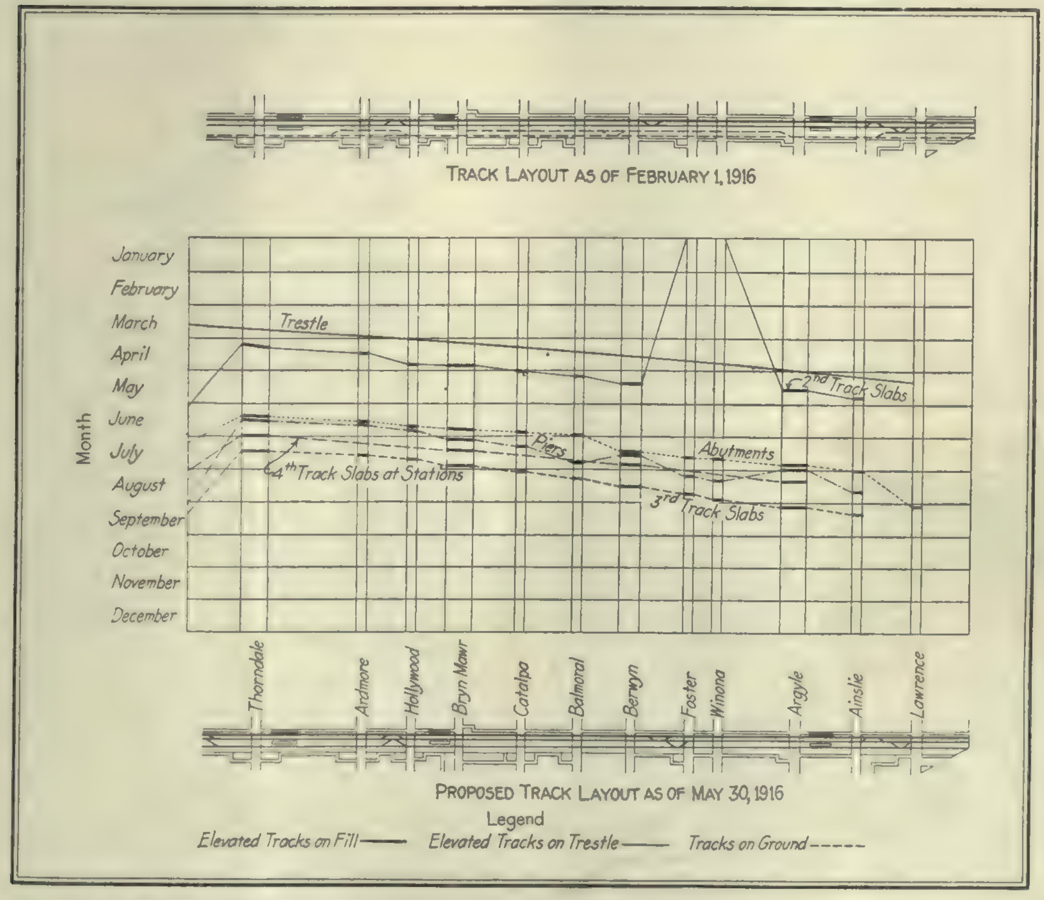
Move Brick Refuse Burner on Barge Without Jacking

A BRICK refuse burner at Everett, Wash., has recently been removed from its pile foundation, loaded on a scow, moved to a location several miles distant and set up again without the use of jacks, and without damaging the brickwork in the slightest degree.

The burner rested on sixteen piles cut off about 10 ft. above the ground, which was bare at low tide, and capped with 12 x 12 in. timbers on which rested a deck of 6 x 12-in. timbers. Half of each pile was cut away to a depth of 32 in. below the caps, and eight headers, to carry the track for moving the burner, were spiked securely to the piles at the bottom of this cut. At the next high tide stringers were floated in place and secured below the old caps. On the following tide the track stringers were floated in place, rollers put between the track and the upper stringers, and the track stringers wedged tight from the headers. By cutting away the other half of the pile heads below the track stringers, the refuse burner was left on the rollers ready to move. The barge was brought in at high tide and held in place until low tide, when its end was at the right height to load the burner. This was pulled aboard by two men with a hand winch. The barge floated in 5 ft. of water and was towed to its new location and secured in position for unloading.

Between the sixteen piles of the new foundation sixteen other piles had been driven and cut off 30 in. lower than the permanent piling. The track for unloading the burner rested on these temporary piles. The burner was pulled out on this track, barely clearing the permanent piling. The falsework piling was then cut away, allowing the track, rollers and upper stringers to drop down and leaving the burner on its new foundation.

BRICK REFUSE BURNER MOVED ON BARGE



THIS DIAGRAMMATIC REPRESENTATION OF A TRACK-ELEVATION PROGRAM HAS PROVED VERY SATISFACTORY IN MAINTAINING PROGRESS

Accounting for the Contractor: Depreciation and Reserve

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company, Scranton, Pa.

CONTRACTORS' portable plant is subject to more rapid depreciation than the stationary equipment of the average manufacturing or industrial concern. Experience will furnish the best basis for each contractor to assume, but for a practical demonstration let us say that 10 per cent per annum will cover the average loss chargeable to the gradual wearing out of the plant. Before closing the books for the year, an entry in the following form should appear in the journal:

Dec. 31	Depreciation	$800	
	To Reserve for Depreciation.		$800

The depreciation account will be absorbed into the net undivided-profits account, or the annual deficit, as the case may be, and the reserve for depreciation carried over into next year's business as a nominal liability.

The annual percentage charge for depreciation covers only the gradual impairment of the plant's efficiency as a result of wear and tear. Certain definite charges may also be made against depreciation in the event of a destructive accident or the sale of a piece of machinery at less than cost. For example, let us assume that the concrete mixer referred to in the preceding article has been so badly damaged as to be practically worthless, discarded as scrap and sold for $50 to a junk dealer whom, for convenience, we will call Tony Pasquale.

The journal entry would read:

July 15	Tony Pasquale—July	$50	
	Depreciation	750	
	To Plant		$800

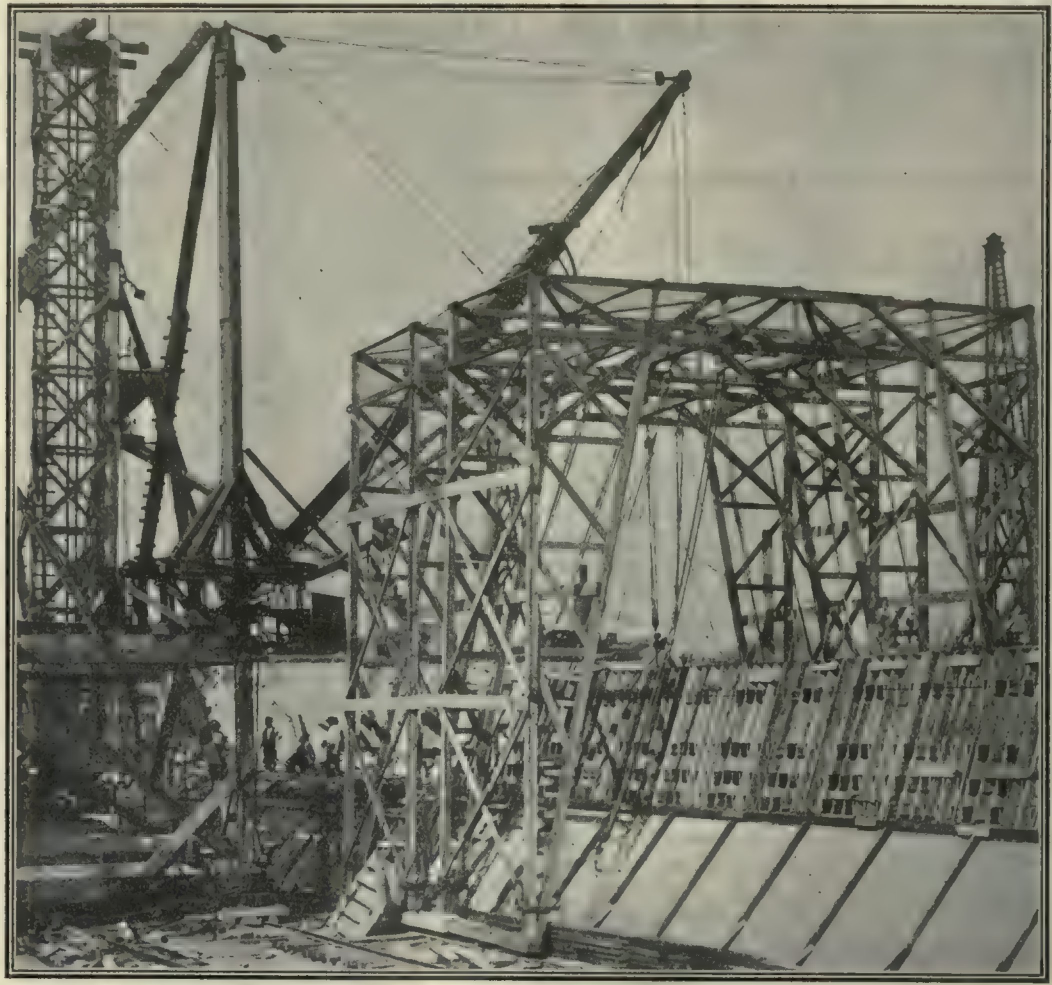
The card describing the mixer would be marked "Sold for scrap, July 15, 1916. See Journal, page ——," and the card removed from the group following the index-card marked "Bridge No. 4," and retired to the back of the file, after an index tab marked "Discard."

A similar treatment would follow the case of a sale of second-hand equipment, though the charge for depreciation would naturally be relatively much smaller.

In the rare but occasional case which may follow a shortage of a certain line of equipment in the market, accompanied by an unprecedented demand, when second-hand plant may be sold at an advance, the profit is credited to reserve for depreciation.

To the account for reserve for depreciation should be charged the cost of new parts purchased to replace those worn out, such as car brasses, bearings, derrick fittings, and the raw materials for repairs. A repair account may be kept, but at the conclusion of the fiscal year it may be carried into the depreciation reserve.

Plant renewals and betterments in general, not otherwise provided for, should also be absorbed by this reserve. Other uses for the account will suggest themselves in actual experience. The account has a compensating value, and while it appears among the nominal liabilities, it is largely in the nature of a variable surplus.



RIG MOVED COMPLETE SECTION OF FORMS FOR ONE LIFT, 128 FEET LONG, IN 9 HOURS

Light Traveler Straddles Reservoir Wall to Handle Forms

A TRAVELER built entirely of 2-in. lumber, of light weight and occupying little room in a space already crowded with construction plant, was recently used to handle sectional wood forms for the dividing wall in a large reservoir in a Western city. The wall, 387 ft. in length, was built in three sections, each 129 ft. long, a complete set of wood forms being constructed for one section and used three times. The wall was divided into four lifts vertically, and the form sections were made 6 ft. long, with a 6-in. fitting space between each section. Those for the bottom lift weighed about 1000 lb. to the section and those for the upper lifts 500 to 600 lb.

The traveler was made as light as possible so that it could be moved by hand, and for this reason was built entirely of 2 x 6-in. lumber, with the exception of the bottom sills and some of the horizontal braces, which were 2 x 10 in. It could have been more economically built of heavier sections, but its weight would have been considerably increased. The traveler was provided with six sets of falls on each side of the wall, each set handling one section of forms. To move a set of forms from one wall section to the next, they were lifted from position with the falls, the lines tied up and the whole traveler, with twelve form sections suspended, was moved down the wall to the point where the forms were to be re-erected; the forms were then lowered and the traveler returned for twelve more sections.

It is stated that a gang of ten men removed a complete section of forms on both sides of the wall, 129 ft. in length, transported and set them on the next section in about nine hours' time. This, of course, did not include the fitting and bracing of the forms in position. The traveler was moved when loaded by means of falls fastened to the bottom sills and to deadmen.

As the working space along the wall was crowded with traveler derricks and other equipment, it is thought that this traveler was by far the most practical and economical means for handling the form sections. It contained about 4800 ft. b. m. of lumber and cost, complete, about $250.

WAGONS ARE LOADED RAPIDLY BY WHEEL SCRAPERS DUMPING THROUGH TRAP IN BRIDGE

Wheel Scrapers Dumped Through Bridge Over Wagons

By ALBERT S. FRY
Morgan Engineering Co., Memphis, Tenn.

THE PHOTOGRAPH shows the method being used for handling earth in making the excavation for a reservoir which will be one of the units of the flood-protection work now being constructed for the city of Memphis. This work was described on page 775 of the Engineering Record for June 10 last.

A fill was thrown up to an elevation several feet above the street grade. In this fill a timber subway was constructed with a covering of heavy planks. Dump wagons entered the subway from the adjoining street and halted in position with the wagon box under an opening in the subway covering. Wheel scrapers are being used to make the excavation. These, loaded, travel up along the top of the fill until the subway is reached. Here the contents of the wheelers are dumped through the opening in the subway roof into the wagons beneath. When one wagon is full, it pulls out and another takes its place. Enough wagons and scrapers are used so that there is little delay in carrying on the excavation.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Tropical Storm Sweeps Over Southern States

Wind Velocity Reported 105 Miles an Hour—Rainfall at Birmingham, Ala., 14.04 Inches in Five Days—Damage Runs Into Millions

A tropical storm sweeping over the Gulf states July 5 destroyed railroad lines, wharves, telegraph wires, did damage estimated at $7,000,000 and flooded many cities. The storm centered over Pensacola and Mobile and completely destroyed communication with those cities for several days. The rainfall at Pensacola is given as 7.1 in. in a day; at Birmingham 14.04 in. in five days.

Pensacola Naval Station Damaged

Seven navy hydroplanes, the new dirigible hangar and the naval station at Pensacola were damaged to such an extent that $150,000 will hardly suffice for making repairs. Docks were wrecked, ships driven ashore and all telegraph communication destroyed. The rainfall for twenty-four hours was 7.1 in. and the wind velocity reported to be 104 miles per hour from the East. The Louisville & Nashville Railroad bridge across Escambia Bay has been washed away and about eleven miles of track have been damaged by the floods. Estimates from Pensacola give the damage due to the hurricane as $7,000,000. At Tampa the greatest wind velocity was 19 miles per hour and the maximum rainfall 0.43 in. July 4.

Mobile Is Flooded

The damage at Mobile, Ala., is estimated at $3,000,000. The city is inundated for four or five blocks back from the waterfront and the terminal station, located 4½ blocks from the water line, is flooded to a depth of 3 ft. Wharves, coal-handling machinery, buildings and ships have been more or less affected by water and the gale, whose velocity is reported to have been from 70 to 105 miles an hour. The lowest barometric reading of 28.92 was taken at 5 p. m. July 5. Train service between Mobile and New Orleans is impossible.

Bridges Destroyed at Birmingham

Unprecedented floods have been reported from all over Alabama. In Birmingham 14.04 in. of rain fell between the night of July 5 and 3 p. m., July 10, while for July 7 the precipitation was 8.87 in. Estimates by the city engineer give the damage to streets as $50,000 and to roads and bridges about $75,000.

The rainfall at Fort Gaines in one day was more than 9 in., resulting in 5-ft. floods over the railroad tracks. At New Orleans comparatively little damage was done and the wind velocity was only 38 miles per hour.

River Rises 23½ Feet Above Low Water Mark

Swollen by recent rains and melting snow, the Willamette River is reported to have risen 23½ ft. above low-water mark at Portland, Ore. That is the highest stage recorded in several years. Reports from The Dalles, Ore., state that the Columbia River has reached the flood stage of 40 ft. without causing damage.

Roosevelt Recruiting Engineers

In the division of troops which Colonel Roosevelt proposes to raise there will be included a full regiment of engineers. T. C. Desmond, consulting engineer, 110 West Thirty-fourth Street, New York City, is receiving applications for enrollments, assisted by Col. L. H. Grahame, formerly commissioner of public works at Porto Rico.

Appoint Committee on Activated-Sludge Process

Members and associate members of the American Society of Civil Engineers interested in sewage disposal met informally June 28 in Pittsburgh to discuss various problems in connection with the treatment of sewage by the activated-sludge method. The report of the acting secretary, T. Chalkley Hatton, dated July 6, states that the time has not yet come for effecting a permanent organization to avoid duplication of experiments in the United States and Canada and preventing control of the activated-sludge process by patents issued without complete information having been submitted to the commissioner of patents. Believing that the best results could be obtained through a committee and personal service, F. A. Dallyn, provincial sanitary engineer, Toronto; George T. Hammond, engineer of designs, Borough of Brooklyn, New York City, and T. Chalkley Hatton, chief engineer of the sewerage commission, Milwaukee, were appointed to prepare standard definitions and other terms relating to the activated-sludge process of treating sewage. They will also tabulate and distribute a summary of work now being done or contemplated and suggest such correlation of current work as may be desirable.

The question of submitting to the commissioner of patents information relating to priority of knowledge of the activated-sludge process was left with Prof. Earle B. Phelps, H. W. Clark, George T. Hammond and Dr. Edward Bartow, with the understanding that all members present should assist by giving the commissioner all possible information in affidavit form.

Contractors' Association Gives Views on Engineering Society

"The Engineering Record editorially comments on a paper read by James W. Rollins before the Engineers' Society of Western Pennsylvania on unfair contract clauses, and says: 'What is needed is for the engineering organizations, especially the American Society of Civil Engineers, to take a decisive stand and back up the individual engineer with all their influence,' and suggests that the whole subject of contract documents be studied by a competent committee and standards recommended. Highly commendable, and very much to be desired—but not a new idea at all. We don't even claim to have thought of it first, since that has been the underlying thought expressed in all of these papers on contracts for the past score of years. We are, however, skeptical about any assistance from the American Society of Civil Engineers. Long ago we made such a suggestion to this and that influential member of the society, but it meant real work and wasn't received with a bit of enthusiasm. Beyond valuable contributions to engineering literature, the American society has not distinguished itself in any constructive advances or improvements in engineering practice."—*Bulletin, General Contractors' Association, June,* 1916.

Neeld Tunnel Project Killed

The Neeld or South Hills tunnel at Pittsburgh, involving an expenditure of about $1,350,000, of which nearly $50,000 has already been spent, will not be built. The Supreme Court of Pennsylvania recently ruled that the act under which the tunnel was authorized is unconstitutional. It is said that new bills will be presented at the next session of the legislature.

$22,000,000 to Complete New York Subway

Advance in Cost of Material and Labor Affects Estimates to Complete Work—Increase of $7,000,000 on Original Estimate

To complete New York's $350,000,000 subway, $21,834,387 will be needed to provide for the completion of Contracts 3 and 4. In addition, $4,500,000 will be expended for finishing the Sixtieth Street tunnel. The report of Commissioner Travis H. Whitney and Le Roy T. Harkness to the Board of Estimate says that when the 1913 appropriations were made detailed plans for a greater part of the lines had not been made and in some cases the routes themselves had not been determined upon. The estimates were therefore general.

The report shows that construction work under the Brooklyn contract will be nearly $8,300,000 in excess of the original estimates owing largely to the advance in prices of materials and labor caused by the war. As there is more work remaining to be done under Contract 4 than under Contract 3, the war prices have had greater effect on the estimates to complete the work. The item of interest under Contract 4 runs $4,109,000 ahead of the original estimate.

$4,500,000 for Sixtieth Street Tunnel

The report points out that the net increase in the cost of construction work itself is only $7,000,000 on the original estimate of more than $202,000,000 for construction on both contracts. The increased cost so far as construction work proper is concerned is less than 3½ per cent.

The Board of Estimate is reminded that the Sixtieth Street tunnel, to be used as a substitute for the Queensboro Bridge, will also require an appropriation of approximately $4,500,000.

The sum given at the Public Service Commission's office for the entire cost of the subway system when completed is $350,000,000.

President Signs Good-Roads Bill

President Wilson, July 11, signed the Good-Roads Bill authorizing the expenditure of $85,000,000 in five years by the federal government. The provisions of the bill were outlined on page 42 of the Engineering Record of July 8.

Names New York Buildings Board

Mayor Mitchel of New York this week appointed the Board of Standards and Appeals to take the place of the old Board of Examiners. It will have jurisdiction over the building operations in each of the five boroughs. Included in the membership of the new body are Rudolph Miller, chairman, formerly superintendent of buildings of the Borough of Manhattan, and Howard C. Baird, consulting engineer, member of the firm of Boller, Hodge & Baird.

$35,000,000 to Improve Steel Plants

Announcement was made July 11 by Charles M. Schwab, chairman of the board of directors of the Bethlehem Steel Corporation, that $35,000,000 will be spent on improvements for the Steelton and Sparrows Point plants. At Steelton $15,000,000 will be expended and at Sparrows Point $20,000,000. Rolling mills, blast furnaces, plate mills, coke ovens and new tracks are among the improvements planned.

Form $1,000,000 Company for South American Business

The Latin-American Corporation, with a capital stock of $1,000,000, has been organized by the American International Corporation to handle and investigate proposals from South American sources. An expert engineering and construction staff will be maintained to build and supervise the operation of the properties.

According to W. S. Kies, vice-president, the new corporation has under consideration many specific projects, including the consolidation and rehabilitation of existing tram lines; the construction of public work, including water-supply systems, sewerage systems and harbor developments, and the construction and development of railways.

University of Iowa Offers Five-Year Chemical Course

The State University of Iowa has discontinued its four-year course in chemical engineering and substituted five years' study of that subject. The new course includes enough mechanical-engineering subjects to acquaint the chemical engineer with those mechanical principles with which he should be familiar. Inspection trips to chemical or metallurgical works are planned and each student is expected to spend at least two periods of six weeks each in the employ of some industrial establishment.

$3,000,000 Deed to Imperial Valley Irrigation System Changes Hands

The deed to the irrigation system in California and Mexico, formerly the California Development Company, has been delivered by the Southern Pacific Company to the Imperial Valley irrigation district. The consideration was $3,000,000 of the district's bonds. This completes the transaction reported in the Engineering Record of Dec. 4, 1915, page 707, and March 4, 1916, page 335, whereby the district acquires control of the irrigation system.

Engineers Organizing in Northwest

An auxiliary corps of engineers, according to reports from Seattle, is being organized. Technically trained men who would be useful in time of war are being listed according to their qualifications.

Bayonne, N. J., Without Water

The bursting of a main in the Newark meadows last Saturday left Bayonne, N. J., temporarily without water. The situation was partly relieved by sending a supply through an emergency main from Jersey City.

Illinois Engineers Get Active Field Practice at Camp Dunne

THE COMMISSARY DEPARTMENT of the Illinois engineers section of Camp Dunne is a busy and popular place, as evidenced by the upper left-hand picture. "Lined Up to Receive Orders for the Day" would explain the upper right-hand illustration. The center photo is of three Chicago & Western Indiana Railroad engineers—E. V. Powell, A. M. Cornell and D. A. Tomlinson. Six-mile tramps are a part of the camp routine. The lower left picture shows the engineers starting on a cross-country "hike." The advance guard scouts ahead of the main body and transmits the news by the method of signaling illustrated in the lower right-hand photo.

Cloudburst Floods Boston

A terrific cloudburst and thunderstorm that swept over Boston and vicinity July 3 caused more than $100,000 damage in Boston alone. The Washington Street tunnel and the Cambridge subway at Washington and Summer streets were flooded and out of commission for half an hour. Several streets were filled with water to a depth of nearly a foot. The total precipitation for the day is given as 2.3 in.

May Use Cement Sewer Pipe in Seattle

The Board of Public Works of Seattle has agreed to permit the use of cement sewer-pipe specifications. The details are being handled by A. H. Dimock, city engineer.

Engineer Urges Nationalization of Foreigners by Education

In a report to the Chicago Association of Commerce on Americanization and citizenship, Robert Isham Randolph, consulting engineer, of Chicago, chairman of the committee-at-large, holds that the logical agency for carrying on the work of education among adult foreigners can best be done by the public schools. To overcome the difficulties of getting and retaining attendance it is urged that contractors and other employers influence their unnaturalized employees to take advantage of such facilities and prepare themselves for citizenship.

Give Away 600 Meter Boxes

THE Terre Haute (Ind.) Waterworks Company, in twenty minutes, recently distributed more than 600 meter boxes to be used by the citizens of that city as flower receptacles for growing plants

What Engineers and Contractors Are Doing

A. E. BROKER has resigned as assistant highway engineer for Milwaukee County, Wisconsin, to become superintendent for the Chickamauga Quarry & Construction Company, at Savannah, Ga. The Chickamauga company has a contract for the concrete work on the Savannah Warehouse & Compress Company's new building near Savannah.

CARL B. ELY, formerly assistant superintendent of the bridge and construction department of the Steelton plant of the old Pennsylvania Steel Company, has been made superintendent of that department, succeeding Thomas Earle, transferred to Bethlehem. Mr. Ely was graduated from Yale University in 1900 and then served as apprentice in the Altoona shops of the Pennsylvania Railroad for two years. For a few months in 1902 he was in charge of inspecting and testing at the steel rail plant of the Consolidated Lake Su-

perior Company and in October of that year joined the Pennsylvania Steel Company. In 1904 he was made assistant engineer and a few years later was promoted to the assistant superintendency of the department of which he is now the head.

GEORGE L. HOSMER, formerly assistant professor at the Massachusetts Institute of Technology, has been made associate professor of topographical surveying at the institute.

WARREN W. INGLIS, who for the past two years has been engaged as engineer on the design of the new plant of the Remington Arms-Union Metallic Cartridge Company, has been made resident engineer at the Benson mines, at Benson Mines, N. Y.

EUGENE C. MILES, formerly associate editor of the Engineering Record, has been made editor of the *American Gas Light Journal*, New York City. Mr. Miles was graduated from Pennsylvania Military College in 1906 and from then until early in 1908 served on the engineering forces of the Pennsylvania Railroad on the East River and land tunnels, New York City. He left the employ of the Pennsylvania to become assistant engineer in the department of public works of the Republic of Cuba. He returned to New York City the following year and until June, 1910, was engineer for the Hanover Contracting Company on the installation of water mains and appurtenances in the boroughs of Manhattan and Richmond. He was made engineer on wharf construction at Port an Prince, Haiti, for the Empire Engineering Corporation, of New York City, in June, 1910, but resigned in September of that year to return to the Hanover Contracting Company. He joined the staff of the Engineering Record early in 1915.

W. STALEY WICKER, after serving for nearly a year as assistant engineer on highway construction in Davidson County, North Carolina, has resigned to become building inspector for the Atlantic Coast Line Railroad.

R. L. DAUGHERTY, assistant professor of hydraulics in Sibley College, Cornell University, has resigned and has been appointed professor of hydraulic engineering in Rensselaer Polytechnic Institute, succeeding Prof. Lewis F. Moody, who has resigned to enter private practice. Professor Daugherty was graduated from Leland Stanford University in 1909 and for one year thereafter was instructor in experimental engineering at his alma mater before going to Cornell. He is the author of "Hydraulic Turbines," "Centrifugal Pumps" and "Hydraulics."

GEORGE W. FULLER, consulting engineer of New York City, has been awarded the Edward Longstreth medal of merit by the Franklin Institute, Philadelphia, for his paper on "Biochemical and Engineering Aspects of Sanitary Water Supply." The paper, which was published in the "Journal" of the institute in July, 1915, was a comprehensive description of practical means of measuring the sanitary quality of water supplies.

ROBERT A. CUMMINGS, JR., who was graduated from the civil engineering course at Yale University last month, will shortly enter the office of his father, Robert A. Cummings, consulting engineer, Pittsburgh.

PROF. A. N. TALBOT, of the University of Illinois, the well-known authority on reinforced-concrete, was honored with the degree of doctor of engineering by the University of Michigan at its commencement exercises late last month. The University of Pennsylvania conferred the degree of doctor of science on him last year. Professor Talbot, in addition to his services on various technical committees on concrete, is chairman of the committee on track stresses of the American Society of Civil Engineers, a past director of that society and also a past-president of the American Society for Testing Materials.

EARLE C. WAITE has been promoted from structural engineer for the Bethlehem Steel Company to civil engineer in the office of the vice-president in charge of securing raw materials.

L. R. TALBOT was recently made construction engineer for the Shawinigan Water & Power Company, at Shawinigan Falls, Quebec, Canada. Mr. Talbot will work on the storage dam on the upper St. Lawrence River and on the construction of a transmission line.

JAMES L. TIGHE, consulting hydraulic engineer, of Holyoke, Mass., has been engaged by the board of public works to assist in estimating the value of the Springfield waterworks. Mr. Tighe was connected with the Holyoke engineering department for 19 years, and resigned to engage in consulting practice about six years ago.

WILLIAM H. KAVANAUGH, professor of experimental engineering at the University of Minnesota, will Sept. 1, become connected with the University of Pennsylvania in a similar capacity. Professor Kavanaugh has been a member of the faculty of the University of Minnesota for fifteen years, the last nine as head of the department of experimental engineering.

HENRY O. POND has resigned as mechanical engineer for Westinghouse Church Kerr & Company to take charge of the timber, pulp and water-power interests of E. B. Cadwell & Company, New York City.

ARTHUR LEDERER has resigned as chief chemist for the Sanitary District of Chicago to study the course for health officers at Harvard-Technology.

R. E. KOON, consulting engineer, of Portland, Ore., will be in charge of the engineering work in connection with the construction of the 26-mile Sultan River pipe line project for which the contract was let June 5. The work, which involves the expenditure of about $600,000 and will furnish a new source of water supply for the city of Everett, Wash., will be completed late in 1917. Mr. Koon made the surveys for the Sultan River project as the representative of Burns & McDonnell, consulting engineers, of Kansas City.

ELIOT N. SMITH, formerly with the firm of Smith, Hauser & McIsaacs, New York City, has been made supervisor of the recently created bureau of engineering of Nutley, N. J. After being graduated from Oberlin College in 1900 Mr. Smith spent four years at Harvard University. Upon graduation he was made instrumentman for the Massachusetts State Harbor and Land Commission and in August, 1904, became connected with the Rapid Transit Railroad Commission, New York City. He was assistant engineer at the time of his resignation in 1906, when he accepted a similar position with the Board of Water Supply, New York City. Mr. Smith resigned after nine years' service with that board to become associated with Smith, Hauser & McIsaacs.

A. D. LUDLOW, engineer and contractor, was recently made sewer engineer in the department of engineering, Kansas City, Mo. For two years after being graduated from the University of Kansas in 1894, Mr. Ludlow was structural steel draftsman for J. A. L. Waddell, consulting engineer, Kansas City. He spent the next five years as designer of sewers and metal structures in the city engineer's office. In 1902 he was made assistant engineer for the Kansas City Southern Railway, but in 1907 returned to the engineering department of the city as assistant engineer. During the construction of the new station and terminal Mr. Ludlow was assistant engineer for the Kansas City Terminal Railway, his period of employment by that road extending from July, 1909, to October, 1912. While with that company he designed the $1,000,000 O. K. Creek sewer described in the Engineering Record for Nov. 2, 1912, page 480. Mr. Ludlow entered the contracting field in 1912, specializing in reinforced-concrete and sewer construction. The Kansas City sewer department was recently reorganized to handle a large amount of work that has accumulated during the past two years, including the $1,750,000 Blue River sewer provided for in a recent bond issue.

EDMUND T. PERKINS, consulting engineer, of Chicago, has been appointed a member of a new committee of the Chicago Association of Commerce on military and naval affairs. The work of the committee will include soldiers' relief and welfare, relief of soldiers' families, recruiting, transportation and sanitation.

FRANK G. WHITE, who for the past five years has been with the State Harbor Commission of California, where he had risen to the position of principal assistant engineer, was July 7 made chief engineer of the commission. Mr. White is a graduate of the University of Iowa, class of 1899.

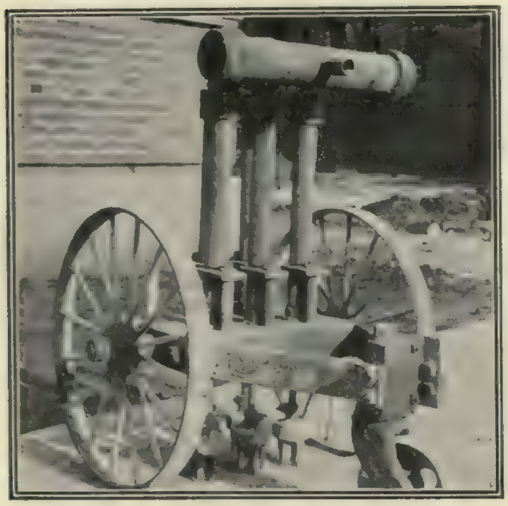
Obituary Notes

JOSEPH RAMSEY, JR., president of the Lorain, Ashland & Southern Railroad and past-president of the Wabash Railroad, died July 7 at his home in East Orange, N. J., at the age of 66. Mr. Ramsey was born at Pittsburgh, Pa., in 1850 and was educated at the Western University of Pennsylvania. He entered railway service in 1869 as a member of the engineer corps of the Pittsburgh, Cincinnati, Chicago & St. Louis Railway and was later engaged by different railways on engineering work until his appointment as engineer for the Bell's Gap Railroad in 1872. After a year's service he was made chief engineer and superintendent for that road, in which position he remained until 1879, when he resigned to take a similar position with the New Castle & Lake Erie. He left that road after ten months' service to become chief engineer and superintendent for the Pittsburgh Southern Railroad. He was made chief engineer and general manager for the Pittsburgh, Chartiers & Youghiogheny Railroad in 1882 and in the next year held a similar office with two other railways and with the Chartiers Block Company. In 1883 he was made engineer and in 1886 chief engineer for the Cincinnati, Hamilton & Dayton. January of 1890 found him assistant to the president of the Cleveland, Cincinnati, Chicago & St. Louis Railway, which office he held until the middle of the following year. Indications of Mr. Ramsey's executive ability rapidly became apparent in 1890, when he was made president of the Peoria & Pekin Union Railway in addition to his other offices. Appointments to executive positions with various roads followed closely during the five years which preceded his appointment as vice-president and general manager of the Wabash Railroad in 1895. He was elected to the presidency of that road in 1901. He resigned in 1905. Mr. Ramsey was president of the following railroads for the periods indicated: Wheeling & Lake Erie, 1901-05; Western Maryland and West Virginia Central & Pittsburgh, 1903-05; Ann Arbor, 1902-05 and 1910-12. He was made president of the Ashland & Western Railway and the Lorain, Ashland & Southern Railroad in 1910 and president of the Wheeling & Lake Erie in 1912.

ROBERT M. ROY, general manager of the Hamilton Bridge Works Company, Ltd., Hamilton, Ontario, died recently in that city. Mr. Roy began his engineering career in 1886 in the engineering department of the Grand Trunk Railway, where he was employed until going to the Brown Manufacturing Company, Belleville, Canada, in 1888. After four years with the Brown company Mr. Roy resigned to take a position with the Central Bridge & Engineering Company at Peterboro. He left the latter firm in 1898 to become assistant engineer of construction for the Hamilton Bridge Works Company. He remained with the company continuously until his death.

Chip Floors for Top Coat with Pneumatic Hammers

A bond between slab and wearing surface of the concrete floor in the new office and record building of the Chicago & North Western Railway in Chicago is being accomplished by chipping the slab surface with pneumatic chipping hammers. By the hand-and-pick method 80 sq. ft. is an 8-hr. day's work. With the specially adapted equipment shown in the photograph three men using one five-gun and two single-gun chipping hammers can



FIVE-GUN HAMMER CHIPS CONCRETE

roughen more than 3000 sq. ft. per day. The five-gun hammer is used for most of the work and the single-gun hammers for trimming around the edges and columns.

Paul J. Kalman & Company, St. Paul, have the contract for the floor work. Their superintendent, Charles E. Cook, estimates that the cost is reduced 60 per cent over hand methods and the efficiency of the bond materially increased. The special hammers, which were furnished by the Kellar Pneumatic Tool Company, Fond du Lac, Wis., were supplied with air by a Zin-Ho portable air compressor.

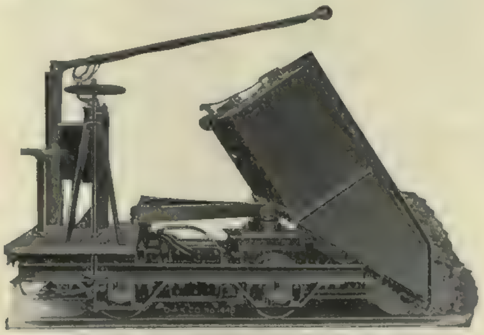
Portable Stone Unloader Costs Little to Install

One of the claims made for the Burch stone unloader is that its cost of installation is small, as a pit about 30 in. deep by 32 in. wide is all the excavation necessary. The belt conveyor travels 225 ft. per minute and delivers stone to the wagon at the rate of 1 cu. yd. a minute. The machine is so constructed that the end of the elevator will be 7½ ft. from the ground with the wagon 20 ft. away from the track. It is also said that stone can be carried with the belt at an angle as great as 29 deg. The unloader is operated by an Alama gasoline engine.

The Burch unloader is manufactured by the Burch Plow Works Company, Crestline, Ohio.

Motor-Driven Dump Car Claimed to Increase Efficiency

A material reduction in the cost of disposing of waste material is said to be effected by the use of a motor-driven dump car made by the Orenstein-Arthur Koppel Company, of Koppel, Pa. The car is 9 ft. 8 in. long, 5 ft. 10 in. wide and 4 ft. 8 in. high and has a

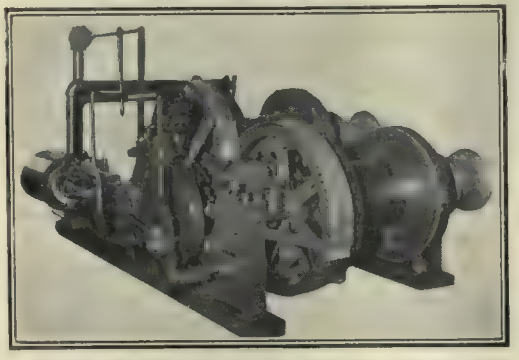


MOTOR-DRIVEN DUMP CAR SAID TO REDUCE COST OF DISPOSING OF WASTE MATERIAL

capacity of 54 cu. ft. It is made to fit any gage from 36 in. to standard and is furnished for use where either alternating or direct current is available. One man can handle the car.

Band Friction Used on Hoist

A newly designed steam hoist equipped with band friction to eliminate end thrust is made in six sizes varying from 7 x 10-in. to 12 x 12-in. cylinders, by the Thomas Elevator Com-



NEW STEAM HOIST HAS BAND FRICTION

pany, Chicago. Other features of this line of the double-cylinder-type hoist are the solid-cast bedplate, cut steel gears throughout, adjustable cross-head gibs, straight-line valve action and a solid-end connecting rod.

Donate Trucks to Aid Militia

The work of moving supplies from the Georgia state arsenal to the freight depot at Atlanta last week was done by Smith Form-A-Trucks. The Smith company donated three trucks for use in hauling the material. More than five carloads of supplies weighing about 70 tons were thus transported.

UNLOADER CARRIES STONE AT ANGLE OF 29 DEGREES

Business Notes

F. T. Kern and **M. R. Hunter** have formed the firm of Kern-Hunter, Inc., First National Bank Building, Milwaukee, Wis. The organization is Wisconsin and northern Michigan representative for a number of companies selling to contractors. Mr. Kern has been in the contractors' equipment field in Milwaukee for ten years. Mr. Hunter was formerly a member of the editorial staff of the Engineering Record.

Lidgerwood Manufacturing Company of New York City has removed its Seattle office to 65 Columbia Street.

O. K. Clutch & Machinery Company of Columbia, Pa., has moved into new and larger quarters in that city.

Herman Nieter, formerly sales manager for the Kennicott Company, Chicago, and later manager of the New York office of the Blaw Steel Construction Company, is now with the American Spray Company, New York City, as sales engineer.

E. R. Marker, district manager for the T. L. Smith Company, Milwaukee, has removed to 609 Wells Street, where he has a complete line of mixer and other contractors' equipment on hand.

Trade Publications

The following companies have recently issued trade literature:

The Pelton Water Wheel Company, San Francisco and New York. Four-page folder, 8 x 11 in., devoted to Pelton waterwheels. Outlines information required for analysis of a proposed water-power development and illustrates different uses to which such power can be put.

The Austin-Western Road Machinery Company, Chicago. Circular, 8 x 11 in., 8 pages. Shows the Austin pneumatic road scarifier in operation attached to the Austin motor road rollers.

National Tube Company, Pittsburgh. Catalogue, 8 x 10 in., 72 pages. Aside from showing many reasons why National pipe should be used the booklet contains pictures and drawings showing damage resulting from installations of poor pipe. Almost every page boasts a picture of a National installation showing some point of unusual interest.

The Parsons Company, Newton, Iowa. Booklet, 6 x 7 in., 12 pages, describing two models of the Parsons backfiller with caterpillar traction. Illustrated with pictures of the machine in operation.

Blaw Steel Construction Company, Pittsburgh. Bulletin 69, 7 x 10 in., 24 pages. Illustrated with photographs of practically every kind of Blaw steel forms for road, sidewalk, curb and gutter work and giving the distinct use of each form. A few of the 15,000 jobs on which Blawforms have been used are also shown.

The Wellman-Seaver-Morgan Company, Cleveland. Circular, 9 x 10 in., 8 pages. Describes and illustrates the Johnson hydraulic valve for water-power plants and supply systems. Shows one of the 8-ft. Johnson valves used by the Salmon River Power Company and the 12-ft. Johnson valve built for the Utah Power & Light Company.

Trussed Concrete Steel Company, Youngstown, Ohio. Volume entitled "Kahn Road Book," 5 x 8 in., 128 pages. The first part contains a general historical review of concrete pavements as well as tables giving cost data. The reinforcing of concrete pavement is thoroughly discussed, under which heading the Kahn road mesh is described. Expansion joints and the necessity for protecting the edges occupy another section, in which is included information regarding Kahn armor plates and the installing device. Specifications for concrete highways are included with pictures of that kind of roads.

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Pity the Poor Railroad

A RECENT editorial plaint in the Baltimore *Sun* is a sample of the type of economics imposed by the public on the railroads. It appears that while some improvements are being made in the tunnel near the present station, freight traffic is being diverted around the city. The *Sun* very promptly asks whether the change foreshadows the diversion of part of the passenger traffic, adding that Baltimore cannot tolerate the curtailment of its passenger-train accommodations. It might lessen the stopping off of through passengers! The adequacy of the service and the railroad's return on its investments apparently do not interest the *Sun*. Let the stockholder hold the bag. And lest this attitude be thought a mere whim of the journal in question, let it be said that to prevent just such a diversion the Maryland Legislature passed a law some years ago prohibiting the railroad from building a cutoff within 16 miles of the city. Truly the railroad is the public clown. How else account for the antics it is made to perform?

Who's Who at Conventions

A DETAIL to which local committees in charge of convention arrangements may well give heed is the convention badge. The general practice is to give each member a numbered badge. A much better system, which is occasionally adopted, is to have the member's name on the badge. The numbering of delegates robs a meeting of the personal touch which can be secured by using names. One of the prime objects of all such gatherings is to promote social intercourse, and in a national association, where members congregate from widely separated sections, men do not always have a wide personal acquaintance. They may, however, know one another by reputation, and if a man carries his name on his badge he may be readily approached by those who wish to meet him. The mere fact of carrying the name displayed also makes for greater cordiality, the feeling being that the badges are an indication that formal introductions are not necessary.

No Pump House in Park

THIS week's developments in the controversy over the erection of a pump house above one of the Catskill aqueduct shafts within the limits of Morningside Park, New York City, indicate that the structure will be placed underground. Its proposed location on the surface in the park area occasioned a storm of protest from the press, civic bodies and individuals. Deeming the matter of civic importance, the American Institute of Consulting Engineers appointed a committee, headed by William J. Wilgus, to investigate and report on the question. Its findings indicated that a subsurface pump structure was feasible, and it is probable that the committee of the Board of Estimate and Apportionment which has this matter under consideration will advocate this solution to the problem. Of course the underground structure will involve a greater cost than the one originally planned—$50,000 or more. Nevertheless it is believed that the payment of this sum is preferable to an invasion of an area set aside for park purposes. Then, too, the building of the station above ground would set a dangerous precedent. The outcome is in accordance with the Engineering Record's opinion, expressed in a previous issue, as to the undesirability of encroaching on park lands. If no other solution than a pump house above ground were possible public necessity might have justified the original plan. There appears to be no doubt, however, that the subsurface station is feasible. Under these circumstances there should be no encroachment upon the park area.

Arbitration vs. Suits

ARBITRATIONS of disputes arising over engineering contracts involving private parties are so common as to excite no comment among engineers. With increasing frequency disputes involving the public and public-service corporations are being settled in the same way. The Engineering Record has called attention to several such cases, and in this issue Farley Gannett tells of the satisfactory settlement of a public-service case which had already gone to the state supreme court and had been ordered retried. In two months the board settled what the courts had failed to determine during the course of two years of litigation. Mr. Gannett points out that arbitration in such cases offers a speedy and satisfactory settlement where the jurisdiction of public-service commissions does not apply. This is not disputed, but attention is called to the fact that at least one public service commission is conducting its work, when decisions depend entirely or largely upon engineering facts, in the same spirit as the arbitration that Mr. Gannett describes. Engineering hearings are held at which the engineer of the commission presides and acts as arbitrator. The conclusions usually are reached by unanimous agreement. When there are points about which no agreement can be reached they are specified in the detailed report to the commission. The advantage of such a procedure is obvious. It does not in any way change the policy or theory of the case held by the attorneys of either side and the briefs and arguments of attorneys proceed before the commission, after the engineers' conference is finished, in the usual way. Contestants who have appeared before the commission in cases where the procedure has been handled in this way have said that the presentation of their cases has been very much facilitated. The commission likewise has saved time. The practice deserves wider adoption.

Larceny

PROTEST against the stealing of engineers' ideas by other engineers and by manufacturers is heard with too great frequency. Generally there is no remedy at law, so that the only hope for a lessening of the practice lies in raising the general level of the profession and of the business ethics. Periodical public protests, however, may help to shame those who deliberately filch from others. Of recent instances there come to mind imitation of a novel and successful water-softening plant, the appropriation of details from designs submitted by a builder of turbines and the use of some special apparatus designed for sewage treatment. Each one can lengthen the list from his own experience. Of course, there is another angle of this matter—that advancement of the race demands that more efficient devices and methods be applied as rapidly as practicable. To accept the old when there is better available is not only a mark of incompetence but a brake on progress. More fundamental than that broad consideration, however, is the principle that the laborer is worthy of his hire, that a man should receive the reward of his discovery and his efforts. Jones cannot cite in his defense for appropriating Smith's method that it would be an injustice to his client to use an obsolete process. The proper procedure is to call Smith into consultation and let him profit by his skill. Another phase of the question is that it is usually economical to come to the originator of a device for help. In two of the cases cited above the designs were purloined bodily and applied to conditions where they did not exactly apply. In one case there was a partial failure; in the other, a wise client took the precaution to consult the originator and saved himself from certain loss. Manifestly the principle of respect for another's development must be applied with judgment. To draw no lessons from the experiences of others would be death to progress. In reinforced concrete, for example, the little developments here and there brought about the rapid advance. The true gentleman will have no difficulty in telling how far he may go and when he should consult with, or at least give credit to, the originator.

Gasoline and Sewer Explosions

INSOFAR as the civil engineer's work is concerned the tremendous increase in the use of motor vehicles during the last few years has had its most marked effect in the field of road building, but there is another phase of the motor situation, not so important, to be sure, but still of enough consequence to place a new obligation upon municipal engineers. Every now and then a section of some large city is shaken by an explosion in its sewerage system. Lives of pedestrians are endangered by manhole heads popping skyward, pavements are cracked, window panes broken and sewer walls shattered. It has been pretty clearly shown that such explosions are traceable directly to the presence of gasoline vapor. Garages are the chief source of trouble, though dry-cleaning establishments, where large quantities of naphtha are used, are also to blame.

Not long ago Pittsburgh experienced two serious sewer explosions, and an investigation of their causes was undertaken by the U. S. Bureau of Mines, co-operating with the municipal authorities. The results of this study have just been published in Technical Paper 117, by G. A. Burrell and H. T. Boyd of the Bureau of Mines. The tests were made in a sewer 8 ft. 3 in. wide and 8 ft. 6 in. high, tapped by six manholes. Gasoline was dumped into the sewer at the upper manhole and tests of the sewer air were made between that point and the outlet into the Allegheny River, 2706 ft. distant. As a general rule, according to the report, 1.5 per cent of gasoline may be fixed as the low explosive limit of mixtures of gasoline vapor and air. The results of the tests indicate that one barrel (55 gal.) of gasoline dumped at once into the sewer, in which the flow was 19.6 sec.-ft. and the velocity 6½ ft. per second, caused the formation of an explosive mixture for only a few minutes at any given point. The largest quantity of gasoline vapor in any sample was 2.19 per cent at manhole 3. When a barrel of gasoline was poured into the sewer at the rate of 5 gal. per minute, instead of being dumped, as in the first test, the highest percentage of gasoline vapor 2 ft. above the water surface was 0.70 per cent. The highest percentage 2 in. above was 1.67 per cent. Thus at certain periods, and at points 2 in. above the water, explosive atmospheres existed, but 2 ft. above the water the atmospheres were not explosive.

When the sewer was bulkheaded, to simulate conditions that would prevail if the outlet were submerged, a dangerous condition resulted from dumping into the sewer at one point one barrel of gasoline at the rate of 5 gal. per minute. At some places a dangerous atmosphere continued for 5 hours. This result, of course, is attributable to the slowing up of the flow. Repeating this test with only one-half barrel of gasoline, admitted at a 5-gal.-per-minute rate, there did not result at any time a dangerous condition except during the first 15 minutes.

While the report does not contain any recommendation concerning the prevention of sewer explosions, the information it carries should be of considerable interest to municipal engineers charged with the maintenance of sewerage systems.

Engineering at the Front

THE half has not yet been told of the service of the engineer in the present warfare along the western front. In fact, the success of military operations there depends on intensive transportation, most of it of a temporary character. The Germans, as is well known, had their military railroads thoroughly prepared as far as the Belgian and French frontiers, with numerous lines reaching this territory and expanding into branches with elaborate unloading facilities, so that at the first moment of war men and material could be spread out quickly along the whole front. The Allies had much smaller resources of this kind and have had to organize them since the outbreak of hostilities. It is reported on good authority that along the British front alone hundreds of miles of light railway have been laid on temporary roadbeds sometimes hardly more than superficial, to enable rapid transportation of troops and supplies. These lines connect at every available point with the French railway system and serve as feeders for the wonderfully perfect motor transport system between their termini and the firing lines. Just how the work has been organized is at present a military secret, but that it has been done thoroughly recent events plainly show. When a soldier at the front "somewhere in France" can be regularly supplied with clean clothes from his London home month in and month out, it shows what organization and engineering have been able to do for the British system of transport.

One is tempted to inquire how long it would take to accomplish a similar feat in this country, where railroading, in the ordinary sense, is really a national specialty. As part of the general preparedness campaign, in which American engineers have taken so great an interest, provisions should be made to follow the example thus set. Here is a magnificent opportunity for co-operation between the practical transportation engineers and the government, if that slow-moving organization is capable of efficient co-operation. The British military railways stop out of shell range of the hostile front, and from that point on tractors and motor trucks take up the burden. It is well known that some of the very best of these have come from America, but what effort has been made to plan for motor vehicles especially adapted to the somewhat more difficult American conditions? That material comparatively standard has been able to do good work in the little affair of supplying General Pershing's force is small comfort, for the transportation required for a few regiments and light field batteries is a bagatelle compared with that demanded for fifty divisions or more, and artillery massed to an extent that never has been even approximated in any previous war. We need, and we need badly, the earnest efforts of the automobile engineers in planning for the production when necessary, from standard parts as far as possible, of a full equipment of motor trucks and tractors for heavy pieces specially designed to meet the requirements of country near the American coast, as well as along its frontiers. It is just such planning that is expected of the Industrial Preparedness Committee of the Naval Consulting Board. The success of any campaign against America, by whomsoever conducted, depends chiefly on the quickness and power of the first blow, and this as a rule comes, as it came two years ago, almost without warning.

The aeroplane engineer, too, needs to wake up and come to the front. Considering the fact that the conquest of the air was fundamentally an American achievement it is not cheerful when one of the few great masters of the art in this country openly confesses that by the time he gets a new idea into construction it is, from a foreign point of view, antiquated. Along the Mexican frontier we need aeroplanes by the score for scouting purposes, yet the observer in charge of the army service reports that it is extremely difficult to get suitable propellers for the few machines which the government has, the standard forms not being adapted to stand up in hot climates. It is quite safe to say that the government does not possess a single plane equipped with effective bomb-dropping apparatus, with a proper machine gun emplacement or armored even enough to protect the driver and observer from casual musketry, let alone from machine guns and shrapnel. In the next war aeroplanes will play even a greater part than now, not only in scouting and fighting, but even in supply. Had the British in Mesopotamia had half a dozen planes of large carrying capacity, which could perfectly well be produced, Kut-el-Amara might not have been starved out.

It is high time to wake up and muster the engineering skill of the country to the point at least of quiet preparations for efficient action. The work of the Naval Consulting Board shows that laymen are ready to do their part.

The Engineer's Interest in Political Economy

ENGINEERS are apt to forget, in the hurry of designing and building, the means by which society produces its wealth. They are more directly concerned with that production than almost any other class of men. It is refreshing, therefore, when the retiring president of so influential an organization as the Engineers' Club of Philadelphia sees fit to pass by, in his last official message to the members, all that has to do with the immediate business of increasing the amount of wealth produced for a given effort, and to direct attention to the interest engineers ought to take in what becomes of that wealth after it is produced.

It is often held that the distribution of wealth, as affected by matters like the public ownership of natural resources, is a

political and economic question about which engineers, being merely organizers and creators of means for producing wealth, do not need to worry. Engineers, however, are personally concerned, in common with everyone else, over the distribution of wealth. They are, moreover, vitally interested in that distribution because they are engineers. The volume of wealth turned into producing capital directly limits the activities and accomplishments of the profession. The order and manner in which the natural resources of the country are developed dictate at present the lines along which the engineer must work. The engineer might, under different economic conditions, increase the production of wealth at a much greater rate and on a more sound basis if he himself had the power to determine the extent and direction of the development of these natural resources. The problem requires engineering ability for its solution.

While Mr. Ledoux's address may seem far afield to some—and the Engineering Record remarks, in passing, that it is not in sympathy with all of Mr. Ledoux's opinions—the subjects with which he deals are those that the engineer must take up if he is to realize the possibilities that lie before him.

The Elusive Elastic Limit

THE DISCUSSION of the relation between yield point and proportional limit of steel at the recent meeting of the American Society for Testing Materials, abstracted on page 78 of last week's issue, serves to call attention anew to the present deplorable lack of agreement as to how the term "elastic limit," or its numerous variants, should be defined, and how its value should be determined. However illuminating and suggestive that discussion proved in other respects, nevertheless, insofar as the particular features under consideration are concerned, it has only served to emphasize the previous confusion. That criticism applies in some measure also to the report of Committee E1, on standard methods of testing, presented at the same meeting. That committee has offered the following three definitions, which, upon approval by letter ballot, will be embodied in the A. S. T. M. Standard Methods for Testing:

1. "Elastic Limit is the greatest load per unit of original cross-section which does not produce a permanent set."

2. "Proportional Limit is the load per unit of original cross-section at which the deformations cease to be directly proportional to the loads."

3. "Yield Point is the load per unit of original area at which a marked increase in the deformation of the specimen occurs without increase of load."

Definitions 1 and 2 are followed by the explanatory note: "This determination is rarely made in the commercial testing of materials."

In the present A. S. T. M. Standard Methods the foregoing definition for "proportional limit" is used to define the "elastic limit," although it is stated elsewhere that the *real* elastic limit is that covered by the first of the above three definitions. In the topical discussion previously alluded to, Mr. Howard made the statement, apparently at variance with many existing records, that "the behavior of steel is generally such that the elastic limit and proportional limit coincide"; also that the term yield point "does not appear to have any fixed meaning," an assertion which, though measurably justified for materials possessing no true yield point, is seemingly unwarranted for the general run of structural steel.

The Engineering Record submits that it is imperatively incumbent upon Committee E1 to seek to bring early order out of this chaos, insofar, at least, as the practical requirements of specifications for materials are concerned. The scientific phases of the problem, which are incomparably more exacting and perplexing, may well be left for mature subsequent consideration. In any future report on these features it is to be hoped that the committee will offer, in support of its findings, authoritative test data from published records or its own independent researches.

Limiting ourselves to the practical aspects of the existing situation, the proposed new definition for elastic limit, though concededly correct in a strict but narrow scientific sense, is open to certain serious objections: First, in that the values would be greatly affected by the gage length and the sensitiveness of the measuring apparatus; second, that if both these elements could be standardized, there would still be no escape from the effect of initial stresses and nonhomogeneity in the material, from which practically no material is exempt, not to mention other important disturbing influences alluded to in Professor Moore's discussion. Evidence is, in fact, not lacking which would point logically to the conclusion that ferrous metals, loaded for the first time after leaving the finishing rolls, will exhibit "set" under the smallest initial load, if only the measuring apparatus is sufficiently delicate for its detection. That circumstance, together with the extreme slowness of the test, and the fact that the resulting values would apparently have no recognizable physical significance, would inevitably tend to discredit this definition for practical purposes. Its acceptance would, in effect, remove the term elastic limit from engineering literature and relegate it to purely scientific uses.

The committee cannot keep the thought too prominently in view that it is, after all, the *physical significance* of the results in which the interest of engineers is centered. Engineers cannot be expected to prescribe, and manufacturers cannot afford to adopt, refined and time-consuming methods unless it can be convincingly shown that the results to which they lead have a physical significance of superior value, and that they cannot be obtained within adequate limits by simpler and quicker means. If that can be made evident, a suitable readjustment in commercial testing would necessarily follow. In the meantime it would seem ill-advised to put forward an impracticable definition for a thing whose practical value is, to say the least, unproved.

It is hardly to be doubted that the term yield point in the sense in which it is defined by Committee E1, which makes it applicable only to materials possessing a true yield point, will long remain the principal reliance in practical elastic strength determinations for such materials. This definition has, moreover, the merit of being in strict accord with the use of that term throughout the A. S. T. M. specifications wherein its determination by the drop of the scale-beam is in every instance explicitly prescribed, this method being feasible, of course, only for materials which have a true yield point. For other materials, for which this term becomes a misnomer, it would seem wise, from a practical viewpoint, for the committee to follow the lead of the Subcommittee on Methods of Tests of Committee A1, on steel, which, it may incidentally be observed, is under the same chairman, Professor Lanza, by defining the elastic limit as that load per unit of original cross-section at which the rate of elongation shows a sudden increase as seen by observations on a suitable extensometer. This would also avoid an impending glaring inconsistency in the revised A. S. T. M. standards, and would mean substantially a return, for the definition of elastic limit, to the proposed definition for proportional limit, a term not now recognized in any of the A. S. T. M. specifications. The elastic limit, as thus defined, offers the important advantage that it can be found with comparative ease and speed, and with sufficient accuracy for practical purposes, without stoppage of the testing machine, if the pulling speed is kept within proper limits, as has been shown by experience in a number of leading commercial and research laboratories.

In this way it is believed satisfactory provision would be made for the only two terms relating to elastic strength—namely, yield point and elastic limit—which figure in present-day specifications, and in a manner entirely consistent with the revised A. S. T. M. standards for materials. While the term elastic limit, in the sense here advocated, might perhaps more logically be supplanted by the term proportional limit, as suggested by Major Morse, such an attempt at abandoning a term so long established would inject an added element of complication which it would seem desirable to avoid.

As a better ultimate solution for commercial purposes, it is hoped that a simple apparatus will yet be developed which will yield a graphic record of the average deformations on opposite sides of the test specimen and the corresponding loads. This would serve to establish both the proportional limit—under whatever name—and the yield point. While the relative importance of these two physical constants cannot yet be definitely stated, enough is known to indicate that each has its individual practical significance for particular purposes, and that jointly they serve to detect inferior material of which the yield point alone may give no indication. The development and general use of such an apparatus would prove a long step toward putting an end to existing confusion.

CAMP EAST OF JOB ON NARROW CAUSEWAY STRETCHING 6 MILES ACROSS BEAR LAKE

Largest Bridge Caissons Rivaled by Timber Crib Sunk in Free Air in 34 Days

Narrow Space Available 3 Miles from Shore on Causeway Across Bear Lake, Idaho, Governs Layout of Construction and Concrete Spouting Plants

IN THE MIDDLE of a 300-ft. causeway of fine sand and clay which stretches for six miles across the northern end of Bear Lake in Idaho has been sunk, by open dredging, a timber caisson rivaling in size the large pneumatic caissons built for the Quebec, Manhattan and other bridges. Within this caisson is being constructed the main part of the Lifton pumping station of the Utah Power & Light Company, the design and object of which were described on page 68 of the Engineering Record of July 15, 1916. The work being twelve miles by indifferent roads from the two nearest railway points, it was necessary to get in all the plant and most of the materials during the winter while good snow roads were available. As the large retaining wall, the electrical equipment room, and the discharge flume are being constructed together with the station itself, a central plant for screening aggregate and mixing and spouting concrete was built. The open-dredging method and the heavy weighting necessary required a caisson with 16-in. walls and heavy interior bracing, trussed to support the weight pockets, in the construction of which were used 800,000 ft. b. m. of timber and 122 tons of bolts.

The elaborate formwork for the station itself could not well be built until the caisson bracing had been removed, and only the concrete skeleton of the main outside and cross walls is being built in successive lifts as the bracing is removed. When the bracing has been taken out in this way, the forms for the intakes, pump foundations, etc., can be built in clear open wells, allowing better work and more satisfactory location of the construction joints.

More Difficult Work Begun First

The contract naturally divided itself into the caisson, the cofferdam at its west end for the electrical equipment room, the deep retaining wall on the east end, the discharge flume and the concrete pile cutoff walls. The work has been started in this order, with the idea of having the preliminary work of excavation and pile driving finished in the same order, and at the right intervals to make concreting continuous.

It might be thought that some of the less difficult sections would have been started at first to provide a place to concrete at an early date. The work was begun, however, in the fall of 1915, and the caisson, the largest section, was constructed first both because concreting over the large area to be covered would have been expensive in the severe cold of winter and because sinking so large a caisson by open dredging was sure to cause settlement and likely to damage adjoining cofferdams or pile-driving work.

Camp and Timber Framing First Considerations

In view of these facts, the first work done while building the camp was to lay out a complete yard for framing the caisson timbers, start work on this feature and erect the four derricks to be used in building and sinking the caisson. The way in which this work was planned to secure the least possible handling of material on the narrow causeway is well illustrated in the accompanying drawings.

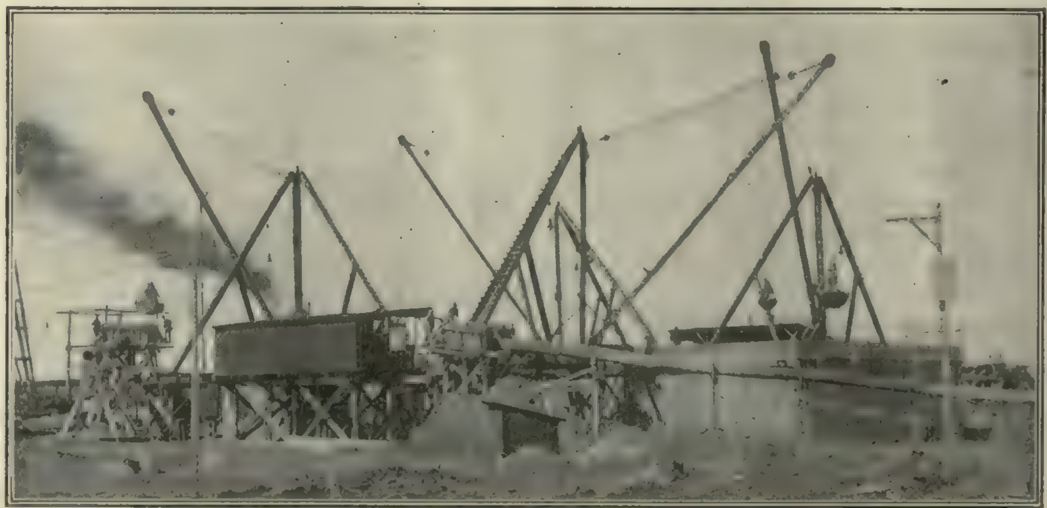
As the caisson was built up it was sunk by dredging with clamshell buckets, about 5000 of the 17,000 cu. yd. dredged being used for weight. The rest, and later that from the weight pockets, was dumped into hoppers and washed away in steel pipe flumes. The fine sand and clay were very hard to dig under water. Early in the sinking it was discovered that the amount of clay in the quicksand made it possible to pump out the caisson and loosen the packed bottom with picks until the dredge buckets could dig it economically. This was continued until the caisson reached final elevation. While the bottom remained firm at all times, the water following down the sides of the caisson brought in a great deal of sand under the cutting edge and caused the derrick staging to settle in spite of the fact that it was supported on piles driven 10 ft. below the final elevation of the cutting edge.

The caisson itself, 62 x 140.5 ft., sunk to a depth of 46 ft., compares in size with the 55 x 180-ft. caisson sunk for one of the Quebec bridge piers and the two 78 x 144-ft. caissons on which the Manhattan bridge rests. The big bridge caissons, however, have been handled with compressed air, and it is thought that the present one is probably the largest timber caisson successfully sunk without the help of the even support which the use of compressed air makes possible.

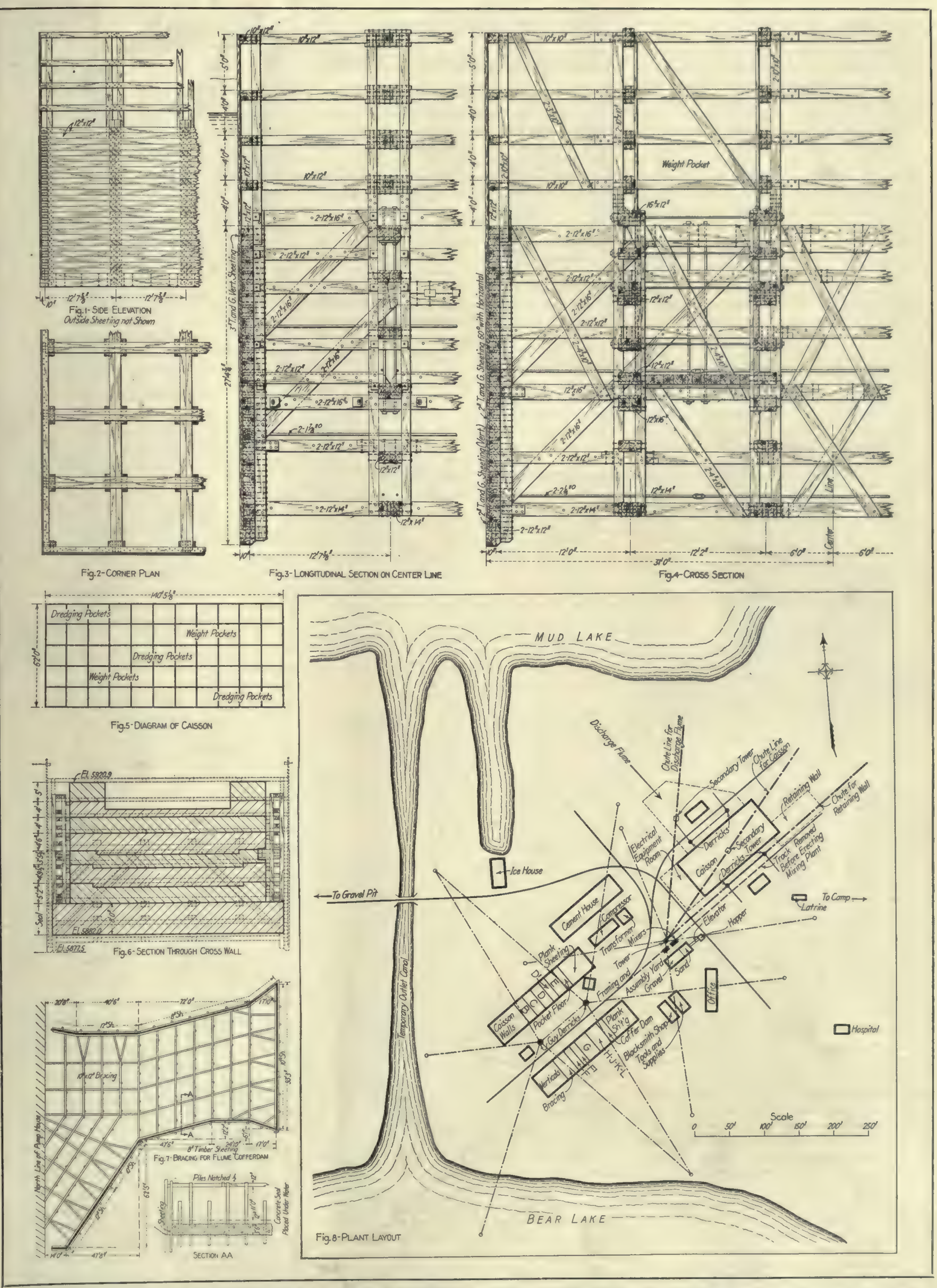
Bottom Rises with Pile Driving

The caisson reached final elevation April 6 last, forty-four days after sinking was begun. For ten days of this time excavation was suspended while the second build-up was made. In driving the 770 foundation piles with jets and followers to a penetration of 30 to 40 ft. below the footing, the sand bottom raised 2 ft. It was brought down to grade again by stirring up the packed sand and clay with the jets used to drive the piles and by pumping it out with centrifugal pumps. An 8-ft. seal of concrete was then placed by tremie in the open.

The concrete shell to support the walls of the caisson while the interior concrete work is being completed is being carried up in 5-ft. lifts, the concrete being poured directly against blocking set against the timber walls of the caisson between posts, after removing each successive layer of bracing. Concrete walls under the discharge flume, extending out to the double vertical posts of the caisson on that side, permit the removal of all bracing below the floor



BIG CAISSON SUNK BY FOUR DERRICKS—STEEL FLUMES CARRY AWAY SPOIL



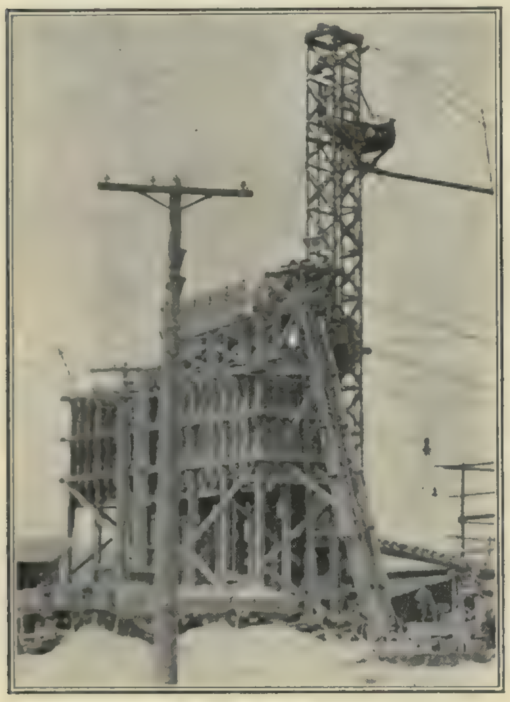
CONTRACT WAS LAID OUT TO DEVELOP WORK ON CAISSON, ELECTRICAL-EQUIPMENT ROOM, RETAINING WALL AND DISCHARGE FLUME IN ORDER

Figs. 1 to 4—Details of timber caisson construction. Fig. 5—Plan showing location of weight pockets. Fig. 6—Section through cross-wall of the concrete shell built as bracing was removed, showing transition blocking. Fig. 7—Plan of cofferdam for discharge flume. Fig. 8—Layout of construction plant. Sections of framing yard reserved for each caisson course. Concrete plant not erected till assembling of caisson was completed.

of the flume. The spaces under the flume between these walls and the space between the concrete and the caisson elsewhere will be backfilled, except on the intake side. Here, after the approach channel has been dredged, the whole side of the caisson will be pulled over into it and removed.

The caisson wall will be cut inside of the three cofferdams for the retaining wall, the flume and the electrical-equipment room to join those structures to the concrete of the station proper. A steel cofferdam which will be excavated to a depth of 40 ft. has been driven for the retaining wall, while the electrical-equipment room requires 24 ft. of excavation across the width of the caisson at the other end.

The only bracing in the flume cofferdam will be placed above water, the 12-in. splined fir sheeting being relied on to span from this



SCREENING, MIXING AND SPOUTING PLANT

bracing to the concrete seal. Because of the size of this cofferdam, a number of extra long foundation piles will be driven and cut off at water level to support intersections of the bracing. After the piles have been driven the seal will be concreted against the wall of the caisson. The latter will then be removed almost to the bottom of the seal and the floor of the flume completed to the side of the pumping station.

After a long search, a narrow deposit of suitable sand and gravel, 150 x 1000 ft. and 4 or 5 ft. thick, was found near the west end of the causeway. It is worked with a skid-derrick dragline, which dumps into 4-yd. cars that are hauled three miles to the job by a 15-ton 3-ft. gage steam dinkey. These cars feed an elevator delivering to a rotary screen on top of the storage bins. To save building these bins to the extra height necessary for direct gravity feed to the mixers, a traveling measuring hopper running the length of the bins on a track above and behind the mixers, was used. Two mixers, one 1-yd. and one 1¾-yd., were available, and both were set up to insure against delays. They discharge into a tower skip which is hoisted 110 ft., from which elevation the concrete is spouted to a distributing tower. This tower is now set on the center of the caisson, from which position the secondary chutes can cover the main station and the electrical-equipment room at one end. It will be moved once to concrete the retaining wall and again to concrete the discharge flume. In all, 15,000 cu. yd. of concrete will be poured, requiring about 200,000 ft. b.m. of form lumber.

Hauling Materials and Plant

Cement was received at Dingle Siding, twelve miles east of the job, and 6000 bbl. were hauled in and stored during the winter. The plant, timber and other supplies were all received at Paris, twelve miles northwest of the job, and practically everything was hauled in before the snow roads became soft early in April.

Most of the hoists and other equipment are electrically driven, and the rest of the plant, together with the wood-boring tools, is run with air supplied by an electrically driven compressor station containing two machines, each of 1000 cu. ft. capacity per minute. The air lines were difficult to maintain in the extreme cold, and it is thought that if there had not been a large saving in using equipment with which other units of the power system had been built as compared to bringing new electrically driven plant into the country, the use of air machines would not have been profitable. Current for the construction plant has been supplied through a 44,000-volt transmission line, which will furnish power later to the pumping plant.

The Lifton pumping station is being built by the Jarrett-Chambers Company for the Utah Power & Light Company, a subsidiary of the Electric Bond & Share Company, the engineering forces of which have had charge of the design and construction of the entire development. The construction methods and plant layout were designed by Ralph H. Chambers and Edwin S. Jarrett, and the work is being carried out under their personal direction.

Auto-Truck Line Competes with Two Railroads

Charges Same Rates and Hauls Loads Much Beyond Rated Capacity of Trucks—Heavy Wagon Fitted with Rubber Tires Used as Trailer

FOR somewhat over a year an auto-truck freight line, taking advantage of a new brick-paved roadway between the two cities, has been in operation between Tampa and Plant City, Fla.—a distance of 22 miles—in direct competition with two steam railroads. The rate charged for the freight is the same as that charged by the steam lines; but the advantage to the shipper in using the motor line consists in the fact that deliveries are made direct to the consignee, thus eliminating the expense of transportation to and from the freight stations.

There are two 2-ton Selden trucks in the service, both a little more than a year old. In addition there is a heavy wagon fitted with rubber-tired wheels. This also has a capacity of 2 tons and is used as a trailer behind one of the machines.

Four men are employed in the service. Two of these, the chauffeurs, are paid $3 per day each. The other two are negro laborers, who receive $1 per day each.

The cost of oil and gasoline averages about $12.50 a week for each truck. It is estimated that 10 miles of travel is obtained from a gallon of gasoline.

All minor repairs are made by the chauffeurs. The owners of the line operate a sawmill at Plant City and do a great deal of work in their own machine shop. Other repairs are made in garages. The total cost of repairs is about $300 a year for each truck.

At the Tampa terminal the company uses part of a store as a station and at the Plant City end it has a barn.

The yearly license expense is $50 for each truck. The tires average about 8000 miles in service and cost $25 each for the front wheels and $52 each for the rear wheels. The tires on the trailer cost $22 each and render 20,000 miles of service.

Depreciation is figured at the rate of 33 1/3 per cent, with the original value of the trucks $2,200 each and that of the trailer $250. The depreciation is heavy, as the trucks are overloaded very often and the drivers are not of a very high type. The average load for truck and trailer is about 2½ tons, though 3½-ton loads for the trucks and 3 tons for the trailer have been carried. The average speed maintained on trips is 8 miles per hour.

Condition of Road

The entire road from Tampa to Plant City is built of vitrified brick. It is new and smooth, but for a heavy truck with stiff springs there is considerable vibration owing to the slight difference in the height of the bricks. The weather is never cold enough to interfere with operations. During the greater portion of the year there is very little rain, but during the summer months there is usually a shower lasting from one to two hours each afternoon. Records from the local weather bureau for the past five years show an average of 111 days of rain for an average annual rainfall of 49½ in.

The principal commodity shipped from Tampa is groceries. There is also considerable hardware, grain, feed and miscellaneous traffic. From Plant City to Tampa the principal freight is lumber, canned goods, crate material and vegetables.

As stated previously, the rates charged by the truck line are the same as the railroad rates. There are different rates for different commodities. The rate on groceries is 32 cents per 100 lb., which is about the average on all goods. The business is on a strictly cash basis.

The trucks leave Plant City early each morning and return the same day. The line is operated by the Plant City Truck Company.

Chlorination at Camp Whitman

When it was decided to supply the mobilization camp for New York State troops at Beekman, N. Y., with water from Fishkill Creek, instead of from driven wells, a rush order for liquid chlorine sterilizing apparatus was telephoned to New York City. At 10 a. m., June 24, the Wallace & Tiernan Company received the order. The apparatus left the company's factory at 4.30 p. m. the same day, together with a small cylinder containing about 10 lb. of chlorine, which was taken along so that the apparatus could be placed in service pending the arrival of a larger supply of chlorine. The equipment was installed and in operation on the night of June 24. Alan M. E. Johnstone, one of the assistant engineers of the Wallace & Tiernan Company, was sergeant in Company A of the 22d Corps of Engineers. He was detailed by Colonel Lucas to supervise the sterilization of the water supply. Sergeant Johnstone made a trip to his company's factory on short notice and took the apparatus back with him.

Separate Sludge Digestion Improves Imhoff-Tank Operation by Keeping Sewage Fresh

Auxiliary Sludge Chamber Provided—Two Pumps Simultaneously Force Fresh and Decomposed Sludge Into One Pipe to Secure Mixing

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Translated by Leslie C. Frank, Sanitary Engineer, U. S. Public Health Service

THE MOST MODERN and the most widely used methods of sewage treatment show an unmistakable tendency to keep the sewage as fresh as possible, to remove the settled sludge from the settling chamber as rapidly as possible, and to cause this sludge subsequently to undergo a process of anaërobic decomposition in a separate chamber. Imhoff tanks are included in this category. The characteristic of an Imhoff tank is that it is composed of a sludge chamber situated under a settling chamber and so connected with the settling chamber by means of a slot as to permit the settling sludge to slide by gravity from the latter into the former, but so as to prevent any flow of sewage through the sludge chamber.

Objection has sometimes been made to Imhoff tanks on the ground that they necessitate two-storied construction, with its attendant difficulties and expense; and attempts have frequently been made to secure the advantages of Imhoff tanks by placing a sedimentation chamber and a sludge-digestion chamber side by side and then pumping the sludge from the former to the latter as a substitute for the gravity flow in Imhoff tanks. However, many difficulties have developed in the course of these attempts and it is only recently that these difficulties have been obviated.

SEPARATE SLUDGE DIGESTION

In the following discussion, apparatus will be described in which the settling chamber and the sludge-digestion chamber are situated side by side and in which it has been found possible both to keep the sewage fresh and to digest the sludge satisfactorily. All apparatus herein described has been constructed and operated on a practical basis in large municipal sewage plants.

The difficulties which have developed in connection with separate sludge digestion are twofold. They relate to the settling chamber and also to the sludge chamber. The problem in connection with the settling chamber is to remove the sludge from it so frequently and so completely as to insure the maintenance of the sewage in a fresh condition. The older type of plant, in which it is necessary to pump out the total water content of the tank each time sludge is removed, will not be discussed here, as this type of plant is not practical. There is only one other form of plant, and in this form the sludge is removed from the tank without discharging the supernatant liquid. The invert of the sedimentation chamber in designs of this kind must be divided into one or more sumps and a sludge-discharge pipe inserted for each sump so that its lower end reaches to the lowest end of the sump. In the operation of plants of this kind it has developed that the sludge cannot all be removed, but that a considerable portion always remains sticking to the walls. In addition, the inevitable funneling of the sludge in the sump and the consequent discharge of water with the sludge unnecessarily increase the water content of the latter. The residue of sludge which remains in the sedimentation chamber decomposes, gasifies, floats to the surface and may thus escape with the effluent.

In the accompanying drawing these difficulties have been avoided by the addition of a hood above each sludge sump. The presence of this hood makes it unnecessary to remove all of the sludge at each operation. Even if the remaining sludge should become septic and float it would be confined to the hood and not endanger the effluent. In effect, it would rise to the surface inside the hood, sooner or later give up its gases and finally sink again to be removed with the next sludge discharge. Inasmuch as the sludge is never completely removed, it is impossible for water to break through and escape with the discharging sludge.

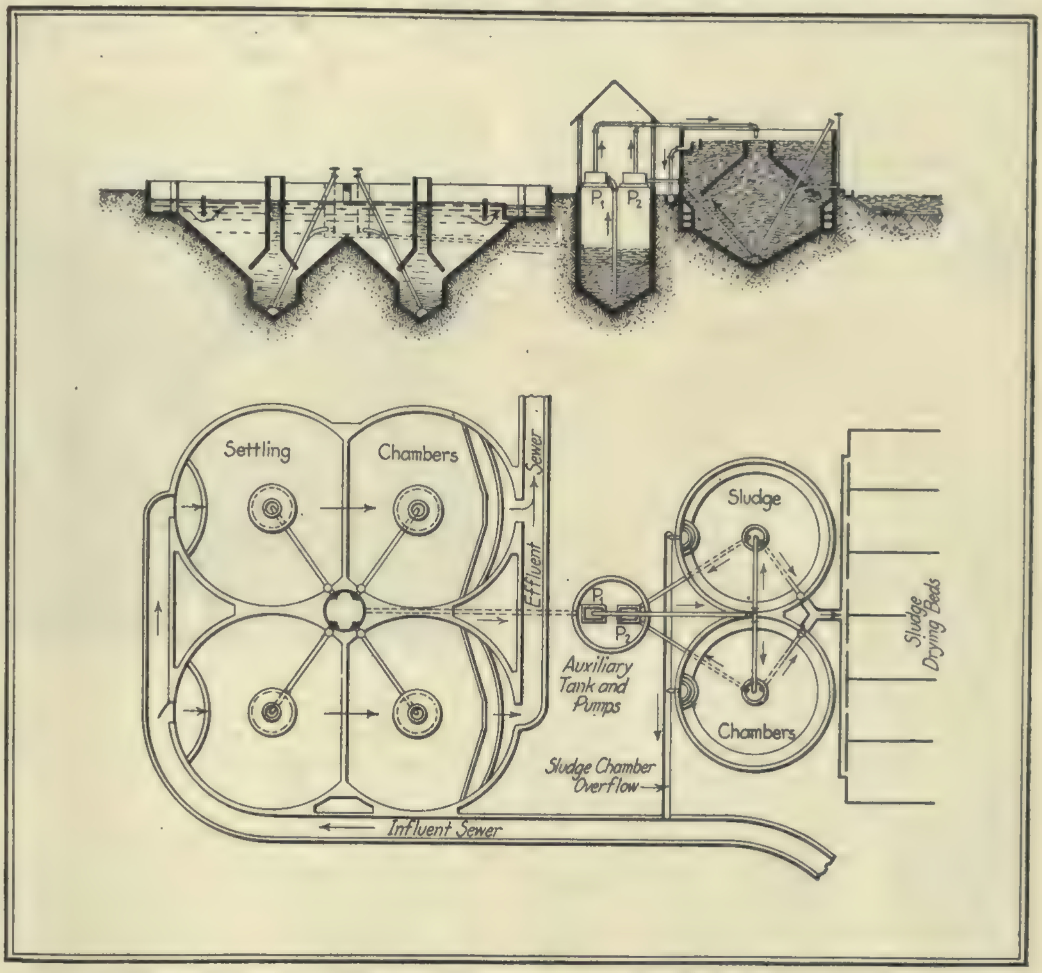
In addition to this device, which makes it possible to obtain sludge of relatively low moisture content and simultaneously to keep the sewage fresh, there are also a number of other new features included in the drawing. The tank is cylindrical and its invert is conical. Such a design permits the same slope at all points of the invert and causes the sludge to slide uniformly toward the lowest point. Statically, also, this form of tank is the best. It makes possible the use of thinner reinforced-concrete walls than any other design, since it is exactly adapted to receive the stresses produced by the upward pressure of ground water and by the radial pressure of the liquid contents.

FLOW HORIZONTAL

The direction of sewage flow in the tank is horizontal and not downward and upward, as has hitherto been usual with circular tanks. The downward and upward direction of flow has been found to be inferior from the standpoint of percentage removal of settleable solids. Nor does the sewage flow from center to circumference as in the past. It flows from one side of the tank to the other, so as to produce a longer flow line and at the same time to eliminate a considerable portion of the excessively long circumferential effluent channel. This form of tank therefore approaches most nearly an ideal design from the three standpoints of statics, sewage sedimentation and sludge removal. The drawing shows two tanks combined as one.

The decomposition of sewage sludge in separate chambers was first believed possible in shallow flat-bottomed tanks. It was thought that it would simply be necessary to pump the sludge into these tanks and allow it to remain until sufficiently decomposed. All attempts of this kind have, so far as I am aware, failed. The sludge in these tanks produces unpleasant odors and takes a long time to decompose to anything like a condition in which it can be dried without nuisance.

A properly designed sludge-digestion



FRESH SLUDGE FLOWS BY GRAVITY FROM SETTLING CHAMBERS TO AUXILIARY SLUDGE CHAMBER PROVIDED WITH PUMPS, WHICH DISCHARGE SIMULTANEOUSLY INTO A SINGLE PIPE TO SECURE THOROUGH MIXTURE

plant should be one in which the sludge takes only a few months to decompose to a condition in which it dries easily and without producing a nuisance. Neither should any foul odors be produced in such a plant during the process of decomposition. These requirements have been satisfied in Imhoff tanks, and it seems logical, therefore, to imitate artificially in the separate digestion process the conditions obtaining in an Imhoff tank. The design shown in the drawing is the result of a successful attempt to imitate these conditions.

Promote Growth of Organisms

In order to achieve odorless decomposition it is necessary to promote the growth of the proper organisms and to maintain the conditions necessary for their existence. With this in mind it seems logical to *feed* the sludge that is properly decomposing and to *inoculate* the fresh sludge with the proper organisms as soon as it arrives. This inoculation is necessary so that the fresh sludge may not have an opportunity of entering into improper decomposition—for example, acid decomposition. Both of these conditions may be fulfilled by the same device. In short, it is merely necessary to *mix* the fresh and decomposed sludge in accordance with certain rules. Such mixing may be most simply done in closed pipes.

In the drawing it will be seen that the fresh sludge flows by gravity from the settling chamber to an auxiliary sludge chamber. This chamber is provided with a pump P_1. It will be observed also that a pipe leads from the bottom of the sludge digestion tank to a second pump P_2, also located above the auxiliary chamber. In operation the two pumps simultaneously force both fresh and decomposed sludge into a common sludge pipe. This manner of operation results in immediate mixture of fresh and decomposed sludge in any desired proportion and in the discharge of this mixture into the digestion chamber. Further mixing occurs in the digestion chamber itself by means of the rising gas bubbles. The small gas bubbles which develop as a result of the decomposition process remain sticking in part to the sludge particles and by increasing in size progressively reduce the mass specific gravity of the combined sludge particle and gas bubble until it is less than that of water. At this time, of course, the two rise to the surface of the tank.

If the action taking place on the inside of the digestion chamber could be observed it would be seen that large and small particles of sludge are continuously rising to the surface of the tank, there giving up their gas bubbles, and, once more heavier than water, sinking back to the sludge layer at the bottom of the tank. This natural mixing, however, is insufficient. If it alone be depended upon it will be found that in a short time a scum layer will develop and will grow thicker and thicker. When, after this begins to take place, gas-laden sludge particles rise as described they are not able to release themselves from their gas bubbles because of this impenetrable mat on the surface, but instead become imprisoned in it. Little motion or mixing takes place in this scum layer, and for this reason it will be found that the decomposition taking place in the scum layer will be relatively feeble, may indeed be an undesirable or nuisance-producing kind of decomposition. This evil may be artificially avoided by constructing in the digestion chamber a partition or apron which operates in a similar manner to the partition walls in Imhoff tanks. With this apron in place the gas bubbles are deflected to a definite point or points in the tank surface. In the drawing this point is shown as the middle of the tank. In consequence of this provision there will be no rising gas bubbles at any other part of the tank surface, and any floating sludge there, not being continually buoyed up afresh by rising gas bubbles, will gradually become heavier than water and sink to the bottom. In the middle of the tank, however, to which point all of the gas bubbles are being deflected, the combined stirring action of the gas bubbles is so strong as continuously to break up the scum layer.

It seems logical, also, to make this part of the tank surface the part at which the fresh sludge is introduced, because at this point exists the best opportunity for the fresh sludge to become mixed most quickly and most uniformly with the contents of the tank.

Uniform Temperature Desirable

Since the decomposition of the sludge depends upon living organisms it is necessary to maintain the temperature as uniform as possible. In Imhoff tanks this occurs naturally by virtue of the depth of the tank and because of the fact that the sewage which flows through the settling chamber above the sludge chamber is fairly uniformly warm. Separate sludge digestion chambers built above ground may develop difficulties because it may not be possible without artificial aid to prevent harmful fluctuations of temperature. Artificial means may therefore in this case be of advantage. In the drawing are shown circumferential conduits on the inside of the tank. These may be operated either with warm water supplied from a central heating plant or simply with sewage.

Lumber Cut of Central States in 1915

The U. S. Forest Service announces that 37 billion thousand board feet of lumber was cut in the Central States in 1915, a decrease of 300 million thousand feet over the previous year. There are 29,941 mills and the final estimate is made from reports received from 16,248.

Surveying 1000 Square Miles with the Camera

Phototopographical Survey Covers 93 Square Miles Per Month at Less Than the Cost of Plane-Table Work

GOVERNMENT officials wanted a map of the Columbia National Forest in Washington, which contains about 1,000,000 acres. The area is very rough and heavily timbered, so that the cost of a complete survey would have been considerable, even if funds for special surveys had been available, which were not. The matter was referred to the engineers of the Forest Service, and has been worked out in such a way that the surveys were made and accurate maps showing 100-ft. contours and all streams were produced ready for the engraver at a total cost of $4.60 per square mile.

The work, which is to be finished this year, has been handled almost entirely by one man, who spends the open seasons in field work and the winters in working up the notes. With a single man as assistant and packer, two saddle horses and two pack animals, he covered an average of 93 square miles per month. When the weather was good he "occupied stations," making observations and photographs; and when there was smoke or rain the party moved camp, made new trails or traversed roughly the level areas where phototopographic methods were least effective. Work progressing in this manner for several years has produced each season accurate maps of those sections of the forest where data about the topography were desired immediately; and in the course of continued experience, particularly convenient methods have been developed and applied.

THIS PHOTOGRAPH EQUALS A BOOK FULL OF TOPOGRAPHIC NOTES

Field Work

The camera used is a Coast and Geodetic Survey outfit No. 8, using Seed nonhalation L ortho 5 x 8-in. plates. Plates are developed in the field, a tank and changing bag being utilized. The usual practice is to make four exposures at each station, each embracing the view within a 65-deg. angle. The selection of stations is the phase of the field work which requires the most care, both as to number of reference points visible and the view of adjacent slopes which the station commands. It has been noted that the most useful views are taken when the shadows are such as to bring out the

contour of the hills. The accompanying photograph illustrates the qualities which the topographer endeavored to secure when possible. Practically all the photographs are taken through a ray screen with U. S. aperture 64.

Averages for the seasons in which the field work has been carried on show that stations were occupied on 30 to 40 per cent of field days, that 32 per cent of field days were spent in moving camp and that photography was not feasible on account of smoke, fog or rain on 32 per cent of the field days. About fifteen stations are occupied each month, and the usual contour of the territory covered is such as to require about sixteen stations per 100 square miles.

The cost of the field work, exclusive of the primary triangulation which had already been done by the Coast and Geodetic Survey, was made up of the salaries of topographer and packer, provisions and photographic supplies, the use of four horses and their maintenance. Averaging the total of these items for two years gave a rate of $2.75 per square mile for the field work. The last season there were an additional man in the party some of the time and two extra horses, which increased the cost accordingly.

OFFICE WORK

In the office the topographer works up approximately 50 square miles of the map each month. The scale is 1 in. to the mile and the contour interval is 100 ft. The map is laid out first, showing the primary points located by the Coast and Geodetic Survey, and from these points the locations and stations selected by the topographer are put in, using the photographs and a method of intersection or resection as conditions permit. There are nine primary survey points in the forest and about fifteen main locations which the topographer uses as reference in orienting the remaining 200 locations.

All these points are located on the map by plotting the observed angles with an accurate protractor. When more than two photographs show a point which it is desired to locate on the map, each additional view in which it appears constitutes an additional check on its position as already plotted. Where there is any question about position, as many views as possible are consulted and used to check.

Each photograph bears on its margin the mark of a horizon line below and above which depressions and elevations are measured respectively. Three points are used to determine elevations through which contours are drawn, and it has been found that the results thus obtained are correct to within 50 ft. of actual elevations. This is considered close enough for the work in hand, particularly in country where the timber is high.

The cost of the office work, which included only the topographer's salary and supplies, averaged $1.85 per square mile for two years, so that the total cost for field and office amounted to $4.60 per mile in these seasons. Since that time some sections of the work where particularly accurate results were desired were done with greater care, using five locations per mile, and this work cost about $7.65 per square mile.

In 1911 the same topographer was employed in making a plane-table survey of a similar area. The cost of this survey, with map ready for the engraver, was $6.15 per square mile. In comparing these two cost figures it should be borne in mind that the plane-table is slower. In work with that instrument only 53 square miles per month were covered, as compared to 93 square miles with the other method.

The work in the Columbia National Forest has been done under the direction of George H. Cecil, district forester. Lage Wernstedt, forest examiner, carried on the field and office work.

Water Measured by Volume in Large Turbine Test

Used as Check on Current-Meter Determinations at Turners Falls Electric Plant — Measurements Made Through Ice

TO CHECK the quantity of water used during tests of the 7500-kva. units at the plant of the Turners Falls Power & Electric Company volume measurements, as well as current-meter determinations, were made. The former were secured by observing the extent to which the pond was drawn down and making a careful survey of the pond area. The methods were described recently in a hearing before the Massachusetts Gas and Electric Light Commission.

The power output of the wheels, which are of the I. P. Morris vertical type, was measured electrically and corrections were then made for generator efficiency. The head was measured by gages in the wheel case and in the river. To obtain the quantity of water, the current meter was used in the canal just in front of the wheel to be tested. In order to separate the test unit from the other units, a flume about 40 ft. long was built in front of the openings to the head gates. Two current meters were used in this flume.

The test was somewhat complicated by being made in winter, and it was for this reason that bulk measurement was used, ice on current meters sometimes being troublesome. The pond measurements required more time and were not so frequently made, but the two methods checked within 1 sec.-ft. out of 1600 sec.-ft. The amount the pond was drawn down was measured on twenty-two gages up and down the length of the canal, as the variation in different places needed to be considered. At various times twenty-eight men were reading gages. A test run required two hours. The ice on the pond made it easier to get an accurate measurement of the drawing down of the water, no wind effects being present. Every gage was in a small hole cut in the ice and the water was perfectly still. There was some leakage out of the canal, which was measured by closing the cofferdam gates at night and measuring the reduction in canal level.

Dusting Prevents Coal Mine Explosion

The Federal Bureau of Mines has concluded, as a result of a large number of experiments, that the dusting of finely pulverized rock in coal mines prevents, or at least checks, explosions. Experiments have been made not only in the government's experimental mine near Pittsburgh, but also in actual workings. The work has progressed so far that the effective proportion of shale dust to coal dust has been determined for coal dust from many seams. A special gasoline-driven car with a blower has been designed for distributing the dust.

Stream Flow, Not Rainfall, Best Criterion for Yield

Clemens Herschel Urges Engineers to Use River Measurements as Most Reliable Basis for Water-Power Predictions

WHY, when seeking runoff, should engineers turn their backs upon it, and go off poring over records of rainfall, and endeavor, by dint of much tribulation, to compute a relation between it and rainfall? This is the question asked by Clemens Herschel, consulting engineer, of New York City, in a recent discussion, before the Boston Society of Civil Engineers, of power estimates from stream flow and rainfall data. That sort of thing, he said, was well enough in the '40s of the nineteenth century, when it was started, but to-day it must be recognized as a false method of work, and engineers' energies should be concentrated on stream measurements and a comparison of such, when the future yield of drainage areas is in question. It is submitted that by such comparisons or analogies much more reliable results in the line of yield prognostications can to-day be obtained, when direct gagings are lacking, than rainfall studies, and computations based upon them, can ever furnish. The main points in Mr. Herschel's argument follow:

RUNOFF DIAGRAMS

Having given a record of runoff gagings, how shall they be arranged for the use of the hydraulic engineer?

Now, confining ourselves to the considerations uppermost in the mind of the engineer of water *power*—not water *supply*—it has long been clear that there must be one best way; also that in the interests of efficient work and of an avoidance of wasted effort this best way should be followed, rather than pursue the study of many such ways.

A mine of information on stream flows is contained in the reports of the U. S. Geological Survey on that subject, which now number 400 volumes. It is no exaggeration to say that for water-power purposes, giving all data needed for that purpose, these 400 bulky reports could be condensed into 400 single-page cuts contained in one volume, and at an enormous saving to the work, time and expenses of the hydraulic engineer.

For the purpose of facilitating comparison and reducing all the records to the same specific scale, as it were, the collected diagrams should be plotted to represent second-feet per square mile, instead of second-feet. Underlying details would not be lost, but if ever needed (a matter of some doubt) could be supplied by the Survey Office. In answer to an inquiry requesting suggestions, Mr. Herschel made the above recommendations to the Geological Survey office and reiterates it as his matured opinion on the subject.

If the daily discharges of a river at a certain point be plotted for the 365 days of the year, *in the order of their magnitude* (not consecutively in the order of the date of their occurrence), a perfectly smooth curve showing the year's discharge will be produced. Take fifteen or twenty such years, if the records avail, and three such curves may be produced—one of average flow, another enveloping all the minima flows, and a third enveloping the maxima flows. And for a period of that length the

discharge of that river, at that point, has been portrayed practically for all time. Nothing, or little more, is needed in its hydrographic study, for the uses of a constructing engineer. Its original data may have interest for a meteorologist, when he philosophizes as to the relation between such three curves and rainfall data, but an engineer has nothing to do with that. The rainfall may be anything; it will not change the recorded runoff, nor the ranges of runoff shown by these three curves. And it is these data that are needed for useful purposes—the province of the engineer—in contradistinction to the pastures of recreation that incite the philosopher or scientist. The same data may also be presented, if preferred, in tabular form—would have to be so, before they can be "boiled down" into the diagram which has been described.

Tables and Diagrams

As an example of the tables and diagrams spoken of, one of each is reproduced in Mr. Herschel's printed discussion in the June *Journal* of the Boston Society of Civil Engineers. Bold-face figures in the table, showing maximum and minimum in each horizontal line, give the data for the enveloping curves that have been spoken of. Two full lines extending across the table mark the limits between which the economical capacity for turbines to be installed will ordinarily be found. The data for the curve of average flow (averages of each horizontal line) can be readily found from the table.

The diagram referred to is the concise and true representation of the regimen of the river, giving all data needed by a hydraulic power engineer. If we had such diagrams for the principal points on every river of importance in the United States, Mr. Herschel contends, it would be the fulfillment of hydrographic study of river flow within the United States. A single volume containing such diagrams would then take the place of the several hundred volumes of undigested material relating to river flow which now obstruct useful work and the exercise of judgment, not to mention the lucubrations of rainfall recorders and of their obsequious followers.

In taking up this subject, let us assume that we speak here only of the ultimate development at any given mill site. Power machinery may be installed at time intervals, as power is called for. Even the power house may be built in sections. Let us also recognize that while power dams and power houses are built to last forever, and as a matter of fact naturally do endure on the average longer than most any other work an engineer is called upon to design and construct, yet the duration of such things as "load-factors" and given "peak loads" are in comparison but fading fancies. How, then, can they properly enter into a computation for powerhouse design in conjunction with factors that are eternal, or nearly so? The tendency of powerhouse management is constantly to strive for a load factor of one, and both the progress of invention and of sociology is working to that end. By the time a network of interconnected power wires, each arranged to convey a constant daily quantity of power, will have spread over all the thickly settled portions, or over the whole of the United States, farms included, which is rapidly being accomplished, where will the load factor and peak load be then?

The state of electrical development just described is rapidly being accomplished in the Province of Ontario, Canada, as a state enterprise, and there is nothing but notions of sociology to hinder its coming true in the United States by private enterprise. Another consideration which this thought brings up is the one of variable power from day to day at any mill site; very present to those who are operating or have operated water power on most any stream except on those constituting the outflow of the Great Lakes; and the subject of permanent and surplus power, or, to use the later terms, of "primary" and "secondary" power.

Suppose we assume that there is no secondary power (there need not be); that it is all power that can be relied on to be at hand when called for. So far as Mr. Herschel's judgment goes, based on ten years' experience in the administration of a water power, that is the only kind of power that should be offered for sale in the existing and the to-be-expected development of the business; in the interests of the seller, no less than in that of the buyer; and with the legitimate aid of heat engines and fall increasers to tide over low water and "backwater" troubles, and in spite of unavoidable annually recurring diminutions of power output, during nearly all the days of the year, there is no difficulty in attaining a uniformity of power output throughout every day of the year.

One might go further and prove that only by amalgamating heat engine and hydraulic power in this way can a full or complete return be gained from hydraulic power plant investments. All this was well understood full fifty years ago in New England manufacturing circles, if not elsewhere; but, with the advent of the electrical transmission of power, an army of ardent electricians, ill informed on hydraulic matters, were let loose upon an expectant country, and they had to learn all this over again. Some of them and their backers have not learned it yet. We still hear of the minimum flow of the river on any one day in twenty years, as furnishing the measure of "primary" power, and there are great hydraulic power plants that needlessly waste over their dams, on more than half the days of an average year, a quantity of water which if properly utilized would generate 100,000,000 or 150,000,000 kilowatt-hours annually, at a cost less than the fuel cost of the heat engines that must be installed to tide over *low-water* diminutions of normal power output.

Then there is the consideration of how much reservoir capacity or pondage is to be added to the power plant for the purpose of making the water supply more uniform, tending toward that happy era when there shall be no more times of low water and no more freshets.

A German Opinion

A German writer has recently stated such a proposition as follows: "Procedure for the determination of the most economical part of the annual run-off to be used; size of reservoir; and amount of auxiliary heat power which should be selected in the construction of water-power plants."

As the learned author treats the subject, this includes a choice and determination: (*a*) Whether to use no water at all, or all the water that comes down the brook or river during the year; or what portion of the annual discharge of the stream is to be utilized; (*b*) whether to have no reservoirs, or reservoirs large enough to utilize the whole annual river flow; or what intermediary reservoir capacity is to be constructed; (*c*) whether to have water power only or to use auxiliary heat engines; and, if any are to be used, to what extent; certainly a comprehensive program. And all this is to be answered strictly by computation, and results given by formulas expressed in mathematical symbols! Does not this suggest the line: "Out of too much learning become mad?"

But let us analyze the task entered upon; (*a*) and (*b*) may be considered together, (*a*) being a function of (*b*). And economic reservoir capacity, to ordinary minds, is plainly a local consideration, to be answered in each case by the local situation, let the formulas say what they will.

It is only very gradually that the mere idea of the applicability of the powers of eminent domain to the taking of land by condemnation for water-power purposes is being recognized in state constitutions and in court decisions, thence spreading to legislation (see a decision of the United States Supreme Court of Jan. 24, 1916, in the case of the Alabama Interstate Power Co., opinion by Justice Holmes, as an important step forward in this direction); and without such right the opportunity of making use of computations relating to reservoir volumes would be somewhat doubtful. Then, again, are we to ignore topographical facilities or difficulties in such cases, in favor of the demands of general formulas?

Trial Estimates Valuable

The writer believes that trial estimates will furnish a better guide in the vast majority of cases, very likely in all of them; and general experience has also indicated, at least as a beginning, to be modified if need be, by trial estimates in each case, how to answer division (*c*) of the problem as stated above.

This answer has already been indicated in the table of river flow above referred to, and may be stated as follows: The most economical discharge capacity of the turbines to be installed, so as fully to utilize the run-off at any mill site, is never very far either side on the diagram of the average river discharge on a day, than which there are as many days in the year of a greater as there are of a lesser river flow.

If, now, we have further the fall at the considered mill site appurtenant to the several river flows, fall also may be plotted as a curve; and from the two, quantity and fall, "Macaulay's schoolboy" could compute and plot the curve of resultant power for every day of an average year.

One factor more should, however, be taken into account. To accommodate peak loads or power variations occurring during the day, it is well to install wheels of a greater power capacity than has so far been indicated, running them normally at part gate. With all this entering into the computations, there will result the diagram given above, which presumably will need no explanation.

Auxiliary heat engine power, although its measure is indicated on the diagram, is not needed as a rule at first, except in process of developing the sale of power from the works, up to their full output capacity; and may thus be added gradually, as, indeed, may frequently, hydraulic turbine and even powerhouse capacity. All this makes for convenient elasticity in first installation, but will result, finally, in what we have all along been aiming to attain, primarily or eventually, a full economical utilization of the natural resources of that power site.

How the Government Handles Its Roadway Parties in the Valuation Work

Elaborate Note Forms and Type Sheets Simplify the Inventorying on the Eastern District, and Guide the Special Parties

By C. W. STARK
Associate Editor, Engineering Record

NOT ALL of the problems connected with the federal valuation of the railroads have to do with the fundamental principles of valuation, nor yet with the general questions of orders and administration. The very inventorying of the physical plant, with its infinite number and variety of structures and types, in notes that can be interpreted in the office, and will leave no gaps, is a task in itself, as stated in the article in the issue of July 8, page 43. The district heads have attempted to simplify this part of the work as far as possible by the assignment of the work to the roadway and special branch parties and their squads, and by their note forms. As the roadway parties are the only large parties, and as their records form the backbone of the entire inventory, much depends upon how they handle their work. In the Eastern District an elaborate set of note forms and type data have been adopted. The observations that follow are based upon a visit by the writer to a roadway party working in southern New Jersey. The general method of procedure and use of forms is the same, however, throughout the district.

WORK IS DIVIDED INTO FOUR PARTS

The assignment of work for the roadway party on the Eastern District is substantially the same as on the Western District, described in the Engineering Record of Dec. 26, 1914, page 696. About nine men, including the assistant field engineer in charge, constitute the roadway party. One part of their work embraces chaining the road, noting the pluses of all bridges, culverts, buildings, crossings, switches, signs, rail changes and other items of fixed plant, and either taking such notes as will, with the aid of the office computations, define and describe the item, or noting it over to one of the special parties; another is the cross-sectioning to determine the grading; a third includes the ballast tests, the tests for subsidence, the classification of the grading and the recording of condition notes, while a fourth is the field-office computations, in which the field notes are figured and summarized for transmittal to the Washington office.

Two men chain the line first, marking on the rail all the necessary pluses. They chain the main track or base line, and if necessary any spurs leading to industries. In general they keep no notes. Behind them follow the recorder and the cross-section group, working independently. The latter party, generally consisting of three, takes cross-sections of the roadbed as often as is deemed necessary. In the smooth country visited by the writer a hand level, tape and level rod sufficed, simple four-point sections being taken. In more rugged country, with deep rock cuts, slope boards or other special instruments are resorted to. Grading for station grounds, road crossings and borrow pits is recorded separately.

The recorder works alone while the chaining is being done, picking up the pluses and recording the items and types on the note forms with which he is equipped. To him falls the task of noting every fixed item of the railroad plant other than the grading and ballast, of noting changes in the track itself, and of defining everything in his notes, or indicating it on a memorandum for the bridge or one of the other special branch parties. As his progress is much slower than that of the chaining party, after the chaining is well advanced one member of the latter party accompanies and assists him a good part of the time, while the other usually assists the computers in the office car.

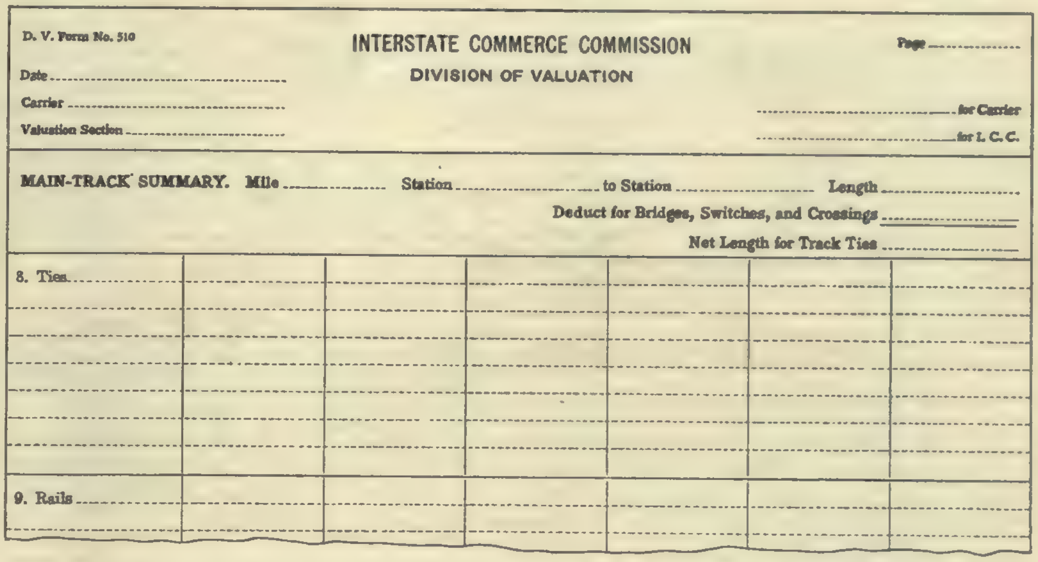
The ballast and subsidence investigations are made jointly by the assistant field engineer, who is in charge of the track and roadway party, and the railroad's representative. A railroad laborer accompanies them with the necessary equipment, and they usually cover several miles of road a day. Ballast depths are determined by digging. On the line visited by the writer, where the ballast was cinders, and where there was considerable soft ground, 1-in. iron-pipe sections were being used to advantage for determining subsidence. Coupled together they could readily be driven through the ballast and the embankment, and the total depth determined. By comparison with the cross-section notes the relation of this to the original ground surface was ascertained, and the depth of subsidence determined. If there seemed to have been considerable subsidence, and the government and railroad representatives disagreed as to the amount, a wash boring was taken at that point.

This party also has its laborer dig to determine the depth of masonry foundations, where plans are lacking or there is disagreement. In other cases, however, where digging or sounding is impracticable or there is disagreement, an agreed depth is determined upon from careful examination.

Necessarily the task of the recorder is a complex one. Every effort has been made to simplify this by note forms and type symbols. Some of the headings are shown. A notable feature of most of them is the liberal provision of blank headings, so that by filling these in, in conjunction with the type symbol, everything under the general classification can be recorded without elaborate descriptive notations.

It is necessary, of course, to draw definite lines between the structures which are inventoried by the track and roadway parties and those which are left for the special branch parties that come later. It will be noted from the sample memoranda sheet that the recorder must state definitely whether or not he has enumerated each structure in which the special party might be interested, thus removing all doubt as to whether it has been inventoried.

The recorder is equipped with two classes of type sheets. He has several type A sheets, which show structures common to all railroads, identified by index symbols. These include sketches which interpret the dimension letters on the form shown for culverts and retaining walls. In addition he has special type sheets, showing standards of the particular road under valuation.


D. V. Form No. 510 INTERSTATE COMMERCE COMMISSION Page ....

Date .... DIVISION OF VALUATION

Carrier ....

.... for Carrier

Valuation Section ....

.... for I. C. C.

MAIN-TRACK SUMMARY. Mile .... Station .... to Station .... Length ....

Deduct for Bridges, Switches, and Crossings ....

Net Length for Track Ties ....

8. Ties ....

9. Rails ....

THE COMPUTERS IN OFFICE CAR SUMMARIZE FIELD INFORMATION ON THIS FORM

DUPLICATE NOTES MADE IN FIELD

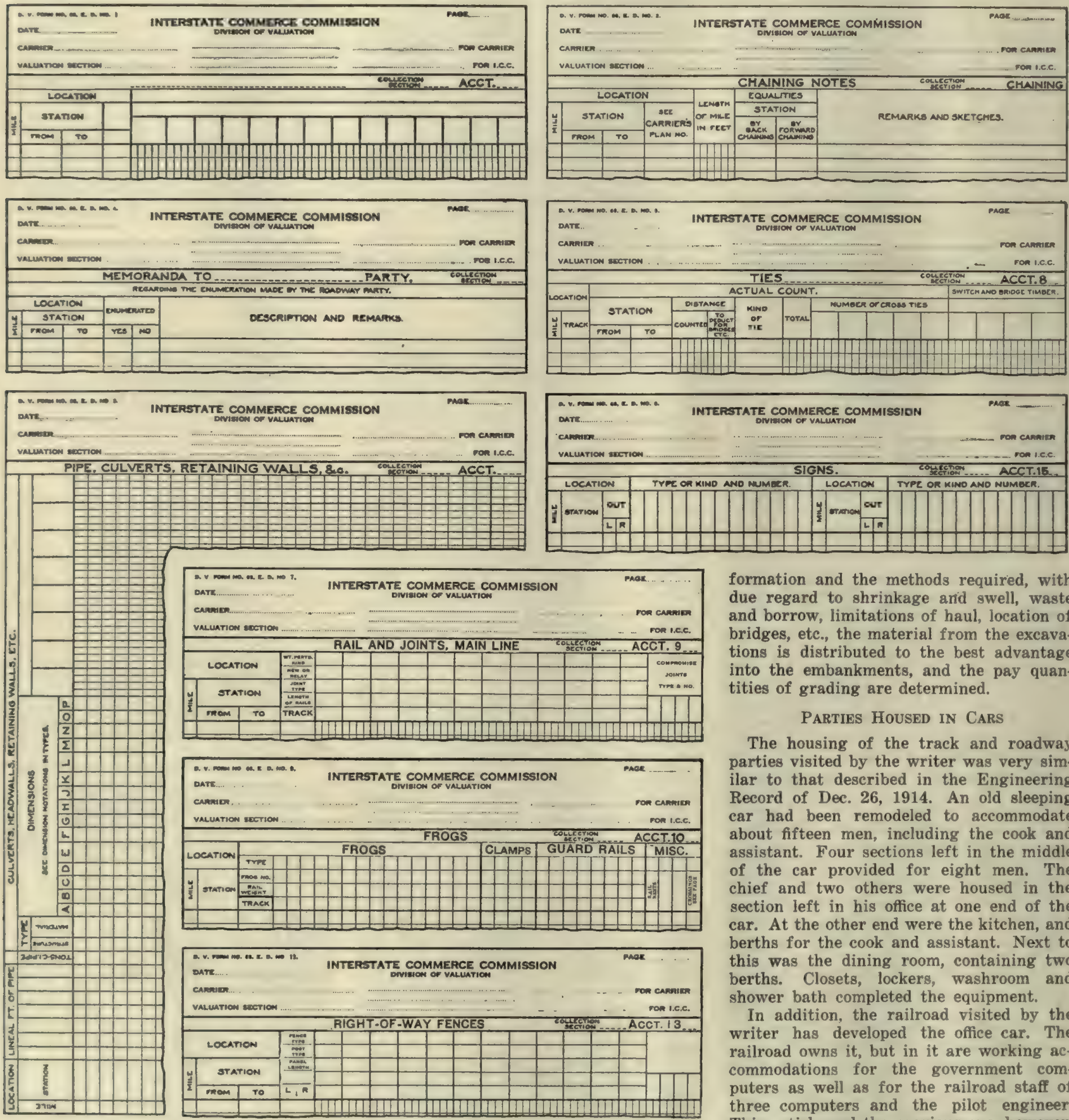
These note forms are ultimately $8\frac{1}{2}$ x 11 in. The original and the carbon are made in one sheet, the original folded over the carbon on a line of perforations at the right-hand edge. On the bottom sheet (carbon copy) is an extra, detachable margin of $1\frac{1}{4}$ in., with holes for binding in the original field book, so that the recorder can readily transfer his sheets and carbon paper in the field. When these notes are turned in the extra margin is torn off, and other holes in both original and carbon permit binding separately. The original sheets are ruled in green and the carbons in red. Each sheet, it will be noted, has blank spaces for the signature of both the carrier's and the government's representative.

The recorder has all of his forms, with a day's supply of blank sheets, fastened in a binder. The sheets for each I. C. C. account are separated by wire clips. The inventory by accounts ordinarily requires handling about fifteen forms. He must, for instance, have three separate forms for culverts, since they may be classified under I. C. C. accounts 3A, 6A or 15A according to their purpose. In addition he has standard blank note sheets, ruled 10 x 10 or 5 x 5, also with carbons, for special sketches. At the back he has his type sheets with thumbnail indexes. He also carries a pocket type,

a folding rule and a tally register. His equipment is cumbersome for cold or windy weather, but it is difficult to see how it could be simplified. When one of the chainmen is assisting the notes are divided.

As the inventory and cross-section notes are completed they are turned over to the computers in the office car, and computed and summarized. Ties are figured from a count by the recorder of two 600-ft. stretches in each mile. Linear feet and tonnage for each rail weight are computed from the survey stations and pluses. Joints are figured from the rail lengths. Types are recorded by symbols.

One feature of the notes transmitted to the Eastern District office at Washington is the volume diagram prepared by the roadway party for the use of the district office in determining the pay quantities of grading. After the cross-section areas have been determined, with or without platting, according as they are simple four-point sections or more complex, they are used as the ordinates and the linear distances between the cross-sections as the abscissas in constructing this diagram, which is platted on "Plate A" profile paper. The areas representing volume are platted above the selected base line for excavations and below the base line for embankments. Subdivisions of the total volumes on account of classified materials, borrow, waste, quantities chargeable to other accounts, etc., are indicated by interior lines on the diagram showing the partial volumes. The diagram is then planimetered for volumes in the field office, as are all quantities of grading to whatever account chargeable, and all available information which may influence the determination of pay quantities is shown thereon.



THESE AND OTHER SELF-EXPLANATORY NOTE FORMS SIMPLIFY RECORDER'S TASK

In the district office the diagram is taken in hand and from a careful study of the information and the methods required, with due regard to shrinkage and swell, waste and borrow, limitations of haul, location of bridges, etc., the material from the excavations is distributed to the best advantage into the embankments, and the pay quantities of grading are determined.

Parties Housed in Cars

The housing of the track and roadway parties visited by the writer was very similar to that described in the Engineering Record of Dec. 26, 1914. An old sleeping car had been remodeled to accommodate about fifteen men, including the cook and assistant. Four sections left in the middle of the car provided for eight men. The chief and two others were housed in the section left in his office at one end of the car. At the other end were the kitchen, and berths for the cook and assistant. Next to this was the dining room, containing two berths. Closets, lockers, washroom and shower bath completed the equipment.

In addition, the railroad visited by the writer has developed the office car. The railroad owns it, but in it are working accommodations for the government computers as well as for the railroad staff of three computers and the pilot engineer. This article and the previous one, however, have been confined to what the government is doing in the valuation work. What some of the railroads are doing will be the basis for other articles.

The two cars, living and office, are kept as near the work as practicable. The work visited by the writer was on a single-track line on flat country. At times the three groups were miles apart, and each group was able to cover a number of miles each day. Consequently it was futile to attempt to follow them too closely with the cars.

Arbitration by Engineers Saves Time and Money in Sewer-Valuation Case

Board of Three Members Reaches Unanimous Decision at Hanover, Pa., in Six Weeks, Eliminating Necessity of Retrial

By FARLEY GANNETT
Consulting Engineer, Harrisburg, Pa.

AFTER valuations by viewers and common pleas jury, and reversal by the State Supreme Court, the valuation for purchase of the plant, property and business of the Hanover Sewer Company at Hanover, Pa., was set on Feb. 28, 1916, by three engineer arbitrators, from the unanimous decision of whom it was agreed no appeal would be allowed. This case was brought previous to the formation of the Public Service Commission; otherwise it would have come before that body.

The borough of Hanover, with a population of 7057 in 1910, determined in 1913 to purchase the sewer system and disposal plant, built in 1902-1903 and owned by the Hanover Sewer Company. Viewers were appointed, as prescribed by the Act of 1901, and their report placed a value of $75,000 on the property. The Hanover Sewer Company and the borough of Hanover both appealed from this finding and the case came for trial in the Common Pleas Court of York County in March, 1914. As a result of this trial the jury placed a valuation on the property and business of the company of $119,454.54.

CASE IS APPEALED

From this verdict the borough of Hanover appealed, and on Oct. 4, 1915, the State Supreme Court upheld the appeal and reversed the judgment, ordering a retrial. The Supreme Court held as follows:

> In the present case the defendant company was undoubtedly entitled to compensation for the value of its business as a going concern and for whatever its franchise could actually be shown to be worth. But it must be remembered that it had no perpetual privilege, and permission to operate was granted to it only under the express provisions of the statute which empowered the municipality to become at any time the owner of the sewerage system and to take over the property of the company by paying the actual value at the time of taking. The sewer company had the right to carry on its business in the borough only until such time as the municipality chose to exercise its right of purchase. It is difficult to see how there could be any appreciable amount of value in such a determinable franchise as that. The company must be regarded as having accepted the privilege of constructing and operating a sewer system upon the condition that it would sell that system and the property used in connection therewith to the municipality for its fair and reasonable value, at the time when the municipality should see fit to take it over.

The court also stated that "if the going value of a concern is to be fixed, in part, by including losses in operation, then a premium may be placed upon poor judgment, misfortune or bad management. The greater the loss the greater would be the value of the plant. Such a theory cannot be accepted as sound."

Following the order for a new trial the two parties to the controversy agreed to have three engineers set the value of the property and business of the Hanover Sewer Company, stipulating that there must be a unanimous report, in which case there would be no appeal.

The company and the borough appointed their representatives in Dec., 1915, and the third member was selected by these two on Jan. 15, 1916. The board of arbitrators was composed of Alfred E. Forstall of New York, Farley Gannett of Harrisburg, Pa., and Ezra B. Whitman of Baltimore, Md.

The board met first at Hanover on Jan. 26, 1916, took some testimony on points which were not made clear by the evidence given at the trial, and inspected the town and disposal works.

After several meetings the board of arbitrators on Feb. 28, 1916, agreed upon a valuation, based principally on the evidence presented at the common pleas trial, of $85,400, plus $4587.85, being the amount expended for extensions since the original trial.

The board of arbitrators found that the original cost of the property, partly actual and partly estimated, was $67,600. The reproduction cost was placed at $79,630 and depreciation at $7,580, giving a reproduction less depreciation value of $72,100.

The award of the arbitrators is $13,300 in excess of the reproduction less depreciation cost, and $17,800 more than the original cost. Both of these costs include allowances, over and above inventory cost, for engineering, contingencies, organization, administration and interest during construction.

DECISION IN SIX WEEKS

Had this case not been arbitrated the retrial would probably have been held in the March term of 1916, when the entire case would have been reopened and all the old testimony presented again. If either side were dissatisfied with the verdict appeal could have been taken and several more years might have elapsed before final adjudication was reached. By the method employed a final decision was reached about two months after the two arbitrators were appointed, and in six weeks after the third was selected. The cost was undoubtedly far less by this procedure than it would have been had retrial been resorted to.

The sewer company constructed its plant 14 years ago, and to-day about one-third of the houses on its lines are connected to the sewers. For many years the revenues were so small as to require the borrowing of money to pay bond interest, and in this way a large accumulated deficit was formed, represented by outstanding notes for about $50,000. The existence of this note issue to cover annual deficits doubtless influenced the jury in making its award of $119,454.54. A sewer connection is not so essential as a water supply tap, especially in a limestone region, where a privy pit dug almost anywhere will carry off sewage. Thus, while the water utility in such a town may be successful, in the absence of an ordinance or state mandate to require sewer connections, a sewer utility may languish.

In 1913 the rates were raised by the sewer company, nearly doubling the earlier rates, and since that time a much better financial showing has been made. Some connections were lost as a result of the increase in rates, but the rate of increase of new attachments was, after the first loss, nearly as high as with the lower schedule. The attorneys for the borough claimed that had the suit for condemnation of the plant not been pending the reduction in consumers would have been greater. The probabilities are that for the last several years the new consumers added have been confined more or less to newly-erected houses.

The following tabulation gives a good idea of the proceedings gone through and the various awards and decisions:

Tribunal	Award	Date	Appeal
Viewers	$75,000.00	October, 1913	By both sides
Common Pleas Court Jury.	119,454.54	March, 1914	By borough
Supreme Court	New trial ordered	Oct. 4, 1915	
Arbitrators ..	$85,400.00*	Feb. 28, 1916	No appeal by terms of agreement

*$4,587.85 to be added for work done since first trial.

There is no desire to suggest that engineers replace the courts and public service commissions in setting the values of public utilities, but it is desirable to illustrate the advantages derived in this particular case, which may apply to other similar cases. The arbitrators in the Hanover case had the decision of the Supreme Court to guide them legally; otherwise it would not have been so practicable a method of procedure. They also had the benefit of the printed testimony given at the court trial.

ANOTHER CASE

The writer had a quite different experience in another arbitration case involving a dispute for extras between a city and a contractor on a large concrete intercepting sewer. In that case the board of arbitrators was composed of a contractor, an engineer and a banker. The two parties agreed to accept the decision of this board without appeal, and it was necessary to take complete testimony under court rules and to hear arguments of attorneys. On account of the difficulty of arranging dates to suit attorneys and arbitrators the case dragged for 18 months and proved costly for expert witnesses, lawyers and arbitrators.

The writer believes that for purely technical cases, where important legal points are not involved, and if appeal is prevented by agreement, arbitration by engineers will save time and money, particularly if the board of arbitrators is permitted to direct the case, arrange sittings and limit discussion and argument. It is also believed that in such instances as the Hanover sewer case, where the law is clearly defined by previous trial and Supreme Court decision, final settlement of valuation by engineer arbitrators, where the jurisdiction of public service commissions does not apply, will usually give satisfactory results.

Unit Stresses in Design of Brooklyn-Brighton Viaduct, Cleveland

An error was made in the description of the design of the Brooklyn-Brighton viaduct in the issue of June 24, page 833, in stating that the beams and columns were designed in accordance with the values allowed in the Cleveland building code. Instead, the unit stresses were based upon formulas as given in the proposed revised form of this building code adopted by the committee on revision, but not formally accepted and passed as part of the Cleveland code.

Give Skin-Friction Data on Shaft Sinking in Chicago

DATA on skin friction encountered in sinking shafts in Chicago to connect to the separate water pipe and conduit tunnel at LaSalle Street paralleling the street railway tunnel under the Chicago River have recently become available, although the work was completed several years ago. The shafts are 10 ft. in internal diameter and about 98 ft. deep below street grade. At the north end the shaft was located on the east side of the street within 2 ft. of the footing course of a seven-story building, and the west side abutted against the piling of the old abandoned tunnel. To protect the building the shaft was started with a 25-ft. length of ⅜-in. steel shell 11½ ft. in diameter, made up of 5-ft. sections, field-riveted to the portions already sunk. Butt joints were used on the outside face and the rivets were countersunk. The shelf of the shoe was made up of a ½ x 9-in. plate, set back 12 in. from the cutting edge. The caisson was supported by four 1½-in. rods, which passed through the shelf and were held at the top by timbers laid across the opening. A single 9-in. ring of brick was built on the shelf and carried up to the top as the shell was lowered.

It required a loading of about 200 tons to start the shell when 15 ft. of its length was in bearing against the clay. The weight was made up as follows: Shell, 12 tons; brickwork, 28 tons; pig iron, 52 tons, and sandbags, about 108 tons. The rate of movement was 10 ft. in four days, and when once started the shell kept moving without additional loading. The material was soft blue clay, and the skin friction based on these weights is 740 lb. per square foot at the start and 440 lb. per square foot when the full 25-ft. length was in bearing and the shell in motion. The classes of material encountered were as follows: Soft blue clay, — 16 to — 31; hard picking clay, — 31 to — 61; hardpan, — 61 to — 75; hardpan and boulders, — 75 to — 85; sand, below — 85; rock usually found at — 90 to — 92.

Below the steel shell the shaft was excavated in 5-ft. sections. The brick walls were increased to 16 in. and supported from the shoe of the caisson by seven 1-in. hanger rods passing through the shelf and carrying at the lower end 10 x 10½-in. plates upon which the brickwork rested. Under the supporting plates 6-in. sleeve nuts were used in place of ordinary nuts and furnished means of adding to the rods after excavating the succeeding sections. To provide additional bearing and take some of the load from the hanger rods, about every 3 ft. in depth two courses of brick were set back into a 4-in. rabbet excavated in the clay.

In sinking the shafts and driving the tunnel it was desirable not to penetrate the sand which overlies the rock, as this usually carries water. Soundings made before the final depth planned for the shafts was reached showed that sand was about a foot higher than anticipated. The grades of tunnel and shaft bottoms were accordingly raised sufficiently to keep out of the sand.

Coke Production

The coke made in the United States in 1915 amounted to 41,581,150 short tons, an increase, as compared with 1914, of 7,025,236 tons, and within 5,000,000 tons of the record output of 1913, according to the U. S. Geological Survey.

U. S. R. S. Project Manager's Duties Defined

Numerous Accomplishments Necessary Include Those of Financier, Diplomat, Engineer and Lawyer

IN AN OUTLINE of the diversified duties of the project manager in the U. S. Reclamation Service D. W. Cole, in the July *Reclamation Record*, indicates that engineers who aspire to these offices will find the "outside" accomplishments quite as necessary as those taught in college. Mr. Cole classifies the duties into engineering, superintending, inspecting, judicial, diplomatic, advisory, fiscal, formal and clerical.

As an Engineer

In his engineering capacity the project manager strives in his way to become that ideal engineer who scientifically organizes, correlates, unifies and directs the efforts of mankind through the forces of nature for the greatest efficiency in the accomplishment of human happiness. Specifically for his project this engineer prepares or supervises the preparation of plans, specifications and estimates for carrying on all construction work, either by contract or by his administration forces.

As a superintendent he organizes and controls the force of "water masters," "canal riders," foremen and laborers—with teams and machinery as required—for the operation and maintenance of the irrigation and drainage systems.

His inspection duties include the examination and approval or rejection of all work in progress, whether done by contract or "force account," as well as the review of irrigation and farming practices which come within his influence for progressive efficiency.

Judicially he holds his little quasi-court for considering and passing upon the innumerable small questions of law and regulations which govern the relations between the Reclamation Service and its constituents, the "water users."

As a Diplomat

The dexterity and finesse of the accomplished diplomat are needful to a project manager who essays the settlement of disputes over water. A man may be a reputable Christian gentleman and still be a "water hog." But the qualities of tactful negotiator must carry the project manager beyond the petty squabbles of irrigators into the field where necessarily conflicting interests must be reconciled in the form of contracts for settlement of permanent water rights, boundaries of lands, definition of privileges, and values of property in general.

His advisory function includes, on the one hand, both the spoken and written aid and comfort to his widespread community of water users, on all conceivable subjects, and, on the other hand, his conferences and reports in which he discusses with government officers all the policies and practices of the complex community life in its relations to the construction, operation of and payment for the irrigation system.

As a Fiscal Agent

As a fiscal representative of the government he is charged with knowledge of and responsibility for the funds allotted to his project. He must specify and supervise purchases, guard expenditures, secure collections, scrutinize all money transactions, certify payrolls, execute contracts, examine the balance sheet and approve all vouchers in advance of payment.

As a clerk, recorder, statistician and historian of project affairs the manager completes his round of duties and finds scope for any remaining energy in his soul.

While the activities suggested in the foregoing outline might be supposed to occupy his time, the manager, moreover, must find time at frequent intervals to entertain official or casual visitors, escort distinguished guests over the project, attend public meetings for giving account of his stewardship to water users or to explain to public bodies the policies, plans or accomplishments of the government; to serve on committees or boards of directors for conducting county affairs, municipal celebrations or state functions, or merely sit in his office and look pleasant while being interviewed or appealed to by reporters, farmers, agents, promoters, investigators or just plain cranks armed with letters of introduction.

Combines Engineering and Business Courses

To Meet Demand for Technically Trained Managers in Manufacturing, Public Utility and Sales Lines

FOR SOME YEARS the College of Applied Science of the University of Iowa has offered a general engineering course four years in length for men who might wish to go into contracting rather than into technical engineering work. A number of men have taken the course, and have done well as contracting engineers. On account of the demand for managers in manufacturing, public-utility, municipal and sales lines, where a combination of technical and business training is advantageous, two new courses have been established. Instruction in them will be begun next September. One combines business with chemistry and the other business with engineering.

A considerable number of electives in engineering subjects is permitted, so that the student may specialize in whatever phase of engineering interests him most—the mechanical, the electrical or the civil field.

The subjects taught and the time allotment to them are given in the following table:

COMBINED COURSE IN ENGINEERING AND BUSINESS

	Hr.
GENERAL SUBJECTS:	
Mathematics	10
Chemistry	8
Metallurgy	6
Physics	12
English	10
Municipal government	3
Electives	12
Total number of hours in general subjects.	**61**
ENGINEERING SUBJECTS:	
Engineering drawing	5
Surveying	3
Mechanical engineering	5
Electrical engineering	6
Approved electives	23
Total number of hours in engineering	**42**
BUSINESS SUBJECTS:	
Elements of economics	3
Elementary accounting	3
Accounting practice	3
Economic geography	2
Raw materials of commerce	2
Labor problems	2
Business efficiency	3
Business organization	3
Business law	2
Commercial law	2
Approved electives	8
Total number of hours in commerce courses	**33**
Total number of hours required for the degree	136

Instrument Plots Profiles of River and Harbor Beds

First of Three Hydrographic Instruments Devised by Argentine Engineer Is Mounted on Boat and Records Soundings Automatically

THREE devices have been developed by Agustin Mercau, an engineer of the Argentine Republic, which have greatly facilitated hydrographic work undertaken by him in that country. The first of these, named the Profilograph, will take a profile of harbor beds, river bottoms, etc., under conditions of weather that would make sounding operations impossible. This article will deal with the Profilograph. His Autophanograph, which maps the route traversed by a boat, and his registering hydrometer will be described subsequently.

The Profilograph

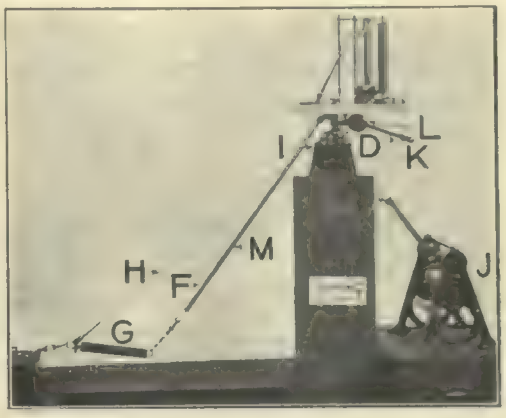
For taking profiles the Profilograph is installed in the bow of a boat, in its symmetrical plane. The depths are obtained by recording on a roll of paper the sines of the angles that a bar, movable about a horizontal axle, describes. This bar is guided by a light steel wire of constant length, held at tension by means of a weight constantly above the bottom, which is dragged along according to the movement of the boat.

A simple rigid bar is substituted for the wire when the apparatus is used as a tide gage, or is operated in small depths. In the first case, the apparatus is fixed, and the free extremity of the bar is equipped with an attached float. In the second case, it is made to slide above a prescribed horizontal. Due to the variations of the level of the water or to the irregularities of the bottom, the bar will describe variable angles with respect to the horizontal. The sines of these are the depths that it is desired to record, referred to the horizontal plane that passes by the axis of rotation of the bar.

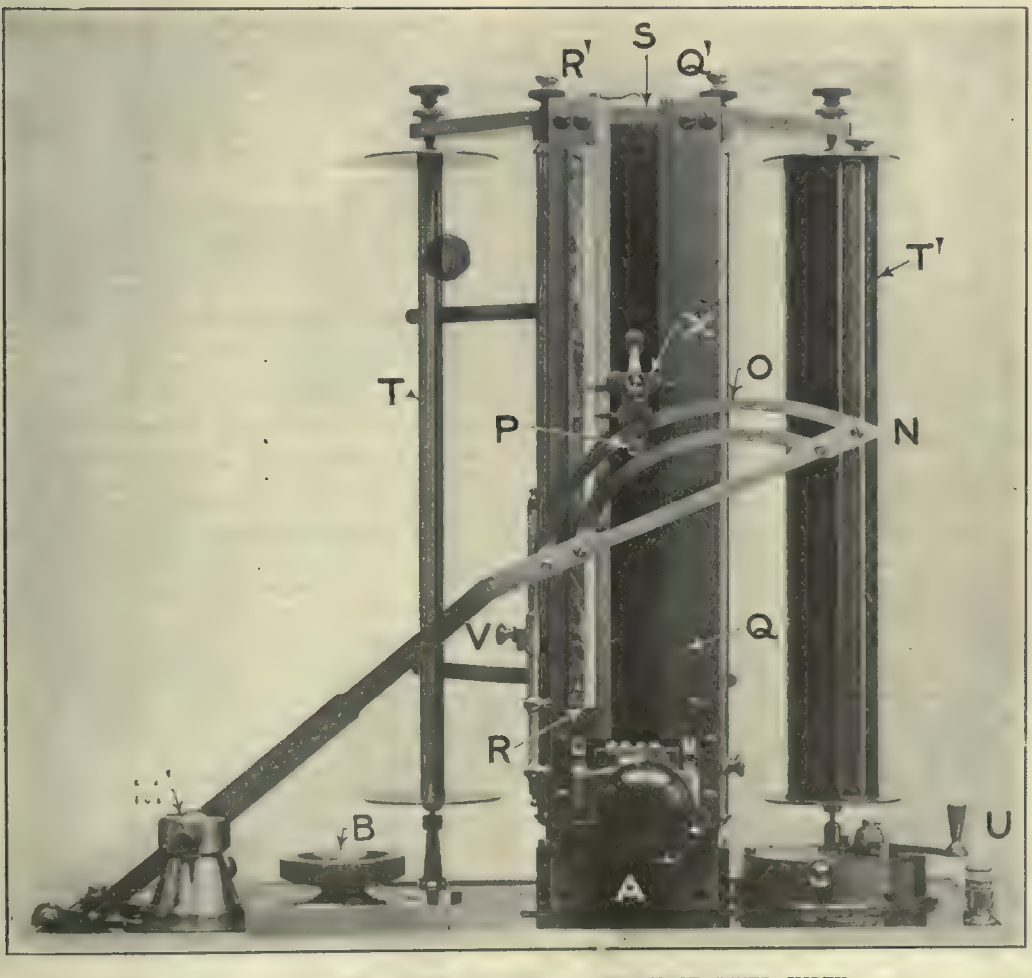
Pencil Sketches Profile

In all cases, the bar designated in the accompanying illustration by the letter *M* moves, by a simple arrangement, a shorter bar (*M'N'*, Fig. 2)that carries on its free end a curved guide (*O*) of determined equation. This moves about a pencil that is also movable, by means of a small swivel that slides guided by the uprights *QQ'* and *RR'*. The shorter bar transforms the angular movement of the long bar in another straight line, proportional in length to the sines of the angles described by it. The pencil (*P*) is moved above a band of paper that passes constantly before an upright plane, which is placed in movement by a clock-work mechanism contained in the box *U*, which makes it pass, on the cylinder, from *T* to *T'*.

The pencil sketches in this manner a continuous line that represents a profile of the bottom. The vertical scale of the diagram so obtained depends on the relations between the point of application of the weights, the axle and the full length of the small bar. In dealing with a profile, the horizontal scale is deduced by establishing the relation between the distance between two points or successive tops and the distance covered by the boat. This is on the supposition that the speed of movement of the paper as well as that of the boat will be constant. Such conditions are attainable by practice. The clock-work mechanism is provided with features that assure the uniformity of its movement. Warning is given when its power is diminishing by a small bell that is actuated by electric contacts. In order to have a line of reference for the diagram, another pencil is fixed on one of the vertical uprights. This travels a straight line horizontally on the paper.



THE PROFILOGRAPH



DIRECT READING MAY BE OBTAINED BY MEANS OF FIXED INDEX

Important Points Can Be Marked on Diagram

An automatic numerator permits the recording of each important point in successive numbers.

A metal scale, fixed on the upright *RR*, permits the direct reading of the depth by means of an index that is connected to the swivel that moves the pencil *P*.

The apparatus can be turned about on the vertical axis, thus making it possible to correct the deviations of the boat with respect to the line, by means of the screws indicated by the letter *D*. The wire (*F*) is united to the balancing weight by means of a steel spring (*G*) that permits the graduation of its tension up to the limit that is desired. This is effected by means of a steel cable (*H*) of greater section, called the cable of security, which is likewise united to the weight, and which, after passing by the pole of direction (*L*), can be manipulated gradually by the small winch (*J*). The weight is of old chain of large mesh.

Tension Put on Cable by Winch

To give the wire the length and tension desired, for on the length of it the vertical scale of the diagram depends, a length of cable is laid out by means of the winch (*J*) so measured that the sum of its length and two-thirds of the length of the arresting weight will be proportionate to the scale that is desired. An equal length of the steel wire is let out at the same time. When the cable of security has been completely unrolled, and is fixed in place by screws to the small cylinder (*L*) a slight tension is put on it by turning the handle *K*. Then, by the same means, a further tension is added until a certain quantity of stress is produced, equal to that of the spring *G*, which is the maximum tension to which it is desired to submit the wire.

In this manner, and because the resistance to the dragging of a much greater weight, the wire remains submitted to a constant tension that can in no case be exceeded, since to do so would break it. The speed of movement should not exceed 6½ ft. per second in order to avoid having the weight raised by virtue of water resistance, and thus have an appreciable influence on the wire and alter, by such means, the indications of the apparatus.

Signs Keep Up Water Standard

All through the purification plant of the Terre Haute Water Company are such signs as "Purity First" and "Keep Up the Standard." Three shifts of operators keep the efficiency of the plant high.

Etching Test to Detect Steel in Wrought-Iron Pipe

Simple and Time-Saving Method for Preparing and Examining Specimens Requires No Special Technique for Satisfactory Results

AN ETCHING test believed to possess many advantages has recently been recommended as an aid in detecting the presence of steel in wrought-iron pipe. While it may be used in detecting steel in any of the commercial shapes of wrought iron, it is particularly suitable for the investigation of iron pipe, in which the presence of steel is a serious factor, since it affects the life of the pipe to a material degree.

The detection of steel by means of picric acid etching and a microscopic examination requires the preparation of a metallographic specimen, and is a tedious operation, involving the expenditure of considerable time and the exercising of great care. Even when the wrought iron contains a large percentage of steel, the steel contents will often be missed, as there is nothing to indicate where the metallographic specimen should be prepared for microscopic examination.

Locating Areas of Steel

The following etching test has been recommended because it eliminates this uncertainty and insures success in discovering any steel which might be mixed with the iron. No claim is made that it is in itself a conclusive test, but it does show up the areas most likely to contain steel, thereby eliminating the necessity for further search and enabling the investigator to proceed at once with the more elaborate preparation of the specimen for microscopic examination.

The procedure is as follows: Three or four sample rings, 2 or 3 in. long, are cut, preferably from different pieces of pipe or from different points on the same length of pipe. The rings are submerged, one at a time, in a solution consisting (by volume) of 25 per cent hydrochloric acid, 1.19 specific gravity; 25 per cent sulphuric acid, 1.84 specific gravity, and 50 per cent water.

After being left in the solution about one minute, the samples are rinsed in cold water and then with alcohol. Both ends of each sample are then examined for bright streaks, which are an indication of steel. An examination of the surface of the metal will not, as a rule, it is pointed out, show steel, as steel scrap is usually inserted in the middle layers of the fagot so as to prevent it from coming to the surface of the finished pipe. If no suspicious-looking streaks are found in the first ring etched, additional rings can be tried. Three or four rings will usually reveal the steel scrap, especially if rings cut from different pieces of pipe are available.

Testing for Steel

A flat should now be filed on the outside of the ring suspected of containing steel where the steel, according to the end indications, is most likely to be found. Filing should be stopped when the suspected steel band or bands are half filed away, or when their maximum surface is exposed. It is not necessary to polish the surface to be examined. The flat should now be etched, proceeding in the same manner as for the etching of the ends, keeping the sample in the solution one minute or as much longer as is necessary to bring out the steel bands in strongest relief. If it is desired to keep the etched surface from fading, it should be covered with white shellac or some other suitable non-acid coating.

If any doubt exists as to whether or not the bright streaks shown on the etched surface are steel, the surface should be polished to the highest possible mirror finish, free from scratches, etched with a 5-per cent solution of picric acid and alcohol, and examined by means of the microscope.

Summing up briefly, the advantages claimed for the above test are: (1) It eliminates much of the uncertainty incident to the use of the picric acid test alone; (2) it saves time in the preparation of the test specimens and in the examination of the etched surface, and (3) it requires only easily obtained materials and no special technique to make a satisfactory test.

This test is recommended and used by the A. M. Byers Company of Pittsburgh, manufacturer of wrought-iron pipe.

Indicate Latin-American Engineering Opportunities

Possibilities in South American Countries Brought Out at Conferences at Massachusetts Institute of Technology

WITH a large ratio of foreigners in its student body, and realizing the greatness of the opportunity that exists for American capital and American engineers in South America, the Technology Christian Association of the Massachusetts Institute of Technology, three years ago, initiated a series of conferences for the purpose of acquainting those in attendance with conditions and the possibilities in South American countries. The speakers, all South Americans, have been men already technically trained who have gone to the institute for the purpose of fitting themselves by advanced work for engineering service in the southern continent. Hardly any important country in South America has not been represented.

Survey of Continents Needed

At one of these conferences Antonio R. Guimaraes of Rio Preto, Brazil, spoke on some of the opportunities of Brazil. He outlined the enormous size of the country, and discussed the lack of surveys. The continent is practically unexplored except for comparatively small areas, and the first essential for all the countries is a survey on the lines of those conducted in the United States by the Geological Survey. In Brazil surveys have been sporadic, as the industries needed them. In the Argentine there is a very expensive work under way by the military engineers.

Next in importance in the country is the extension of the railways. These are in much the same condition as those of the United States were in 1860. There are in Brazil about 14,000 miles, and they penetrate no farther relatively than Cleveland, Ohio, into a country 200,000 square miles larger than the United States. Areas are enormous, the rubber districts being 400 miles from the end of the railway, which itself extends inland 1400 miles from the coast.

One of the great possibilities in South America lies in water-power development. Here there is an enormous opportunity, generally, however, far distant from civilization.

Mr. Guimaraes spoke also of the irrigation possibilities, and stated that in point of canals Holland is likely to be outdone by the mountain portion of Brazil. Here the aborigines had very extensive plants for irrigation, and these may be put into commission once more. Everywhere in the country there is opportunity for electric lighting and power engineering. His own city, according to the speaker, had a decade ago about 75,000 population, but now figures 450,000.

Pedro P. Pizzorno of Manaos, Brazil, made special reference to the climate of the country. It is exceedingly varied, since the republic extends from 2 deg. north to 32 deg. south of the equator. Brazil has been forward in sanitary matters. Yellow fever has been practically exterminated. The swamps have been treated so that malaria has decreased, and the grade of sanitation is quite on a par with that of the northern part of the hemisphere.

Land Reclamation Important in Peru

With reference to Peru, V. F. Checa of Piura called attention to the fact that when Pizarro came to the country there were about 80,000 natives who cultivated 250,000 acres, while the land in cultivation to-day is only a fraction of this amount. Reclaiming of land in Peru will vie with mining development as the important engineering work of the future.

In Chile the government offers engineering education free to its young men, and seeks to keep them in the country. The railway system totals about 4000 miles, and is owned and managed by the government.

Bolivian Mines

C. E. Atwood, an electrical engineer who has spent five years in South America, stated that its development is proceeding rapidly and that there is now opportunity for important work.

He also stated that the Bolivian mines have rich outputs, but much of the valuable metal is in small quantity, being low-grade ore. It is necessary to reduce this on the ground with imported machinery and export the refined product. There is a lack on the west coast of sources of power. There is no coal, little oil, and the water power is far removed. A large portion of the latter is in underground streams.

A young man without capital should get from business men, generally heads of commercial firms in New York, special information with reference to the different opportunities. The inexperienced man who lands in South America without letters may have some difficulty, but at all events a very varied engineering experience. As an electrical engineer Mr. Atwood went up into the country and found it necessary to do mechanical and hydraulic engineering work as well, as the exigencies of his position, far from outside resources, made these different demands on him. Salaries are large, but the cost of living is high.

In giving advice to any men thinking about starting for South America, Mr. Atwood said that Spanish is necessary in most places, but the language is easy. The North American should go south of the equator. Smallpox and typhoid are fairly common.

Fuel Briquet Production

According to the annual statement of the U. S. Geological Survey on fuel briquetting in 1915, now available for distribution, the production during the year was 221,537 short tons, valued at $1,035,716.

CRIBS WERE PLACED WITH GREAT ACCURACY ON DRAGGED BOTTOM

Concrete and Timber Cribs Accurately Placed for Vancouver Wharf

I-Beam Drag Levels Foundation for Dominion Government Pier, the Outer Walls of Which Are Made Up of 100 x 30-Foot Concrete and Timber Cribs

By R. MACKAY FRIPP
Vancouver, B. C.

INCLOSING 5½ acres of ground and providing at low water a depth of 35 ft., a wharf the outer wall of which is made up of timber and concrete cribs has recently been built for the Dominion Government at Vancouver, B. C. After the rock excavation for these cribs had been made, the bottom was covered with 2 ft. of broken stone, leveled with an I-beam drag operated from a scow. The cribs sunk on this foundation showed a maximum variation in line of only 3 in. and in grade of only 2 in. The cribs were built to a height of 10 ft. on ways, launched and completed in the water. A floating concrete plant, with a tower and chute, was used in their construction. The water space between the walls has been filled, leveled and rendered immediately available for trackage. The depth of water at low tide is 35 ft. The range of tide is 16 ft. East and west wings or bulkheads are built at the shore and to retain the filling, which is carried up to the tracks of the Canadian Pacific Railway. A grain elevator with 1,250,000 bushels capacity is in course of construction adjoining the shore end of the wharf.

DRILL SCOW EMPLOYED

Operations were commenced by excavating the stiff heavy clay and boulders which overlay the rock bottom, a dipper dredge being used. To deal with the rock a drill scow, 100 x 30 ft., was built and equipped with drill towers, the drills being 34 and 57 ft. in length. Additional weight was given to them by a 4500-lb. backing. The rock is of a conglomerate nature, closely resembling a coarse concrete of water-worn granite stones and cement and makes very hard drilling, the stones constantly breaking out from the matrix and filling up the holes, which, on this account, sometimes had to be drilled two or three times before they could be charged. The rock was taken out in two and in some places three lifts, depending on the depth; but not more than 12 ft. was taken out in any one lift, as it was found impossible to keep the holes jetted clean enough to allow the drills to work freely at a greater depth. Holes were charged with a hollow-tube pipe with a plunger running through it, the charges being fired by a battery. Single holes were sometimes fired, but a whole range 90 ft. in length by 12 ft. deep and 5 ft. wide was usually discharged at one time, yielding, roughly, about 200 cu. yd. at every shot.

The drill scow, which was the first of its type used in these waters, was set on spuds at each corner, and each spud was worked by a separate engine. As the tide rises and falls about one-tenth of a foot every five minutes, the spuds were constantly changed.

After completing the excavation the bed upon which the cribs rest was covered with a 2-ft. layer of broken stone. This was at first leveled by taking soundings with leads, but as the leads usually fell or slid off projecting stones, these projections above the level were not always registered, and the first crib placed upon sounded levels had to be raised. A new and novel method was then adopted. An I-beam was attached to a bridle on a scow, and cables secured to the back of the scow were passed beneath and fastened to the I-beam, which was then dropped to the grade and drawn backward and forward, after the manner of a harrow, until the bottom was rendered perfectly level. The effectiveness of this method is demonstrated by the fact that the greatest variation in the vertical joints of the western line of cribs did not exceed 3 in.; on the eastern line it was only ½ in., and the greatest variation in the levels of the tops of the cribs was only 2 in.

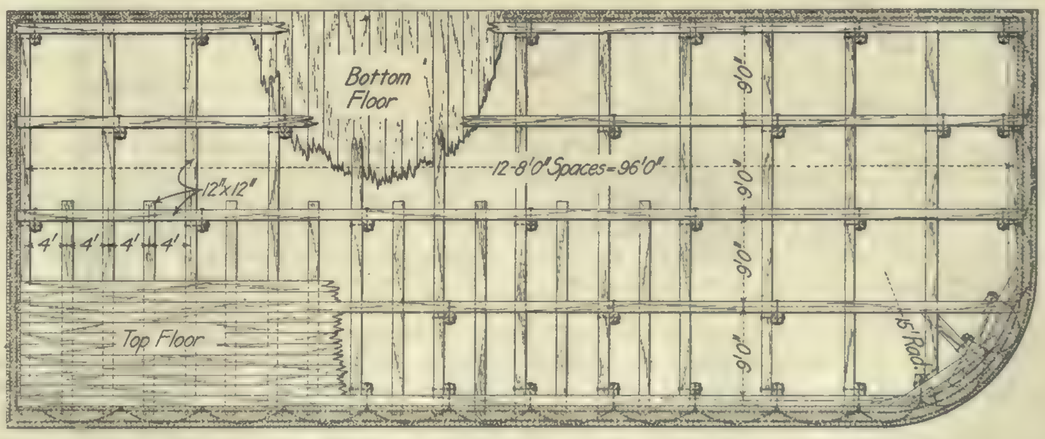
About 60 ft. from the north, or outer, end of the wharf the rock bottom dipped or ran out. It was therefore necessary to excavate to the rock and to fill and pack this space with stone up to the grade. At this point only has there been any settlement whatever, one crib moving outward at the top 2 in. and another 3 in. This settlement, however, occurred during the process of backfilling, when the load was constantly changing; but all settlement ceased when the backfilling was complete and the load became constant.

DETAILS OF CRIB CONSTRUCTION

The construction of the cribs is as follows: A bottom platform was built of 12 x 18-in. fir timbers drifted together with 24-in. drifts at 3-ft. centers. A first course of 12 x 18-in. timbers was drifted to this bottom platform with 24-in. drifts at 3-ft. centers and machine bolts every 5 ft. The remainder of the timbers were drifted with 24-in. drift bolts. Vertical posts were placed at every intersection of longitudinals and cross-ties on the face of the crib and at every alternate intersection in the interior and the back of the crib. These posts were fastened to the longitudinals and cross-ties by machine bolts, nuts and washers. On the face of the crib these bolts were eye-shaped, the eye acting as a fastening for the bent rods of the concrete reinforcement. Cross-ties at 8-ft. centers extended 1 ft. through the face and 6 in. through the back of the crib. Fillers were placed between the cross-ties between the longitudinals, thus forming a solid wall. The longitudinals were set at 9-ft. centers and dovetailed 6 in. through the ends of the cribs. An extra cross-tie placed on the top of the crib made 4-ft. centers for the 12 x 12-in. decking drifted on to these timbers to serve as a foundation for the mass wall.

For launching the cribs, ways were constructed by driving piles at 10-ft. centers longitudinally and 8-ft. centers transversely. These were capped with 12 x 12-in. caps; the stringers were of the same dimension. The ways were 300 ft. in length, 100 ft. wide and given a 6.5-per cent grade. The outer ends of the ways were 1 ft. below low-water mark.

The cribs were built to a height of 10 ft. on a cradle placed at the back of the ways, which were furnished with hauling gear for



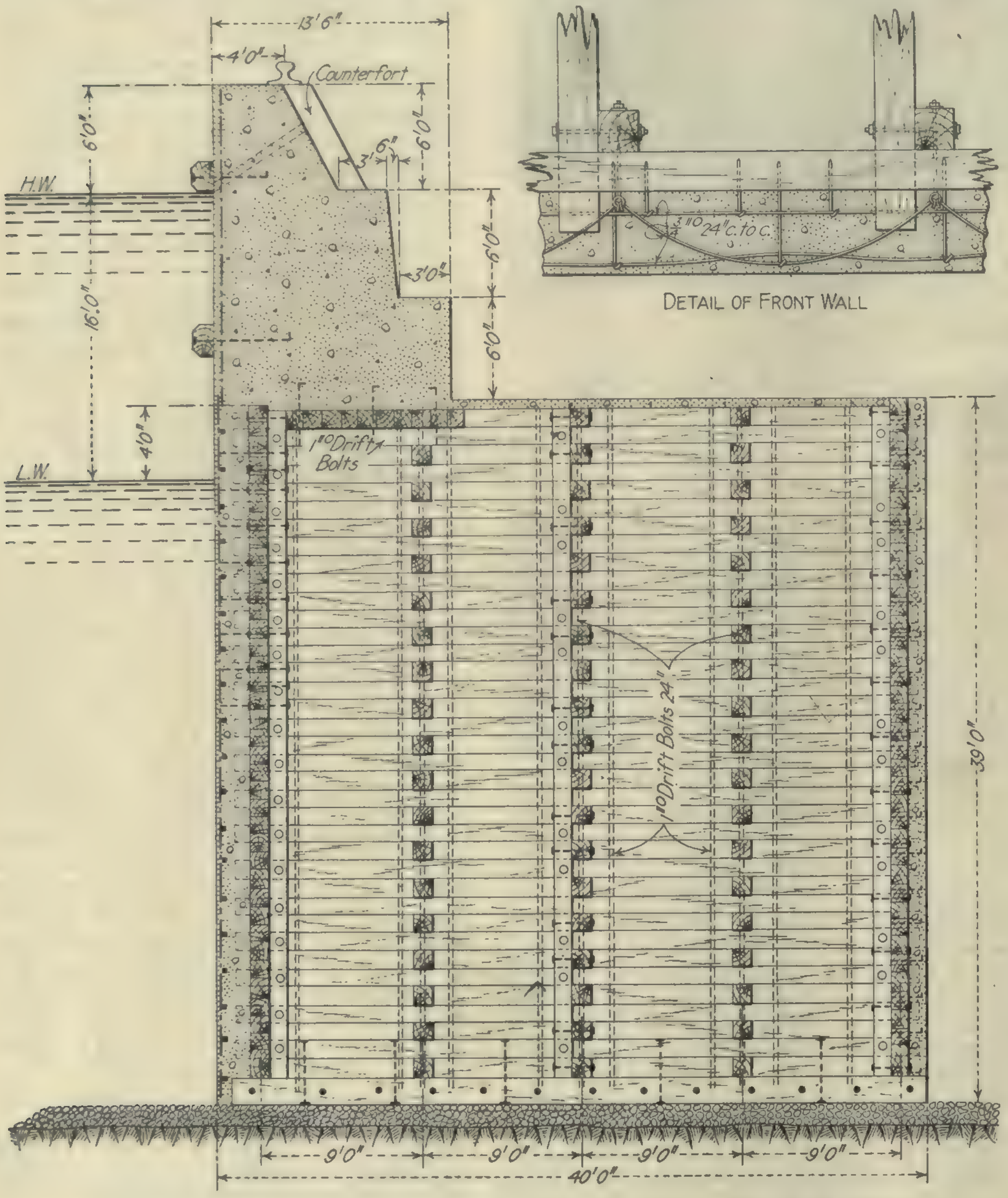
CONCRETE-INCASED CRIBS BUILT WITH ROUND CORNERS AT ANGLES OF WHARF

launching the cribs. The cradle was capable of handling a crib 107 ft. in length. The cribs, after being thoroughly calked and sheathed with concrete, were brought to an even keel by ballast, and when launched drew a little more than 4 ft. 6 in. No difficulty was experienced in launching any of the cribs.

Concrete for sheathing was a 1:3:4 mix, and for the mass walls a 1:3:5 mix. All concreting was done by a floating mixer with a tower and the spouting system, the spouter being used direct on the mass walls. For the sheathing the spout discharged into a hopper and the concrete was distributed thence by buggies.

Material for the backfill, a mixture of sand and clay, was obtained by dredging at various points of the harbor, being clammed into flat scows and reclammed over the wall. The material, of which there was about 400,000 cu. yd., was leveled and kept back from the walls by means of a centrifugal pump with a 10-in. suction and an 8-in. discharge, and was able to handle the dirt to within 6 ft. of grade in the center of the wharf. The fill between the back of the wharf and the Canadian Pacific Railway track was made by cars on tracks, the clamshells discharging into a bunker, beneath which the cars were spotted.

A. W. G. Vassar is the engineer and Henry & McFee & McDonald the contractors.



SOLID CONSTRUCTION SUPPORTS VANCOUVER WHARF WALL AND RETAINS 5-ACRE FILL

New South Wales Irrigators Substantially Assisted

Money Advanced for Building, Planting and Stocking Farms from Two Acres Up—Expert Direction Also Given Settlers

NEW SOUTH WALES furnishes assistance to settlers on its irrigated lands in building homes and farm structures, in purchasing seed, fruit trees and stock, and in actually cultivating the land. The sums advanced may range up to more than $1,500. In addition, expert instruction is furnished to assist the settler in getting the maximum from his holding. In general a cash deposit is required, and repayment may be made on easy terms.

Assistance on Buildings

For the erection of houses on farms of from 2 to 4 acres, assistance is given to the extent of about $875; on farms from 5 to 10 acres, to the extent of $1,275, and on farms of over 10 acres as much as $1,500 may be advanced. Contracts may be made for "type houses," or the settlers may arrange with outside contractors for erection. On the first sum a deposit of 5 per cent is required on the building material when the settler provides all labor. For the second sum, a 10-per cent deposit is required, and for the third the deposit is 15 per cent. Repayments, with interest at 5 per cent, may be spread over either 10 or 12 years. For farm buildings material is supplied on easy terms. A deposit of 5 per cent is required and the conditions are as in the case of residences. The maximum amount of assistance on farm buildings is limited to $125 for farms of 2 to 4 acres, $250 for those of 5 to 10 acres, $385 for 11 to 25-acre farms and $500 for those of over 25 acres. Material to a value of less than $50 must be paid for in cash.

Assistance is given in the matter of fence posts at a rate of $25 per hundred, and for stays and strainers at 50 cents each. A deposit of 5 per cent is required and repayments may cover 10 years. Not less than 100 posts will be supplied on such terms.

Payments may be made for wire netting in periods covering from 12 to 24 months. For seed a deposit of one-third the amount is required and repayments may be spread over two years.

Assistance for Fruit Trees and Stock

Repayments for assistance for fruit trees is limited to one year. The maximum allowable is $150. A deposit of 25 per cent must be made. Repayments are payable in 5 years with interest charged at the rate of 5 per cent. Assistance is given to the extent of $5 per head for cows, and repayments may cover two years from the date of purchase. Allowance is also made for pigs and horses.

Assistance is furnished for cultivation to the extent of from $5 up to $250 per irrigable acre. The work must be carried out by contract. Should a settler desire to live in a cheaper house than that to which he is entitled under the regulations he may obtain additional assistance in his cultivation work. Repayments may be spread over 10 years.

Expert instruction is given settlers with the purpose of helping and guiding them in all branches of their farm work.

Suggests Leaner Grout as Remedy for Expansion Problems

Use of a grout filler less rich in cement than is usual was suggested by D. Moomaw, road engineer of Cuyahoga County, Ohio, as a remedy for one of the causes of expansion which, he asserted, would be present in the construction of monolithic brick pavements of the Paris (Ill.) type. "The greatest amount of expansion is brought about by the swelling of the filler under humidity changes," he declared at the annual meeting of the Ohio Engineering Society held at Columbus recently. "This expansion is in proportion to the amount of cement in the mixture. It will be reduced by reducing the grouting proportions to 1:1½ or 1:2. Since the wearing surface is provided with adequate bottom support, there will be almost an entire absence of vertical shearing stress on the filler, and hence it need not be of as great strength as would be required with a plain sand cushion. Also the regularly specified 1:1 mix for the grout was chiefly in anticipation of the segregation of the sand and cement, the rich mix being provided so that the chances of complete segregation would be less. With the more scientific methods of grouting, this segregation of sand and cement is practically eliminated and a leaner grout will serve equally well, if not better than the old method of mixing the cement and sand in equal portions and drowning it with water."

Subway Columns and Girders Designed to Support Future High Office Building

Heavy Foundation Grillages and Steel Slabs Used in Unusual Subway Construction at Site of Old Grand Union Hotel in New York City

WHERE the new subway construction passes under a corner of the plot at Forty-second Street and Park Avenue, New York City, the site of the old Grand Union Hotel, an unusual design problem was encountered by the engineers of the New York Public Service Commission. Provision had to be made for two conditions of loading on the roof of the subway—for a possible temporary backfill 28 ft. deep and for a future office building, which may be as high as twenty-five stories if of heavy construction, or even higher if of lighter construction.

The subway passes diagonally under one corner of the lot, increasing the difficulty in locating the steel bents for the roof in such a position that the future building columns could be directly supported. Fortunately, the angle between the tracks and the building lines was approximately 45 deg., so that the problem was solved by selecting such column spacing in each direction as would make diagonal lines between columns coincide with subway bents. The bents could thus be given a spacing equal to half the diagonal length between the building columns and these building columns carried directly upon the girders or in a few cases directly by the columns of the steel bents.

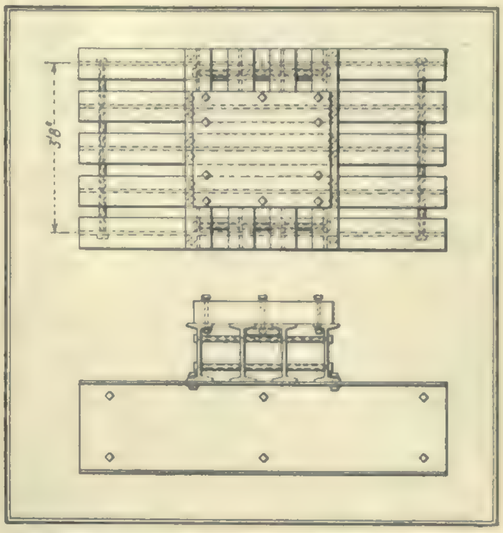
GENERAL LAYOUT

The general plan of the subway track layout at this point has already been described in the Engineering Record of Aug. 28, 1915, page 255, in the article illustrating the construction methods used in connecting the new work to the old tunnel. The accompanying plan of the corner of the Grand Union Hotel lot indicates the position of subway bents, columns and grillages. The building columns are to be spaced 20 ft. 7 in. on centers parallel to Forty-second Street and 21 ft. 6 in. on centers parallel to Park Avenue. The half diagonal length between columns in the direction of the subways is thus nearly 15 ft., a very convenient distance between subway bents, giving three 5-ft. panels for the side-wall beams.

As shown on the accompanying plan view, the building columns are carried at various points of the transverse bents of the subway structure, requiring a separate design for the girders of each bent, owing to the varying relative position of the columns above and below the girders, the lower columns being spaced according to the clearance requirements for the four tracks of the subway.

ASSUMED DESIGN LOADS

In addition to the dead load of the structure itself, the cross girders of the bents were designed for two possible cases of loading. Case 1, as noted on the accompanying drawing of a typical bent, D27, provides for a future office building which may be at least twenty-five stories high. Case 2, for bents D25 to D30, provides for a temporary backfill 28 ft. deep assumed at

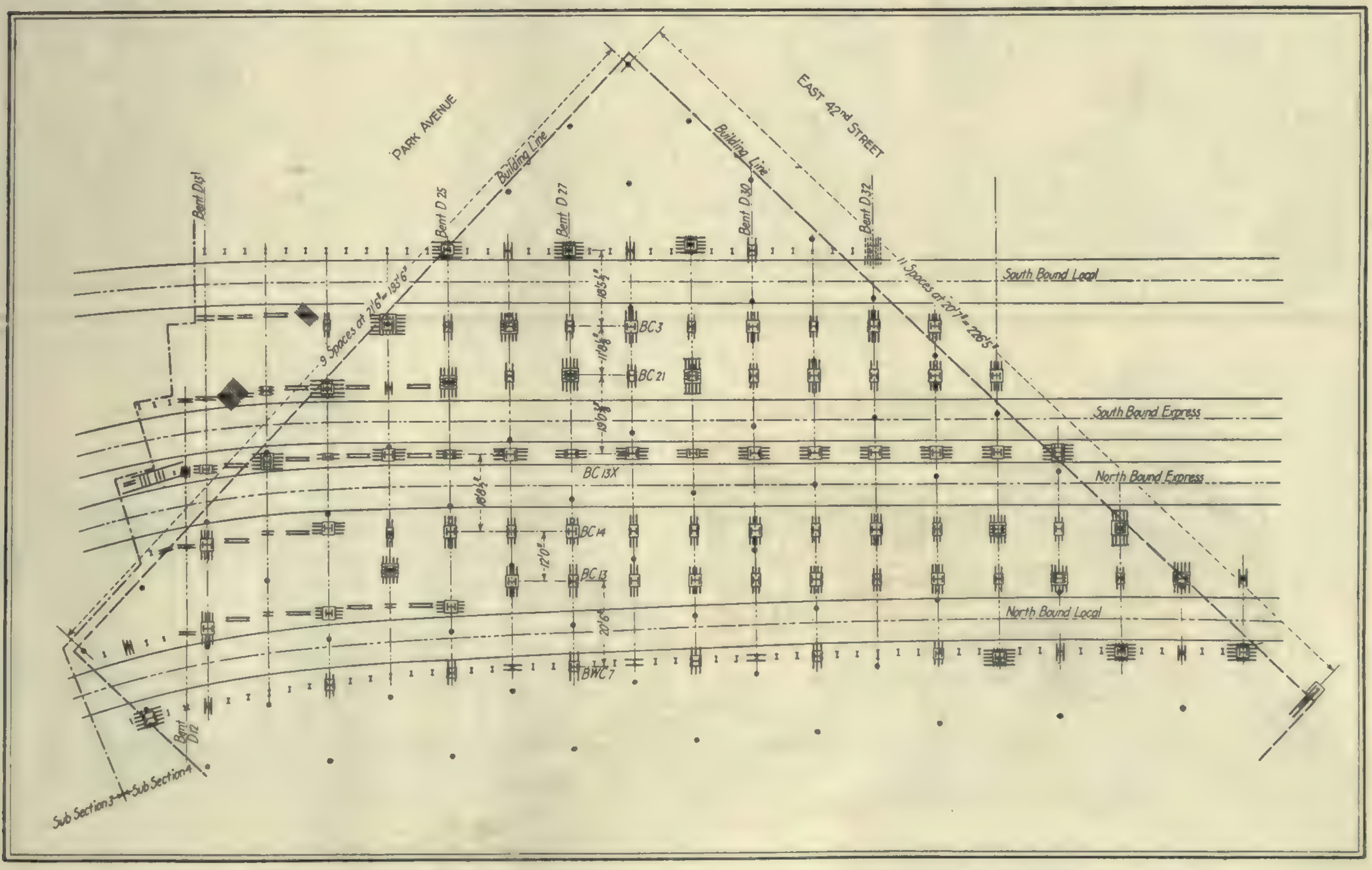


TYPICAL DETAILS OF COLUMN GRILLAGE

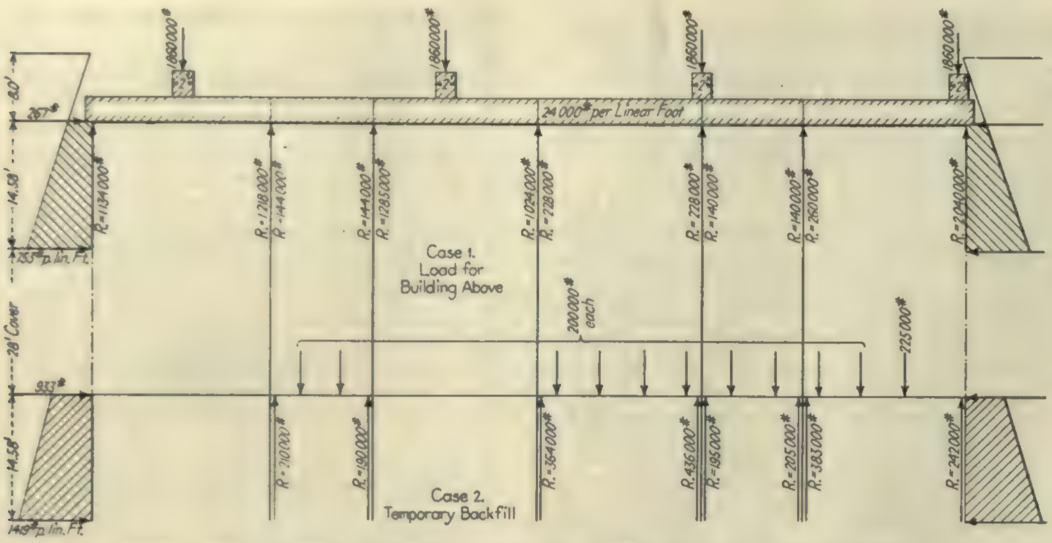
100 lb. per cu. ft., giving a uniform loading on the subway roof of 2800 lb. per sq. ft., amounting to 200,000-lb. concentrations at the connections of the longitudinal beams spaced on 5-ft. centers, as noted.

In providing for the future office building (assumed to be designed according to the New York building code before the recent revision) the average dead load per floor was taken at 125 lb. per sq. ft., including the weight of partitions and columns. This dead load with the prescribed percentages of the specified live loads will give the total column concentrations of 1,860,000 lb. for interior columns, as noted on the drawing. The exterior column loads are 2,134,000 lb. for the columns along Park Avenue and 2,082,000 lb. along Forty-second Street, the weight of outside walls increasing the load carried by these columns.

In addition to the column concentrations, provision is made in Case 1 for a direct



FOUNDATION PLAN OF GRILLAGES FOR SUBWAY COLUMNS INDICATES THE LOCATION OF FUTURE BUILDING COLUMNS



TWO CASES ASSUMED IN DESIGN OF BENTS—LOADS GIVEN FOR TYPICAL BENT

basement load or basement load and fill varying, according to the depth of the latter, from 500 to 1200 lb. per sq. ft. The load of 24,000 lb. per linear ft. on bent D27 is a combination of this load and the weight of the subway roof.

Typical Bent Details

The accompanying detail drawing of a typical bent, D27, indicates the heavy framing, columns and foundation grillages required in this construction. The concrete piers, specified to be carried down to sound rock, in some cases where a seam of jointed rock was encountered had to be made deeper than is indicated by the drawings. Grillages are the usual steel I-beam type, embedded in concrete.

Heavy steel slabs under the columns transfer loads to the grillage beams, and it will be noted that in some cases the top of the column carries heavy steel slabs to receive the future building columns. The sizes of steel slabs specified are based upon rolled or sawed edges, and it is provided that if they are sheared hot, 1 in. must be added to the dimensions each way to secure the net bearing required.

The depths of the cross girders vary, as is shown on the drawing, those girders carrying building columns near their centers being increased in depth for economy.

The design was made by the engineering staff of the New York Public Service Commission for the First District, of which Alfred Craven is chief engineer; Robert Ridgway, engineer of subway construction; D. L. Turner, deputy engineer of subway construction; Sverre Dahm, principal assistant engineer; A. I. Raisman, senior designing engineer, and C. E. Conover, designing engineer in direct charge. The steel was fabricated by the American Bridge Company, subcontractor for the Rapid Transit Subway Construction Company, contractor.

Crooked Highways Straightened

When the present highway department of King County, Washington, was organized and plans for conducting its work were laid out, it was decided to relocate certain crooked roads which had developed, little by little, as the territory had built up. It was found possible to effect a considerable amount of grade and curvature reduction by modern location methods. The old road between Auburn and Enumclaw, a distance of 18 miles, was found to have a maximum grade of 12 per cent. By relocating this line a distance of 4 miles was saved and the new line replaced a grade ¾ mile long in which there had been a total of 2000 deg. of curvature. The relocated line on this grade had only 250 deg. of curvature. South of Seattle the old main road to Auburn has been relocated, and in a distance of 3½ miles the total curvature is being reduced from 1650 to 450 deg. The line is being shortened by ½ mile.

Stoplog Barrier Regulates Romanov Canal

Intake at Main Diversion Channel of Russian Irrigation System in Eastern Turkestan Requires No Dam

By LOUIS ROSS
Civil Engineer, San Francisco

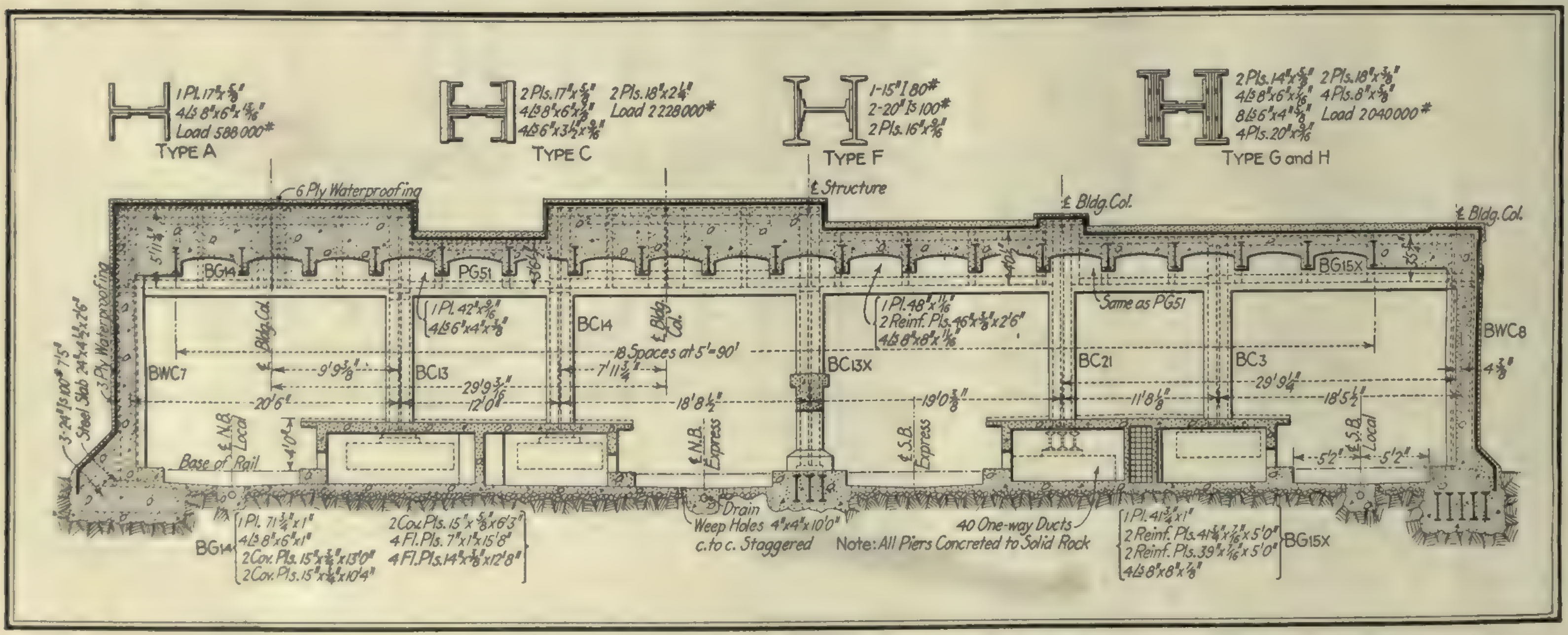
A STOPLOG barrier regulates the intake of the Romanov irrigation canal in eastern Turkestan, keeping out silt by admitting surface water only. The stoplogs are operated by a winch, handled under normal conditions by one laborer. A feature of the works is that no dam was required.

The Romanov canal is the main diversion channel of the irrigation system now being built by the Russian Government to supply water to Hungry Desert in eastern Turkestan from the River Syr-Daria. The canal is now being constructed for a capacity of 1700 sec.-ft., and is to provide water for the first unit of 130,000 acres; but provision is made for enlarging to a canal capacity of 4000 or 5000 sec.-ft. and supplying 400,000 acres. In working out the design the irrigation of the entire 2,000,000-acre area of the desert has also been considered as an ultimate possibility.

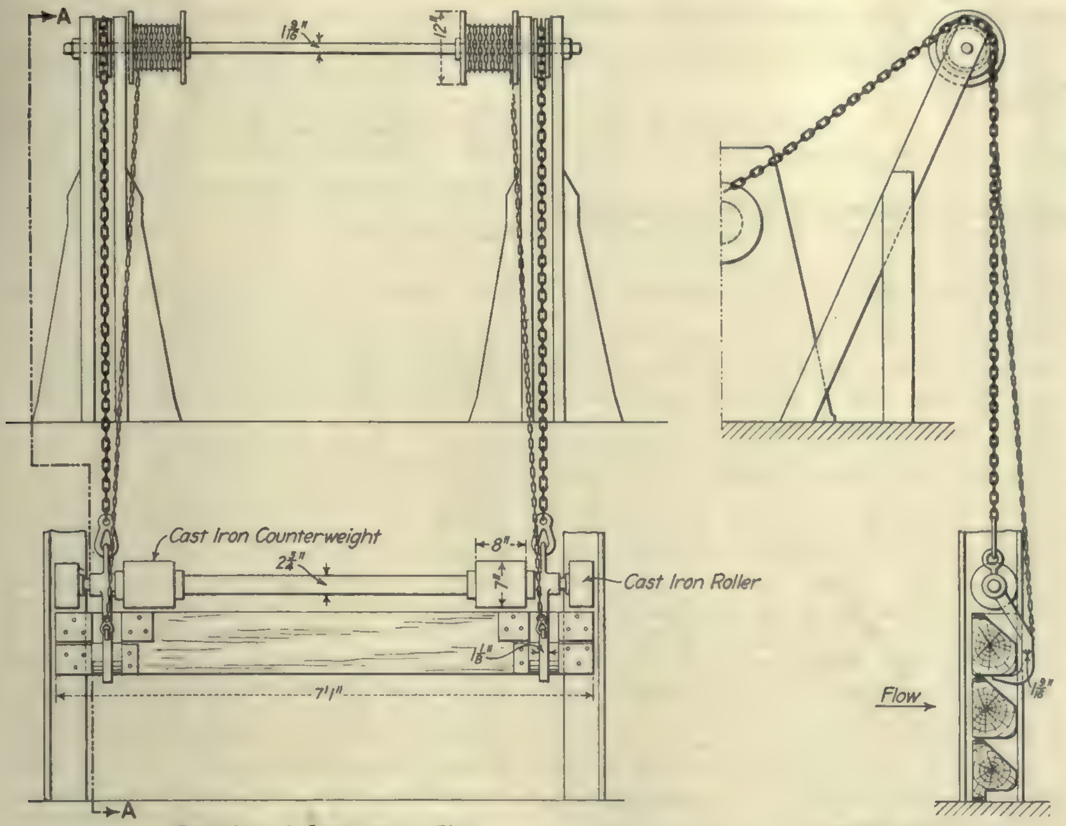
Water Diverted Without a Dam

A peculiar feature of the project is that water is diverted from the river without the use of any dam or other obstruction to the stream. The Department of Agricultural Improvements rejected plans for a dam in 1897 because of the storm of protests and doubts which the suggestion evoked, and after some deliberation it was decided to construct the intake in such a way that the water supply would be constant, independent of any diversion structure. Accordingly, the headworks are located at a point where the shores and bottom of the river consist of a substantial conglomerate not liable to serious washouts, and the sill of the intake was placed 8 ft. below the lowest water level on record.

The headworks, which consist of a granite structure founded on concrete, parallel the direction of the current for a length of 200 ft. and have fifteen arched openings for admitting water to the canal. These openings, each with an area of about 6½x9 ft., are separated by 3½-ft. piers. The masonry work, which is built of the best cut granite.



DETAILS OF TYPICAL BENT D27 SUPPORTING BASEMENT LOADING AND COLUMNS FOR TWENTY-FIVE STORY BUILDING



Elevation of Downstream Side Section A-A

WEIGHTED HOOKS FOR GRAPPLING STOPLOGS

has a total height of 30 ft. above the sills, so that there is no danger of river freshets overflowing into the canal at this point. The accompanying section of the headworks shows the massive type of construction adopted and the recorded water-level fluctuations.

DEVICES FOR CONTROLLING FLOW

Owing to the large amount of silt carried by the Syr-Daria, and in order to reduce scour effects, a stoplog barrier was used so that only surface water was admitted to the canal. These stoplogs are 7 x 10 in. in section, 7 ft. long, and are braced against metal-lined guides. Behind the stoplogs, closure of the canal opening is effected by iron sluice gates sliding on cast-iron guides. A means of dissipating the kinetic energy of the inflowing water was provided by a second set of stoplogs, placed in the canal behind the metal sluice gates so as to retain a volume of water to act as a cushion.

The stoplogs nearest the river were located as close to the metal gate valve as possible, so as to reduce the cost of piers and to permit a combination of operating mechanisms. These stoplogs are handled by the hand winch shown in the sectional view, which is equipped with a pair of chains and grabhooks, as shown in the detail drawing. The combined friction and weight of water on each stoplog requires a maximum lifting force of 2300 lb., and the winch was designed on this basis. To assist in lowering the stoplogs and properly to space and direct the grabhooks, an iron bar or spreader is attached to the low ends of the chains and is provided with iron cylinders, which bring the total weight of the unit being lowered up to 400 lb. When lowering the stoplogs, if there is any tendency to catch or stick, the chains are repeatedly drawn taut and then suddenly released so that the weighted bar strikes light blows on the stoplog, tending to force it downward. The ends of the stoplogs are shod with iron to minimize friction and to provide a firm hold for the hooks. The 45-deg. chamfer is to guide the hooks so that they will engage properly.

The winch is designed to be operated by one laborer, but when the metal weights are used to strike blows on the stoplogs in lowering, four laborers are required. The windlass is also arranged for operating a trash rack which normally rests on top of the stoplogs. The metal sluice gate is also operated with the winch by means of a wormgear and brass nut. The stoplogs retaining the water cushion are handled by a grabhook device similar to that already described, but operated by a wormgear.

HEADWORKS TESTED

The headworks were first tested out in September, 1913, and up to March, 1914, the mechanism is reported to have operated very satisfactorily, with no trouble from silt or drift. It is to be noted that this design is similar to that introduced by the United States Reclamation Service on the Laguna dam, but in that case the depth of water was only 9 ft., against the 22-ft. height in the present instance.

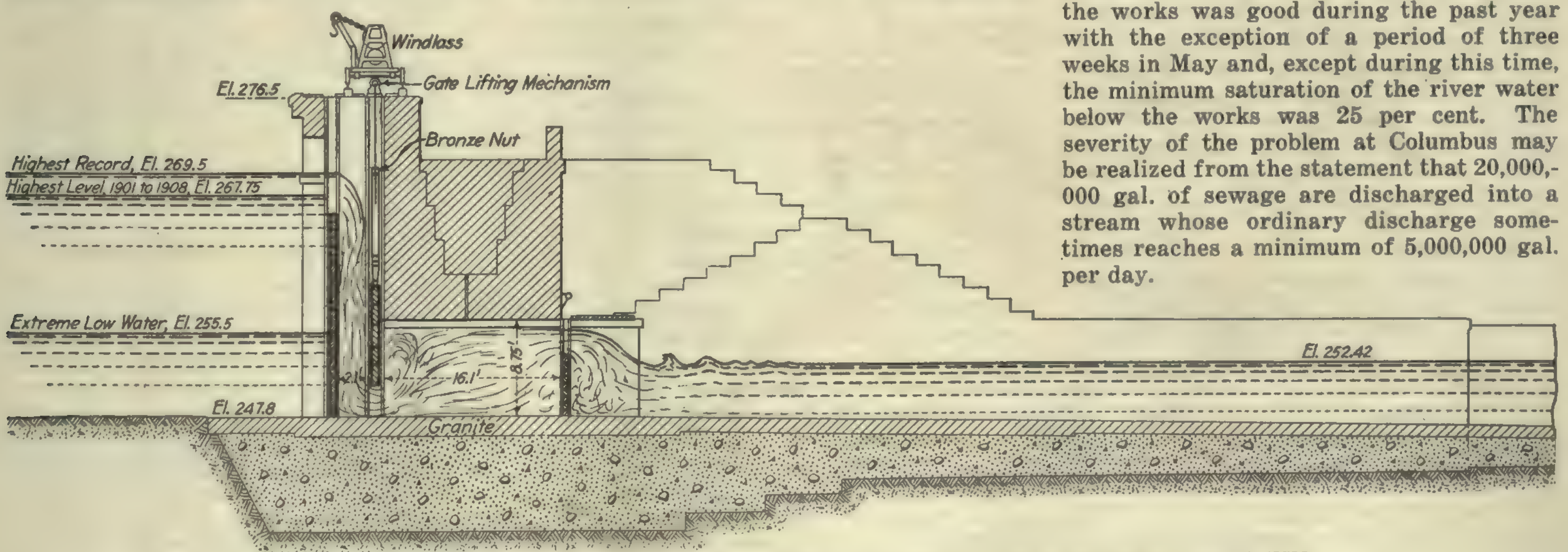
The headworks on the Romanov canal were designed by A. Kursish, civil engineer, Tashkent, Asiatic Russia, from whose report this description has been translated and condensed.

River Inspection Real Test of Sewage Treatment

The purpose of the sewage treatment plant at Columbus, Ohio, is to keep the Scioto River in a reasonably clean condition. To obtain data on this point the scope of the river inspection work has been constantly enlarged during the last four years. The two prime considerations in river inspection work, according to C. B. Hoover, chemist in charge, are as follows: The results of the inspection constitute a record of the existing conditions, and the possibility of the correlation of stream data and analytical data on the treated sewage whereby the sufficiency of the treatment may be predetermined.

In 1912 the temperature and dissolved oxygen of the river water were taken at various points. The amount of the per cent of saturation with oxygen was computed. Gradually the amount of data taken was increased. In 1915 eight additional observations and determinations were made as follows: Dissolved oxygen consumed after one day at 37 deg. C.; presence of odor, color, gasification, floating material, sludge deposits; development of odor in river water after incubation for two days at 37 deg. C.; stability value by methylene blue test of river water at 37 deg. C.

The condition of the Scioto River below the works was good during the past year with the exception of a period of three weeks in May and, except during this time, the minimum saturation of the river water below the works was 25 per cent. The severity of the problem at Columbus may be realized from the statement that 20,000,000 gal. of sewage are discharged into a stream whose ordinary discharge sometimes reaches a minimum of 5,000,000 gal. per day.



SECTION THROUGH ROMANOV CANAL HEADWORKS, SHOWING POSITION OF THE GATE-LIFTING MECHANISM

Literature

For the Civil Engineer and Contractor

New Publications

PORT OF SEATTLE COMMISSION. Fourth Annual Report. Year Ending Dec. 31, 1915. Paper, 6 x 9¼ in.; 93 pages; illustrated. Seattle, Wash., Mechanics Publishing Company.

Reports of traffic manager, chief engineer, auditor and counsel, which include a general review of the work of the commission in the completion and operation of extensive port improvements recently put in service, together with cost data on the structures, financial statistics and a tabulation showing the extent of Seattle's water trade.

DAVID DUBOSE GAILLARD—A MEMORIAL. Compiled and published by the Third U. S. Volunteer Engineers. 6 x 9 in.; 188 pages; 4 illustrations. St. Louis, Third U. S. Volunteer Engineers.

This memorial volume is published by the Third U. S. Volunteer Engineers in memory of Colonel Gaillard, who was their regimental commander during the Spanish-American War. It contains a sketch of Colonel Gaillard's life and tributes to him as a soldier and as an engineer. There are many quotations from various newspapers and magazines published on the occasion of Colonel Gaillard's death.

Books Reviewed

Value for Rate-Making

Author, the late Henry Floy, A.B., M.A., M.E., consulting engineer. Cloth, 6 x 9¼ in.; 322 pages; 4 figures; 16 tables. New York, McGraw-Hill Book Company, Inc. $4 net.

REVIEWED BY C. W. STARK

Associate Editor, Engineering Record

In his new book on value for rate-making Henry Floy, who barely lived to see his work off the press, has made an important contribution to valuation literature. Writers on valuation divide into two classes, according to their views of the relation of utility and public, and the two classes disagree as to the very axioms of valuation. The tenets of the one class—the state-commission side, the agency-theory side—have been ably set forth in book form within a year. As for the other class, which holds, as the reviewer does, that honest investment in public utilities must be protected, even though the public has to pay more for service, many experts have convincingly expounded its principles in societies, conferences and monographs, but to comparatively small audiences. Mr. Floy's new work, however, is the first book presenting this side of the argument that has come to the reviewer's attention since the publication, four years ago, of his earlier work, "The Valuation of Public Utility Properties"; and valuation history has been made in the last four years. The new book should have a wide sale.

Three principles are set forth in the preface, and these three show clearly the author's point of view. They are (1) that fair present value should govern, (2) that theoretical depreciation should be ignored and (3) that certain intangibles should be allowed. His first chapter is introductory and his second is devoted to definitions, which are in general excellent. In chapter 3 he takes up the fundamentals of valuation, and here he offers those of the other school ample opportunity to disagree with him. Yet the pages are replete with extracts from legal decisions in support of his views. This whole chapter of 27 pages is so meaty that it is useless to attempt to summarize it. Suffice it to say that it is based on the three principles referred to.

Chapter 4, "Fair Value for Rate-Making," is not so good. The author has explained in his preface that much matter originally prepared for other purposes has been used, and this chapter gives evidence of it. At the very start there is a half-page repetition of a passage from a court decision already quoted in chapter 3, and there are other evidences of neglect to co-ordinate this chapter with other parts of the book. There is, however, plenty of good logic in the chapter. One point urged by the author is that for efficiency in the utility there must be incentive in the way of a possibility of attractive profits.

Chapter 5 discusses reproduction cost, and leaves little to be desired—first presenting the arguments for reproduction cost new and then going into the inventory, unit prices, contractor's profit, engineering, contingencies, interest and other important details. The chapter includes a page summary of the elements of reproduction cost.

The grouping of subjects in chapters 6 and 7 is somewhat unusual. They are respectively "Land, Paving and Water Rights" and "Franchises, Working Capital and Discount," and together occupy 45 pages. Land is dismissed very briefly, the less important subject of paving is given about the same amount of space, while water rights are discussed at considerable length. Working capital is also given rather more space than appears necessary to set forth its importance.

Going value is the subject of chapter 8, and the author devotes 58 pages to it. He points out the confusion surrounding this term and discusses four meanings that have been given to it. His interpretation of it is what he calls the "comparative plant" method, which makes the figure an estimate of what it would cost to build up the business and revenue of a new plant to that of the existing plant, and not a capitalization of actual past deficits. As he says, the method is strictly a reproduction method. The reviewer is in full accord with his interpretation of the term. While at first glance it may seem that this denies recognition of actual investment, that is a reasonable investor's risk.

The final chapter is on depreciation. In his 76 pages the author applies himself mainly to his argument against any deduction from the rate base for accrued depreciation, and his arguments are sound and complete. He leaves to others the discussion of fine-spun theories for calculating such accrued depreciation, touching but lightly on the straight-line and sinking-fund methods and not mentioning the equal-annual-payment method at all—an omission that the reviewer can hardly regard as a serious one. He does, however, present a few tables that may be useful in depreciation calculations, which, of course, for the determination of depreciation reserves, have to be made as accurately as possible, considering the uncertainties of life lengths and interest rates.

All through the book is a good presentation of the utility side of the valuation controversy—not rabid, but fair. As previously suggested, those who are definitely of the other school will disagree with the author's axioms. To neutrals, however, if there are any, and to those of the Engineering Record's faith, the volume is heartily recommended.

Hydraulics

Author, R. L. Daugherty, assistant professor of hydraulics, Sibley College, Cornell University. Cloth, 6 x 9 in.; 267 pages; 245 illustrations. New York, McGraw-Hill Book Company, Inc. $2.50.

REVIEWED BY A. G. HILLBERG

Civil and Hydraulic Engineer, New York City.

This book has been prepared for students required to study, in a general way, the subject of hydraulics and to serve as a foundation for those who intend to specialize in this branch of engineering. It therefore only "scratches the surface," and a number of important questions have been left out. On the other hand, matters of fundamental importance are explained in a thorough manner, giving the student a rational understanding of the subject. In the preface the author states that "this work has been prepared primarily to meet the needs of his classes."

The book is divided into sixteen chapters, well illustrated by diagrams, line cuts and halftones. In the chapter dealing with dams, only a few of the prevailing types are mentioned. The information conveys in a general way the principles underlying the design of gravity, framed, arched and earth dams. The use of flashboards is explained.

The application of the Kutter and Bazin formulas to other than open channels is not mentioned. In the Bazin formula the coefficients of roughness given are unfamiliar, but after having studied the matter it appears that the author has multiplied the well-known coefficients, given by Bazin, by 1.811. This deviation from well-established and well-known values tends to cause confusion.

For R, the hydraulic radius, the author substitutes m, which is the French practice and not customary in other countries.

Hydraulic machinery, such as waterwheels and centrifugal pumps, takes up about 100 pages. The theory is explained briefly, and for more extended treatment the student is referred to "Hydraulic Turbines" and "Centrifugal Pumps," two books written by the same author whose text is now under review.

The book is clearly written, and will serve admirably the purpose for which it has been published. Its value as a text and reference book for engineers, however, is doubtful, but, according to the author, the book has not been written for that class of readers.

Flood Building to Save Floors

Recent high water in the Mississippi seeped under the levee at Bettendorf, Iowa, and started to force up a 40 x 80-ft. reinforced-concrete floor of the two-story brick paint shop of the Bettendorf Company. The head was 6 ft. and the toe of the dike was 8 ft. away from the building, which rested on a slag fill. When the floor began to bow up in the middle two carloads of lead and pig iron were piled on it without effect, and to save the floor the shop was flooded to equalize the pressure.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Relation Between Yield Point and Proportional Limit

SIR: I have read with interest the discussion of "elastic limit," "proportional limit" and "yield point," in your issue of July 15, page 78. "Proportional limit" is the adaptation of "elastic limit" to practical testing, just as "yield point" was adopted years ago for the same purpose, and with identical meaning. They will continue to be indicated in practical testing by "drop of beam."

If the term "yield point" appears vague it is because it has not been understood. This, I believe, was originally "made in Germany," and its general acceptance here has simplified and clarified practical specifications. HENRY B. SEAMAN.

New York.

High Velocity in Large Hydraulic Dredges

SIR: I note Mr. Massey's letter on the subject of "High Velocity in Large Hydraulic Dredges," published in the Engineering Record of June 17, 1916, page 810, and I trust that you will permit me to trespass a little further on your time and that of your readers.

The basis of the design of the pumping unit and pipe line of a dredge should be the character of the material, the rate at which it is to be handled and the distance to which it must be pumped. These points having been settled, we may proceed with the design, and if a well-balanced unit is to result the disadvantages as well as the advantages of a small-diameter pipe line must be considered. The data for the Toronto project are not given.

Detailed published experiments on the transportation of filter sand through pipes up to 4-in. diameter indicate that when a certain velocity is exceeded, in this case something less than 5 ft., there is no greater tendency for the sand to settle to the bottom in long pipes than in short ones. A study of such published and unpublished data as the writer has been able to obtain leads to the conclusion that there will be no tendency for sand to separate in a 20-in. dredge pipe with a 10-ft. velocity or in a 34-in. dredge pipe with a 12-ft. velocity, regardless of the length of the pipe. In all dredging operations some gravel or larger stones must be provided for, and these will settle to the bottom within a few feet of the pump, after which they may be heard to bound along the pipe at a lively rate. Judging by the sound, there is no increase in the material transported in this manner as the distance from the pump increases.

It is conceded that a higher percentage of solids can be carried with a 16-ft. velocity through a 24-in. pipe than could be carried with a 14-ft. velocity through a 27-in. pipe; but if the power required to transport the yardage through the 24-in. pipe were applied to the 27-in. pipe, the increase in volume of mixture would more than offset the loss in per cent of solids, and the yardage that could be carried by the latter would greatly exceed that carried by the former.

Taking the capacity in cubic yards per hour of a 24-in. pipe with a 16-ft. velocity as the basis, we should have the following comparison:

Advantages of a 27-In. Over a 24-In. Pipe—1. A decrease in the first cost of boilers, engine and pump.

2. A decrease in fuel bills.

3. A decrease in wear and tear on the pump.

4. A decrease in the pipe-line pressure. (In the case of the Cyclone and Tornado the usual rubber sleeves have been replaced by ball-and-socket joints. High pressures will always require stronger construction, offsetting to some extent the saving due to smaller diameter.)

Advantages of a 24-In. Over a 27-In. Pipe—5. Greater ease of handling shore pipe. (The writer has talked to several men who have had experience in handling 27-in. shore pipe, and they are unanimous in saying that there is no especial difficulty in this respect.)

6. Lower first cost of pipe line.

The writer's statement in regard to pump efficiency should have been taken literally. For slow speeds a more efficient dredge pump can be designed for a low head than for a high head. E. J. DENT,

Major, Corps of Engineers, U. S. Army.

Little Rock, Ark.

Brush-and-Stone Jetties Prove Effective

SIR: Attention is called to the very interesting paper by W. I. Risley, in your issue of June 24, on the protective works on Absecon Island which so successfully protected the portions of the beach where the hooked jetties were placed. He has given a full description of their form and cost, but has, apparently inadvertently, failed to mention that the plans which were applied were those secured by letters patent issued to the writer and were used after conference with him as consulting engineer and for which a royalty was paid by the city of Ventnor. This statement is made merely to remove the conclusion, logical from the description, that these forms are public property. They have resulted from an extended research into the intricacies of the various systems in vogue for this class of work, and which have not given entire satisfaction, or have, as stated in the article, cut off access to the beach for bathers, thus destroying one of the chief attractions of the seaside resorts.

The writer does not indorse some modifications which have been added to the "hooked jetties," in the form of the lateral spurs. They tend to check the shoreward drift of the sand and to create gullies and dangerous obstacles to bathers at high tides. Nor does he always consider stone-and-brush filling as essential, since some of the jetties built on exposed beaches at Atlantic City and Far Rockaway, composed of two rows of stockade piles, 6 ft. apart, and merely braced transversely at the upper stringers, have not only forced the low-water line out as much as 500 ft. (at the latter place) but have buried the piles, of which they are the nucleus, out of sight, thus preserving them from injury by waves or teredo.

In general, it may be said that the normal spurs which are so frequently applied in connection with vertical or inclined bulkheads are incorrectly designed, and are thus expensive and inefficient. They do not utilize the dynamic agencies available for accumulating and impounding the littoral drift, save to a very limited extent in the groins, which they form, as may be seen in many recent works along this coast where the beach has been eroded from 300 to 500 ft. in recent years and the jetties have not recovered the loss. The rapid reclamation at Ventnor has enabled the secondary low bulkheads to be erected parallel to the boardwalk, thus creating impounding basins forming sheltered pools for safe bathing and extending the beach seaward. This secondary line, however, retards the growth of the deposits, for it is stated that the vertical fill has been as much as from 4 to 6 ft. at Ventnor. The open hooked jetties have made deposits exceeding 10 ft. in depth and covering several blocks on both flanks of the work at much less cost, so that the evidence of nature should carry great weight as to the relative efficiency of the remedies to be applied.

These statements are made in the interests of the public good and are not in any wise to be regarded as adverse criticisms.

Cynwyd, Pa. LEWIS M. HAUPT.

[In accordance with its custom the Engineering Record submitted a copy of Mr. Haupt's letter to Mr. Risley. The latter's answer follows.—EDITOR.]

SIR: In reply to the letter of Lewis M. Haupt in regard to the jetties at Ventnor City, it seems that he has become somewhat confused in his dates. The Ventnor jetties were constructed during 1912 from plans prepared by the writer independently of Mr. Haupt, and it was not until the spring of 1914 that Mr. Haupt was retained as engineer for Ventnor, and then only to prepare plans and specifications for his "flying buttress." It is true that Mr. Haupt had put in a claim for infringement of his patents on the curved form of jetty, and the fee paid him for the "flying buttress" included any claim that he might have for jetties already constructed and for any jetties of this form that the city desired to build.

However, it was not intended by the writer to give the impression that the curved or "hooked jetty" was public property, but simply a recommendation of this form, as he is of the opinion, through experience with this and other types, that this is the most stable and effective form in which to construct a jetty. The greater efficiency of such jetties, however, depends upon the location selected for placing them and the combination of the forms in a system, as has been done at Ventnor and Longport.

Stone-and-brush filling is very essential for jetties on this beach, where reclamation is not so rapid as at the inlet of Atlantic City or the beaches of Far Rockaway, and the writer feels that it is the use and constant maintenance of the stone and brush that have made the Ventnor jetties so successful. W. I. RISLEY.

Atlantic City, N. J.

Engineers' "Right-of-Entry" Act

SIR: In the course of our practice as engineers in charge of various works for municipalities we have very often been annoyed and sometimes put to considerable trouble during the preliminary stages of the work by the unreasonable hostility of property owners and tenants who have obstructed us in the survey work. Frequently such people will absolutely refuse to permit entry to land through which it is imperative to pass in the process of making necessary surveys and examinations, and sometimes they will go the length of threatening and attempting bodily injury to those employed.

Added to the contingent worries of, say, picking out the best possible route for an outfall sewer and the proper location for a disposal works, fighting briars and mosquitoes, etc., the verbal abuse (frequently highly vitriolic) and dire threats against one's life and liberty by some irate farmer or lot owner may easily become more than a joke. Such opposition frequently takes the form of legal procedure which makes necessary endless extra work and added expense to all parties concerned.

While it is true that nearly all "enabling acts" confer the right to acquire lands and make the necessary surveys, it is often the case that surveys and examinations on the ground are necessary for the very purpose of preparing such acts themselves.

Knowing that we were not alone in such experiences and believing that engineers should at least be entitled by law to carry on their work unmolested so long as that work is not harmful to other people, we last winter drafted an act which we believe covers the situation and, with the co-operation of the Engineers' Club of Baltimore, W. W. Crosby and several of the engineers of the various departments of the state service of Maryland, had it introduced and passed by the Legislature of Maryland as Chapter 649 of the Acts of 1916.

We inclose herewith a copy of this act and would like to have your comments and those of the Engineering Record's readers thereon. It has occurred to us since the act was passed that the engineers of the various branches of the Federal Government should have been included in it. This omission was an oversight on the part of all who were interested in the enactment.

In our opinion some such law should be on the statute books of every state, thereby saving not only trouble and annoyance to the profession but often actual loss to clients. E. G. KASTENHUBER, JR.,
Of Kastenhuber & Anderson, Civil Engineers and Surveyors.
Easton, Md.

[The law, which may well serve as the inspiration of similar acts in other states, follows.—EDITOR.]

AN ACT to empower civil engineers and surveyors to enter and work upon private lands for the purpose of making surveys and examinations, for the purpose of gathering data for proposed public or municipal works or improvements thereto.

Section 1. Be it enacted by the General Assembly of Maryland: That civil engineers and surveyors, when they are in the employ of the state, or any county, or any city, town or village of the state, shall have the right to enter upon any private lands for the purpose of making surveys, running lines of levels or obtaining any needful information or data for the preparation of plans, reports or new legislation necessary for any proposed public sewerage system, waterworks, establishment of corporate boundaries or any extension of the same, highways or improvements to the same, or any public undertaking of a like nature.

Section 2. And be it further enacted: That civil engineers and surveyors when acting under the authority of this act shall have no right to damage or destroy any property or lands entered by them in the legitimate performance of their work, except that they shall have the right to set stakes, markers or monuments or other suitable landmarks or reference points where necessary.

Section 3. And be it further enacted: That no owner, occupant or agent of private lands so entered shall obstruct, impede or annoy civil engineers or surveyors or their employees in the performance of their work under this act, nor shall any such owner, occupant or agent destroy, obliterate or remove any stakes, markers, monuments or other landmarks set or placed by such civil engineers or surveyors, and any owner, occupant or agent violating the provisions of this act shall be guilty of a misdemeanor and subject to a fine of not less than twenty-five dollars ($25) nor more than one hundred dollars ($100), or to imprisonment for not less than 30 days nor more than 60 days or both at the discretion of the court.

Section 4. And be it further enacted: That this act shall take effect as from June 1, 1916.

Engineers and the New Nationalism

SIR: I have read with pleasure and profit the article by Miss Frances A. Kellor in your issue of July 1.

I have long felt that the members of the engineering profession as a class fail to appreciate how their work, and hence possible influence, ramifies through our whole social structure. Failing to recognize this fact, they have too often failed to meet their larger responsibilities.

With Miss Kellor, I hope that our work for preparedness may lead us all to a more complete acceptance of our responsibilities as citizens and members of the great human family.

I agree heartily with Miss Kellor that our engineering colleges have resting upon them a grave responsibility in this connection. A. C. HUMPHREYS,
President, Stevens Institute of Technology.
Hoboken, N. J.

SIR: I thoroughly enjoyed reading Miss Kellor's article entitled "The Engineer and the New Nationalism." It is certainly true that a great opportunity for human service resides in the profession of engineering, and I believe that engineers intrusted with problems relating to the welfare of humanity can be depended upon to respond most heartily.
New York. SPENCER MILLER.

SIR: I have read Miss Frances Kellor's article with attention, and certainly it is a very interesting one, and covers some points to which American industrial life must give consideration, as they will influence a wide field in our national future.

Undoubtedly the engineers of the country should play a very large part in the work outlined by Miss Kellor, and in many cases they undoubtedly will, and I am happy in knowing that their influence is constantly extending, but it will yet require a large amount of educational work and perhaps some rather disagreeable medicine to fully impress upon the controlling powers in industrial work the importance of giving full recognition to the engineering problems of their enterprises.

Our labor situation at this time is in a condition in many ways dissimilar to any of our past experiences and the situation of the future is a problem regarding which we can at the present time only surmise, but undoubtedly there will be absolutely new forces and new conditions to be considered and dealt with.

Miss Kellor paints a picture of the new town and the new industry, but it is not in that line alone that the greatest work must be done. It is the reorganization and reconditioning of the old industries which will bring about the quickest and the greatest results; but agitation is what brings consideration of a subject, and in that way certainly Miss Kellor's article is of great value. ROBERT W. HUNT.
Chicago, Ill.

Coast Erosion and Sea Defense

Speaking before the Institution of Municipal and County Engineers, John S. Brodie, borough engineer of Blackpool (England), presented a summary of his experiences in coast erosion and sea defense. About 10 years ago erosion on the east coast of England resulted in a demand for state assistance in the protection of shores. The agitation culminated in the appointment of a Royal Commission in 1907, and after four years spent in taking evidence and inspecting the coast lines of practically the whole of Great Britain and Ireland, the commission finally reported in 1911 that, within a period of 35 years, while 6640 acres of land had been lost to the United Kingdom by erosion, on the other hand 48,000 acres had by accretion and reclamation been gained. The commission made recommendations to Parliament, but up to the present time no legislation has been enacted.

Expert opinions on sea defense works, according to Mr. Brodie, are divided between the use of sea walls and groins. As usual, the truth of the matter is that neither is of universal application, but that each foreshore must be considered in relation to its own particular circumstances and conditions.

A sea wall may be the best protection for one particular foreshore, while groins may be the best for another, and a combination of both a sea wall and groins may be the only protection adequate for still another. But apart altogether from the adequate protection of the coast line, it must be obvious that groins are very unsightly and inconvenient on a wide sandy foreshore used for recreation purposes, and should be avoided where possible on these grounds alone. It must be further kept in mind that experience has amply shown that there are no engineering difficulties in building a sea wall which will not depend on groins to prevent it from being undermined by the sea.

The financial considerations are really the determining factors in sea defense works.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Odds and Ends, in Hands of Master Mechanic, Make Locomotive

By R. R. RIEMENSCHNEIDER
Canton, Ohio

THE PHOTOGRAPH shows a locomotive built from odds and ends by Dick Neff, master mechanic of the E. J. Landor Company, and used for hauling dump cars of dirt. The locomotive was built right on the job to help dispose of the excavation for an addition now being constructed to the new open-hearth plant of the United Steel Company at Canton, Ohio. It is complete, even to the whistle, but the most interesting part of it is the drive gear. As may plainly be seen in the photograph, this consists of a wire-rope drive tightened on one side by a steamboat ratchet and snatch block and on the other by a small idler on the end of a heavy coil spring. The spliced length of cable is given a turn around each of two flanged wheels, whose pedigree is not disclosed, but which closely resemble traveler derrick wheels. One of these is mounted on the extra-long drum shaft and the other on an extra-long axle of the car. There are rumors that the cable splice pulled out on one occasion and that the locomotive is to be provided with a regulation chain drive. The locomotive handles two dump cars at a time, and has been successful in keeping very busy the clamshell derrick that is handling the bulk of the excavation.

Accounting for the Contractor: Transferring Equipment

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company,
Scranton, Pa.

SINCE the article of this series on handling equipment accounts appeared in the Engineering Record for July 8 (page 57), some inquiries and suggestions have been received in the mail which will prove of general interest, and may elicit further correspondence on the subject.

One correspondent says: "The firm for which I worked was in the habit of allowing the superintendent of the contract from which the plant was being shipped to put a value on all plant and tools except the more expensive pieces of equipment, a price on which would be sent in from the main office. The result always was that the superintendent making the shipment would charge as high a price as he thought the superintendent on the job to which the stuff was going would stand for.

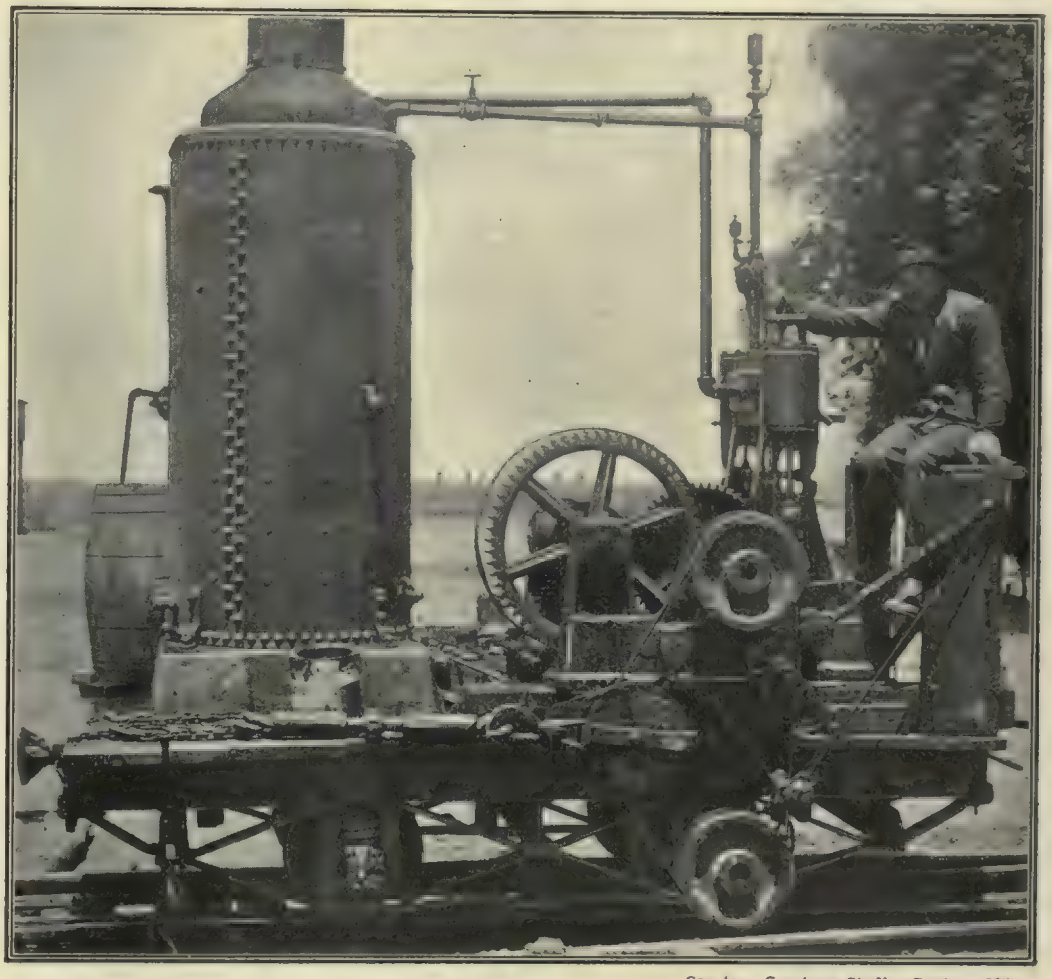
"As this second superintendent figured on getting it back out of the next job to which he sent plant, he would usually accept a valuation much in excess of what the first contract was entitled to. The result was that the company was carrying a large fictitious value on its books. A much better system is used by a contractor in Pittsburgh, who does not allow men on the job to value anything. They merely send an inventory of what is being shipped, and all the charges are transferred at the main office. The inventory, of course, shows the condition of the tools, but there is not nearly so much temptation to make money on paper under this system. I thought possibly you would have an improvement on both of these to suggest in some of your articles."

Of course, the first method outlined is absurd, when no check is kept on the men who make the valuations. This piling up of paper profits not only works harm in fooling the principals of the concern into a notion that they are making more money than they really are (providing the principals are as gullible as the contractor in question evidently was), but it actually costs the contractor real dollars and cents in excess taxes on his personal property, and in case of large operations may even make him liable for an excessive income tax through failure to make proper charges for depreciation and obsolescence as allowed by the federal tax commissioners.

The second method is, I believe, in accord with the best practice for handling small items such as shovels, picks, crowbars, handdrills and other small tools.

Another letter contains, in reference to the transfer of equipment from one contract to another, the following:

"A friend of mine is working for a large building contractor who has solved this difficulty very neatly. This firm has a central storehouse and repair shop to which everything, down to shovels, is sent at the completion of each contract. This storehouse is run as if it were a contractor's equipment company, and all its accounts are kept separate. It charges the different contracts for exactly what it sends them, and my friend says it has made money on the books ever since it was put in, allowing only a fair valuation for the equipment and tools it rents out to the contracts. Also, everything is kept in much better shape."

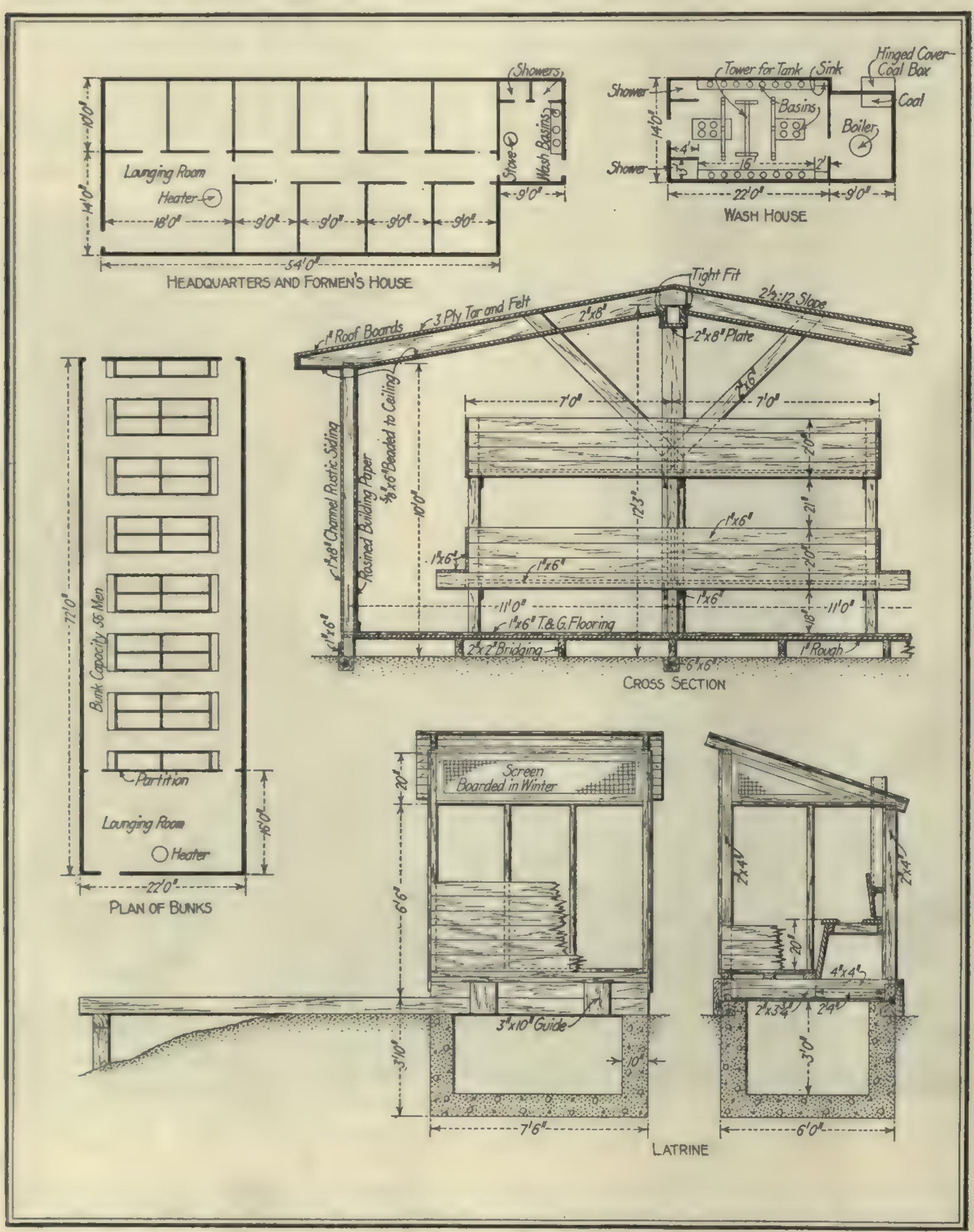


Courtesy Courtney Studio, Canton, Ohio.
HOME MADE, BUT COMPLETE EVEN TO THE WHISTLE—AND IT HANDLES TWO DUMP CARS

At first reading this seems like an excellent suggestion, and for a contractor whose field of operations is limited to a comparatively small area it might work out very well; but its application to a big concern operating in half a dozen or more different states would be difficult. Suppose the Carter Construction Company has two steam shovels and a dragline and all the attendant equipment operating on a job in Massachusetts, a section of railroad construction in New Jersey, and a contract for the erection of an industrial plant in Connecticut. We will say that its storehouse and repair shop is located in some little town in New York where the freight connections are fairly good. The big excavation job in New York is finished, also the railroad contract in New Jersey. The plant from these two places is shipped to the

central storehouse to be overhauled, and in the meantime a big piece of work is landed in Pennsylvania, and the plant in the storehouse is practically all shipped out again.

The equipment could have been overhauled and put in shape almost as economically right on the original jobs and kept there at a nominal storage cost, ready for direct reshipment to the new work. Instead, double charges have been incurred for loading, unloading and freight, and the storehouse is now practically empty and useless until, perhaps, the first of the Massachusetts jobs is finished, when the equipment is shipped into New York State for repairs and storage. Then a requisition comes in from the superintendent of one of the other jobs in Massachusetts for an additional concrete mixer, and it is shipped back from New York. It may have traveled back and forth 200 or 300 miles, when a direct shipment would have involved a freight haul of 50 miles or less; and so the illustration might be amplified ad infinitum.



DETAILS OF CAMP CONSTRUCTION THAT HAS PROVED SATISFACTORY IN COLD CLIMATE

CENTRAL STOREHOUSE AND STATE TAXES

The writer knows one case of a contracting corporation in—well, let us say New Jersey. It had been operating in several states, and finally picked out what seemed an ideal site for a central storage and repair plant in New York State, and as certain contracts were finished it shipped all the released plant to the storehouse. A long "slack" period followed, when comparatively little work was done, except for one singularly successful operation in the company's home state. This particular job, while it was a decided moneymaker, was a labor proposition pure and simple, involving the use of very little expensive equipment.

The great bulk of the plant was in dead storage up in that little New York town. Not a tap of work was done in the state of New York for over a year, but the company was able to declare a large dividend from its "New Jersey" operations. It had not surrendered its franchise or license to operate in New York because it wished to be in position to resume work in that state should opportunity offer. It made its regular annual report to the New York State Tax Bureau, and presently received a tax bill for the regular millage on the dividends paid on nearly 60 per cent of its total capitalization, just because it had reported nearly 60 per cent of its assets as being located within that state. Those assets had been earning nothing—had been, indeed, a source of some expense; but the New York law is fairly clear on the subject. The tax is based on a portion of the total dividends in the ratio that the capital employed within the state bears to the total capitalization, and it is assumed that the ratio of assets within the state to the total assets determines the ratio of capital employed within the state to the total capitalization. The contracting corporation advanced the argument that the assets in dead storage within the state were not "capital employed within the state," within the meaning of the law, but was overruled by the state tax department. A concession was obtained, however, because of the fact that in reporting assets within the state certain valid depreciation charges had been overlooked.

[The series of brief articles on modern accounting methods for contractors by Mr. Lathrop, of which this is the last, will be followed by another series taking up the subject of accounting in the field office—one which has been treated in the first articles only from the business point of view of the main office. The first article of the second series will appear in an early issue.—EDITOR.]

Comfortable Houses Hold Men at Construction Camp

A CONSTRUCTION camp built to furnish thoroughly comfortable living quarters in a "below-zero" climate has been provided by the Jarrett-Chambers Company for the force that is building the Lifton pumping station at Bear Lake, Idaho, described on page — of this issue. There are two houses with separate rooms, shower baths and louging rooms for the foremen and office force, lounging rooms in the four large, light bunkhouses, a central washhouse with showers and laundry tubs, two icehouses, a hospital and an incinerator.

Hot water is provided for the entire camp by a boiler located near the main tank at one end of the washhouse. All the buildings have double walls and floors, and are easily warmed by large coal heaters. A feature of the camp is the latrines, which are built on skids over concrete pits. Every week in cold weather the shelters are slid back out of the way and crude oil is poured in the pits, set on fire and the contents burned out.

Between 200 and 300 tons of ice were cut during cold weather and stored in the two icehouses for the summer, as otherwise it would be almost impossible to have ice in the camp. Ice was supplied, not only to the camp and cold-storage house, but also to the dredge boats at work on the canal. The large mess hall, with a kitchen and a small commissariat at one end, seats 300 men. The headquarters house is provided with special rooms to accommodate visitors.

Well Water for City Properties

The finance committee of the San Francisco board of supervisors proposes to sink wells on municipally owned land with a view to reducing the city's water bills. The public parks and large isolated public buildings, such as the city hospital, would be supplied from this source. The city's water bill in 1915 amounted to \$210,000, it is reported, and during the coming year it is believed that additional expense will be incurred owing to the care necessary for the grounds at the civic center.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Heavy Floods Sweep Over Carolinas and Virginia

Damage Estimated at $12,000,000 Due to Worst Flood in History of North Carolina—Bridges Swept Away

Floods July 16 sweeping over North and South Carolina and Virginia are said to have caused twenty-eight deaths and damage estimated at $12,000,000. Twenty-five industrial plants have been closed at Asheville, N. C., and about 1200 men thrown out of employment. Railroads have suffered heavily and it is impossible to maintain regular train service.

The French Broad River flooded the streets of Asheville and 6 ft. of water was in the Southern Railway station at that point. Two dams at Hendersonville collapsed, but that at Lake Taxaway withstood the high water. The Southern Railway bridge over the Catawba River near Belmont, N. C., has been washed away, as has the Seaboard Air Line bridge over the same river at Mount Holly. The Dravo Power Company's dam is said to have failed July 16.

Bridges Carried Away

Five highway bridges, three in Mecklenburg County, one near Mooresville and another near Statesville, were reported washed away. Four Norfolk & Western Railway bridges on the Galax branch have been reported destroyed, as has one belonging to the Virginia & Southwestern Railway in Tennessee. Reports of the failure of the Appalachian Power Company's dams on the New River are untrue.

At Columbia, S. C., the Congaree River rose 32 ft. above its normal height. Water rose to a height of 2 ft. on the walls of the powerhouse of the Columbia Railway, Gas & Electric Company. Bags of sand were used to help repel the water and heavy 12-in. timbers braced the walls on the inside against the unusual water pressure. The plant of the Columbia Cotton Mills is almost submerged.

Dayton Engineers Will Erect New Society Building

In order to put the engineering side of life before the community two prominent engineers of that city are making possible the erection of a new home for the Engineers' Club of Dayton, Ohio. E. A. Deeds, president of the Dayton Engineering Laboratories Company, and C. F. Kettering, vice-president of the Dayton Engineering Laboratories Company, are the men. The structure will be erected at the corner of Jefferson Street and Monument Avenue on a 99 x 198-ft. plot, already purchased.

Plans have not yet been prepared by Schenck & Williams, the architects. It is stated, however, that the new building will contain a lecture hall with a seating capacity of 500. A complete technical library will also be available.

Approves Conference Report on River and Harbor Bill

By a vote of 187 to 132 the U. S. House of Representatives last week approved the conference report on the river and harbor bill. The action kills the La Follette-Clark amendment which would have prevented the Sanitary District of Chicago from taking sufficient water from Lake Michigan to handle the disposal of the city's sewage. The amendment would also have prevented the state of Illinois from building a deep waterway connecting the Great Lakes with the Mississippi River.

Begin Raising Salmon Bay to Level of Lake Union, Seattle

The mammoth gates of the Lake Washington canal locks at Seattle, Wash., dividing the salt waters of Shilshole Bay from the fresh waters of Salmon Bay, were closed at 8 a. m., July 12, and the work of filling Salmon Bay above the locks to the level of Lake Union was begun. The first link in the $5,000,000 project that will permit ships to pass into Lake Union will be completed, it is estimated by Lieut.-Col. J. B. Cavanaugh, about Aug. 1. The waters of Salmon Bay will be elevated 30 ft. above their present level at low tide. By the date mentioned the canal will be ready to receive ships of 18-ft. draft, but it will be at least two weeks later that vessels of larger size will be allowed to enter. The canal between Lake Washington and Lake Union will not be opened this year, but Lake Washington will be lowered 8 ft. to the level of Lake Union. The latter body of water is large enough to accommodate an enormous fleet.

The work of constructing the canal was begun Nov. 10, 1911. To date Congress has appropriated $2,275,000, while the State of Washington and King County have jointly added $1,000,000 toward defraying the cost. This work was described in the Engineering Record for July 31, 1915, page 141.

Engineers' Society Submits Report on Pittsburgh Subway

A report on the proposed Pittsburgh subway signed by seven prominent members of the Engineers' Society of Western Pennsylvania has been presented to the city council. It recommends the expenditure of $60,000 for location and cost surveys and for determining the necessity for a subway loop. There will probably be no further subway conferences until fall.

Philadelphia to Have New Municipal Auditorium

THE CONSTRUCTION of the Municipal Auditorium for which the people of Philadelphia voted $1,500,000 has been delayed by court proceedings since 1911. The difficulties have now been eliminated and the site selected on the Parkway between Twenty-first, Twenty-second, Hamilton and Callowhill streets. According to John T. Windrim, the architect, the structure will be 348 x 362 ft., with an auditorium 225 ft. square, capable of seating 15,000 people. Halls and committee rooms are to be provided on the upper floors. When used for exhibition purposes 91,000 sq. ft. of floor space will be available. A portico on the Parkway will support a pediment, to the apex of which from the pavement is 106 ft. The tympanum of this pediment is to be ornamented by an allegorical group of sculpture in high relief, illustrating the history of Philadelphia. A railroad siding to the north facilitates the shipment of exhibits. The Parkway will also be completed with funds recently provided.

Adopt Minute Commemorative of Dr. Elmer Lawrence Corthell

Philadelphia Civil Engineers Pay Homage to Late President of American Society of Civil Engineers

The Philadelphia Association of Members of the American Society of Civil Engineers recently adopted a minute commemorative of Dr. Corthell, the late president of the American Society of Civil Engineers. A part of the appreciation reads as follows:

"Among the many who heard his stirring words when ushered to the chair upon his election to the presidency of the American Society of Civil Engineers, none could have failed to catch something of the lofty spirit of the man. His fervent appeal to American engineers to play well their part in the ultimate restoration of good feeling between members of their profession in countries now rent asunder through deadly conflict made a profound impression upon the assemblage. . . . In his informal address on this occasion, his fertile brain outlined many opportunities that lay open to the American Society of Civil Engineers for broader usefulness to the community and nation, and increased service to its members. In this he placed characteristic emphasis on the vital importance of solidarity in the profession in all relations in which the interests of engineers, as such, as members of society, were essentially identical. It was plain in his every word that he looked upon the high office for which he had been chosen not as an honor to be accepted in light spirit, but as an opportunity to give effect to some of the ideals for which he himself had labored so long and to such good purpose.

"We feel that in the death of Dr. Corthell the American Society of Civil Engineers has suffered a grievous and well-nigh irreparable loss."

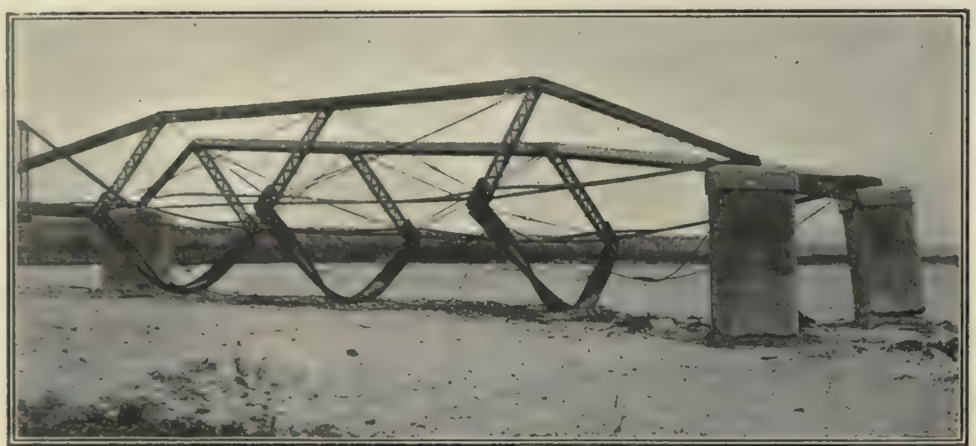
Denies Report That Power Export License Will Be Revoked

Reports that it must sell almost all the power generated at the Niagara Falls (Ontario) plant to the Ontario Hydroelectric Commission or risk the loss of its license to export power to the United States have been denied by L. F. Lovelace, secretary of the Niagara Falls (N. Y.) Power Company. The Ontario government has requested 50,000 hp. to be delivered by next December. The Canadian Niagara Power Company has offered 32,000 hp.—the amount available over the 75,000 hp. now exported to Buffalo. New generators are being installed and the Canadian company expects to meet the commission's requirements by the time specified.

Build Two Miles of Road in Forty-Eight Hours

By working continuously for forty-eight hours, the forces of the Pennsylvania Highway Department recently constructed 2 miles of road in Camp Brumbaugh, where the Pennsylvania National Guard was mobilized. The work was begun on the morning of June 30; it was completed by the following Sunday morning. Four road rollers, three traction engines and three road machines were put to work. Boulders were removed by blasting when necessary. The grading, crowning and draining followed rapidly, and in practically forty-eight hours more than 2 miles of 20-ft. road had been built. Light emulsifying oil was applied and sprinklers employed to keep the dust down.

The highway department intends to recommend an appropriation for durable highways in the camp.



Fire Destroys Bridge Across Rillito River

THE STEEL BRIDGE across the Rillito River, 4 miles north of Tucson, Ariz., was destroyed by fire late last month. The plank floor took fire from some unknown cause and the flames spread rapidly to the wood railings and trestle approach. The fire followed a dry period of several months. The effect of the heat is shown in the pictures. The structure consists of five steel spans, each 60 ft. long, with a 75-ft. trestle approach at each end. The south span, as illustrated, collapsed, breaking the concrete pier just above the stream bed. A road has been built over the dry river bed to handle traffic until the bridge is rebuilt.

This information and the pictures were supplied by A. L. Enger, assistant engineer in the Agricultural Experiment Station of the University of Arizona, Tucson.

To Investigate Changes in Laws Affecting Railroad Regulation

The U. S. House of Representatives has adopted the Newlands joint resolution already passed by the Senate. The action assures a thorough investigation of needed changes in laws affecting the regulation of railroads. The Senate Committee on Interstate Commerce and the House Committee on Interstate and Foreign Commerce are required to make the investigation through a joint sub-committee. The necessary powers for obtaining evidence have been granted. The committee is to report to Congress as soon as possible.

Approves Georgia Highway Commission Bill

The public highways committee of the Georgia House of Representatives has approved a bill creating a state highway commission. Five commissioners will be paid $10 for each day of actual service and not more than $400 a year apiece. A chief engineer will also be employed at a salary not to exceed $400 a month. The bill is a substitute for one drafted by the highway-commission committee of the Georgia Chamber of Commerce.

$70,000,000 to Enlarge Steel Plants

Eugene Grace, president of the Bethlehem Steel Company, has announced further improvements at three of the company's plants. The expenditure of $70,000,000 will be divided as follows: $30,000,000 at South Bethlehem, $30,000,000 at Sparrows Point and $10,000,000 at Steelton. Mr. Grace's announcement was made a few days after that of Charles M. Schwab, noted in last week's issue.

Report $35,000,000 Building Bill

The committee on public buildings and grounds, July 17 reported a bill to the U. S. House of Representatives appropriating $35,000,000 for new federal buildings. The measure also creates a Bureau of Public Buildings to take the place of the office of supervising architect of the treasury. The bureau will, if the measure is passed, have complete jurisdiction over the plans and construction of public buildings. It is not expected that the bill will be voted on until the next session, probably in December.

Street Cleaning Department of New York Increases Efficiency

There was especial timeliness in the presentation of the annual report of the Department of Street Cleaning of New York City just made to the Mayor by Commissioner J. T. Fetherston. Because of the importance of co-operation on the part of the department in combating the present epidemic of infantile paralysis more than ordinary interest attaches to a recital of the changes and improvements in department methods that have added to the effectiveness of its co-operation.

The report shows that co-operation between the citizens and the department has been effected and the number of complaints thereby reduced. The amount of work done was increased at a cost only slightly more than the lowest record of recent years. The area flushed daily was increased 30 per cent. A part of the report is devoted to the "model district," which was equipped with auto tractors, trailers and locomotive cranes at a cost of $112,122.

Despite the increased work handled, the numerical strength of the department and its cost of maintenance for 1914 and 1915 were about equal.

Organize Company to Study Terminal Improvements

The American International Terminal Company has been incorporated by the National City Company, the American International Corporation interests and Stone & Webster. The object of the new company is to study problems relating to railway, steamship, warehouse, and industrial terminals for the purpose of providing better facilities for the extension of the export trade of the United States.

According to W. S. Kies, vice-president, an attempt would be made to consider all of the many propositions for terminal improvements that have come up in all parts of the world, with the idea of determining upon the plan which will give the greatest efficiency at the lowest cost.

W. H. Lyford, who was long connected with a railway terminating in Chicago, has been retained as consulting expert.

$2,000,000 for Roads and Bridges in Porto Rico

The Legislature of Porto Rico at its last regular session authorized a bond issue of $2,000,000 for the construction of roads and bridges. The joint committee of both houses of the Legislature to determine the order of execution of the work has not yet been appointed. The committee will be known as the Economy Commission.

It is estimated that roads to be built in Porto Rico will involve an expenditure of about $3,000,000. While the appropriation is for only $2,000,000, roads and bridge construction included in the recently approved act will necessitate nearly $4,000,000.

Dam Bill Passed by House

The general dam bill regulating water-power development in navigable streams was passed by the U. S. House of Representatives July 14. The measure provides for a system of leases under government regulation. It is designed to induce private investment in water-power development.

Bridge Named for Major-General Meigs

The new structure spanning Rock Creek in line with Pennsylvania Avenue, Washington, D. C., will be known as Meigs bridge. It has been so named in honor of the late Maj.-Gen. Montgomery C. Meigs, who supervised the construction of the Washington aqueduct. General Meigs designed the old bridge which the new structure replaces. He also built the immense Cabin John masonry arch.

Wreck Panama-Pacific Exposition

THE WORK OF WRECKING the Panama-Pacific Exposition buildings has been done largely by using dynamite. The picture shows the dynamiting of the dome of one of the large structures.

Illinois Municipalities to Cease Polluting Fox River

Further resistance of Elgin, Aurora and other Fox River cities to the enforcement of the order of the Illinois Rivers and Lakes Commission to cease polluting the Fox River by sewage is at an end. The case entered June 19, 1914, was dismissed from the Sangamon County circuit court June 26 by voluntary agreement. This means that primary sedimentation tanks or sewage treatment of some kind must be put in service by Jan. 31, 1917.

Pipe Break Leaves Bayonne, N. J., Without Water

The breaking of a joint in a 20-in. cast-iron pipe two weeks ago to-day in the Newark meadows, noted in last week's issue, left Bayonne without a supply of water for 5½ days. C. T. Kavanaugh, Bayonne representative of the New York & New Jersey Water Company, owner of the pipe, estimates the loss of water as 25,000,000 gal. per day.

The break occurred where the pipe crosses the tracks of the Delaware, Lackawanna & Western Railroad near Kearney, N. J. The main is carried through a duct under a 4-ft. fill. It is said that the break was due to vibration caused by the railroad trains.

Future Docks in Chicago to Be of Masonry Construction

Docks built in Chicago after July 15, 1926, must be of masonry, which, of course, means concrete. The ordinance contains no specification for concrete docks, but the department of public works will draw up general plans to which all docks must conform. The commissioner of public works may refuse permits to repair present wooden docks and require their replacement where needed.

To Test Turner Flat-Slab Concrete System at Seattle

The Port of Seattle Commission, C. E. Remsberg, secretary, has instructed Chief Engineer J. R. West and Attorney C. J. France to arrange for a thorough loading test of the Bell Street warehouse. The first test made nearly a year and a half ago resulted in considerable controversy. The warehouse was built on the Turner flat-slab system of concrete construction. The designers maintain that when the first test was made the concrete was "green," and hold that the building will come up to all requirements now that the concrete has aged.

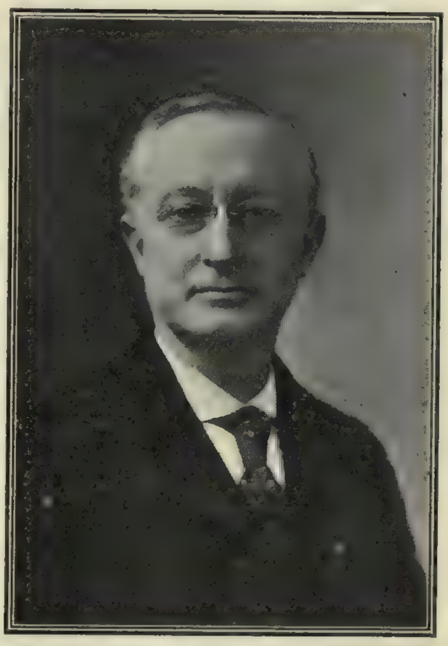
What Engineers and Contractors Are Doing

WILLIS WHITED, engineer of bridges for the highway department of Pennsylvania, has received the honorary degree of Doctor of of Engineering from the state University of Iowa. He was graduated from that institution in 1879.

HENRY W. DURHAM, engineer of Bergen County, N. J., with consulting offices in New York City, has been granted a month's furlough and returned to New York from the Mexican border. Mr. Durham is a corporal in the Seventh Regiment. His was the first leave of absence granted since the troops were mobilized.

C. FRANK ALLEN, a member of the faculty of Massachusetts Institute of Technology for the past thirty years, resigned as professor of railroad engineering July 10. Professor Allen was graduated from the Institute in 1872. For the next six years he was engaged in work connected with the water and sewerage systems of several cities including Boston and Newton, Mass., and Providence, R. I. He went west in 1878 to enter the service of the Atchison, Topeka & Santa Fe Railway. With the exception of a year spent as chief engineer of the Las Vegas, N. M., he was assistant engineer for the Santa Fe until 1885. In that year his study of law had been sufficient for him to be admitted to the bar in New Mexico. He was later (in 1901) admitted to the Massachusetts bar. Professor Allen was made assistant professor of railroad engineering at Massachusetts Institute of Technology, in 1887. He became associate professor two years later and his appointment as professor of railroad engineering followed. Among his technical books are: "Railway Curves and Embankments," "Tables for Earth Computations" and "Field and Office Tables."

Professor of Railroad Engineering of Massachusetts Institute Resigns



C. FRANK ALLEN

THE JOHN T. WALBRIDGE ENGINEERING COMPANY has removed its Chicago office to the Tower Building.

ARTHUR E. OWEN has been promoted from principal assistant engineer of the Central of New Jersey Railroad to succeed the late Joseph O. Osgood as chief engineer. Mr. Owen was educated at Rutgers Scientific School and joined the staff of the engineer of Essex County, New Jersey, in 1896. Two years later he was made draftsman for the Central of New Jersey. He was successively transitman, assistant engineer and assistant to chief engineer for that road.

RUDOLPH P. MILLER has been made chairman of the new Board of Standards and Appeals of New York City. Mr. Miller has for the past two years directed the revision of practically the entire building code of that city with the exception of sections relating to theaters. That section was recently taken up by the committee on buildings. He was made superintendent of buildings in 1910. Previous to that he had a large consulting practice in New York.

HOWARD C. BAIRD, of the firm of Boller, Hodge & Baird, consulting engineers, New York City, was recently appointed a member of the Board of Standards and Appeals of that city. Previous to becoming a member of the firm Mr. Baird was for a number of years principal assistant engineer for Boller & Hodge.

CLIFTON, APPLEGATE & TOOLE, contractors, of Spokane, have opened offices in the First National Bank Building, Missoula, Mont. The company recently secured the contract for constructing 22 miles of the extension of the Chicago, Milwaukee & St. Paul Railway up the Blackfoot River, near Missoula.

MAJOR-GEN. GEORGE W. GOETHALS', Corps of Engineers, U. S. A., resignation as governor of the Panama Canal was accepted by President Wilson July 12. The date on which General Goethals will resign has not yet been announced. He was made a member of the Isthmian Canal Commission in March, 1907, and governor of the Canal Zone in 1914.

HARRY J. CORCORAN, who was graduated from the State University of Iowa last month, is now employed as inspector of rivers and harbors at Grand Rapids, Mich.

LEWIS F. MOODY has resighed as professor of hydraulic engineering at Rensselaer Polytechnic Institute. He has been a member of the faculty of that institution for the past eight years, first as professor of mechanical engineering and then as head of the hydraulic engineering department. Professor Moody will devote his time to the I. P. Morris Company as consulting engineer.

P. H. NASH, formerly division engineer for the J. B. McCrary Company on the Lake County (Florida) highway construction, has been transferred to Shelby, N. C. From that point he will direct the construction of asphaltic concrete pavements as supervising engineer.

R. B. MURDOCK was recently made assistant engineer in the Oregon State Highway Department. He will have charge of surveys to be made for highway work in Coos County, for which $362,000 was recently voted. Mr. Murdock was previously roadmaster of Coos County.

F. H. CRAMER, formerly designer in the bridge department of the Chicago, Burlington & Quincy Railroad, succeeds A. Engh as office engineer of that department.

W. J. COLLIER, of Harrisburg, Pa., has been made engineer at the Steelton plant of the Penn Mary Steel Company.

G. A. HAGGANDER, formerly assistant bridge engineer of the Chicago, Burlington & Quincy, lines east of the Missouri River, with office at Chicago, has been made bridge engineer of the whole system, succeeding C. H. Cartlidge, deceased.

A. ENGH will succeed G. A. Haggander as assistant bridge engineer of the Chicago, Burlington & Quincy, lines east of the Missouri River. Mr. Engh was first employed on engineering work in 1904 by Ralph Modjeski, at Chicago. He went to the American Bridge Company early in the following year and in August, 1905, joined the bridge department of

the Chicago, Burlington & Quincy Railroad. He was made office engineer for the Paducah & Illinois Railroad in 1914, reporting to C. H. Cartlidge, who was then chief engineer. He was appointed to a similar position with the Burlington early in 1915.

REINHARD HEEREN, civil engineer in the bridge and construction department of the Penn Mary Steel Company's Steelton plant, has become associated with the engineering and sales department of the Bethlehem Steel Company.

RICHARD M. KREUTZ, civil engineer in the bridge and construction department Penn Mary Steel Company plant at Steelton, has become associated with the Bethlehem Steel Company's engineering force at Bethlehem, Pa.

F. A. IRVINE was recently made city engineer of Jamestown, N. Y., and not of Titusville, Pa., as stated in the July 1 issue.

R. C. BRIGGS, who resigned from the U. S. Coast and Geodetic Survey in February of this year, has completed his studies at Stanford University. He is again with the Survey at Wrangell, Alaska.

F. W. CARTER will, Sept. 1, dissolve the Carter Contracting & Hauling Company, Seattle, Wash. He will continue in the contracting business as successor to the corporation.

THOMAS G. BUSH, formerly assistant highway commissioner of the State of Washington, has organized Thomas G. Bush & Company, Spokane, Wash., contractors. Before his appointment to the highway commission in 1915 Mr. Bush was manager of F. T. Crowe & Company, Spokane, a firm engaged in selling cement and contractors' equipment.

EDWARD I. CLAWITER has resigned as engineer in charge of the Southern division of Miller & Lux to become engineer for the San Francisco Bridge Company. For two years following his graduation from the Van Der Naillen School of England in 1903 he was assistant city engineer of Manila, P. I. In 1905 he was made chief engineer for the Atlantic, Gulf & Pacific Company, engineers and contractors, at Manila, having charge of harbor improvements. He was made engineer and assistant superintendent of the Atlantic, Gulf & Pacific Company of New York four years later. After a year in New York he went to the J. G. White Company, Limited, as assistant engineer at Buenos Aires, Argentina. He returned to the United States in 1911 as a member of the Hampson-Fielding Engineering Company, Denver, Col. His appointment with Miller & Lux followed.

J. W. FITZGERALD, formerly assistant superintendent of the Western division of the Southern Pacific Railway, at Oakland, Cal., has been made superintendent of the Tucson division, succeeding T. H. Williams.

T. H. WILLIAMS, superintendent of the Tucson division of the Southern Pacific, has been transferred to the Western division, with headquarters at Oakland, Cal.

G. F. NICHOLSON, district engineer for the port commission's east waterway terminals, Seattle, will, July 31, become acting chief engineer of the Seattle Port Commission, to succeed Judson R. West. Mr. Nicholson assisted Paul P. Whitham, former chief engineer of the port commission, in the general lay-out of the Port of Seattle's public terminal system and has been connected with the port since its organization. Previous to that he assisted V. G. Bogue, consulting engineer of New York City, in laying out the harbors of Tacoma, Grays Harbor and Prince Rupert, B. C. Mr. Nicholson is a graduate of the Rose Polytechnic Institute's mechanical engineering department and a post-graduate of its civil engineering department.

GEORGE P. CLAY, an inspector in the Pennsylvania Highway Department, has been made superintendent of Erie County. Mr. Clay has been with the highway department for ten years, rising from chairman to the superintendency of Erie County.

B. B. WEINBERG has been promoted from inspector in the Pennsylvania Highway Department to superintendent of Blair and Cambria counties. He is a graduate of Pennsylvania State College and became connected with the highway department in 1913.

LOUIS L. TRIBUS, of Tribus & Massa, New York City, has been retained as engineering adviser by the residents of Staten Island, New York City, in the legal warfare between them and the contractors to whom the Department of Street Cleaning for Manhattan, Bronx and Brooklyn has awarded the contract for reducing 2000 or more tons of garbage per day. The contractors propose to erect the plant on Staten Island.

MAJOR HARRY BURGESS, Corps of Engineers, U. S. A., has been transferred from Nashville, Tenn., where for the past 4½ years he has had charge of the Nashville and Tennessee Districts, to the Detroit engineering district. Major Burgess relieves Col. Mason M. Patrick, who has taken command of the Second Battalion of Engineers.

NORTON, BIRD & WHITMAN, consulting engineers, Chicago and Baltimore, have begun the publication of a monthly letter on rate-making, valuation and allied public-utility subjects for distribution among their clients and correspondents. It will summarize and comment on commission rulings. The firm is composed of William J. Norton, Paul P. Bird, formerly smoke inspector of Chicago, and Ezra B. Whitman, formerly water engineer of Baltimore.

A. K. WEBSTER resigned recently from the drafting and designing department of the Illinois Central Railroad to become sales engineer in the Chicago office of the American Radiator Company. Mr. Webster has been employed by the Illinois Central since his graduation from the College of Civil Engineering at Cornell University in 1914. At present he is studying in the American Radiator Company's Institute of Thermal Research at Buffalo.

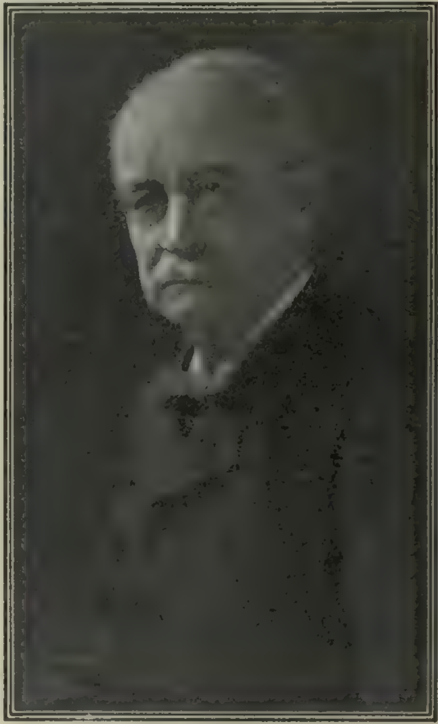
FRANK C. WORBS was recently appointed assistant engineer for the Wheeling & Lake Erie Railroad at Cleveland.

LYMAN H. CAMPBELL has been promoted from a position in the operating department of the Baltimore & Ohio Railroad to trainmaster of the Chicago division, with office at Garrett, Ind. Following his graduation from Yale University in 1913, Mr. Campbell spent four months at the Massachusetts Institute of Technology. He entered the service of the Baltimore & Ohio in January, 1914, and has since been employed in different departments, studying engineering administration, advertising and the solicitation of traffic.

Obituary Notes

DON JUAN WHITTEMORE, consulting engineer to the Chicago, Milwaukee & St. Paul Railway and past-president of the American Society of Civil Engineers, died in Milwaukee July 16 at the age of 86. For sixty-three years he was connected with the same road, resigning in 1910 as chief engineer after holding that position for forty-seven years. Upon his resignation the position of consulting engineer was created for him in honor of the character and length of his service. His latest achievement, undertaken when he was 77 years old, was the building of the Chicago, Milwaukee & Puget Sound Railway, for which he was chief engineer as far west as Butte, Mont. Mr. Whittemore was born at Milton, Vt., in 1830. After a short course at Bakersfield Academy he entered railway service in 1847 as a member of the engineering corps of the Vermont & Canada Railroad. He soon rose to the position of assistant to the chief engineer in charge of construction. Upon completion of the road he was placed in charge of a division of the Great Western Railway of Canada. He went to the Central Ohio Railroad as contractor's engineer on construction in 1852, but remained in the employ of that company only a little more than a year. Four years as assistant to the chief engineer of the La Crosse & Milwaukee Railroad led to his appointment as chief engineer and director of the Southern Minnesota Railroad in 1857. He resigned in 1860 and went to Cuba. During the winter of that year he was chief assistant to the chief engineer of the Ferrocarril Del Oeste. He returned to the United States in the spring of 1861 and took up the duties of chief assistant to the chief engineer of the La Crosse & Milwaukee. When that road was merged with the Chicago, Milwaukee & St. Paul in 1863 he was made chief engineer. Mr. Whittemore was a pioneer in the American cement industry. His experiments in 1874, demonstrating the value of limestone for the manufacture of hydraulic cement, led to the organization of the Milwaukee Portland Cement Company. He was also one of the founders of the Western Portland Cement Company. He has been a member of the American Society of Civil Engineers since 1872 and was elected its president in 1884. His name also appears in the membership lists of the American Society of Mechanical Engineers and of the Institution of Civil Engineers of Great Britain. The Western Society of Engineers claims him as an honorary member.

Consulting Engineer of Chicago, Milwaukee & St. Paul Railway Dies



DON JUAN WHITTEMORE

Good Roads Money Allotted According to Area, Population and Mileage

The method of distribution of the money recently appropriated by Congress for good roads is in proportion to the area, post-roads mileage and population of each state. The figures given in columns 10 and 11 of the table on page 42 of this journal for July 8 are therefore wrong.

A change made after the bill's introduction in Congress provides that three per cent of the total amount is to be set aside for administration of the Washington office. The balance is divided into three equal parts, each to be divided according to the population, area and post-road mileage of each state.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 74 NEW YORK, SATURDAY, JULY 29, 1916 Number 5

Machinery vs. Labor

HARD on the heels of the editorial note in this journal of July 15, page 65, commenting on the compensating advantage of the war in forcing contractors to replace human labor by machinery, comes a letter from a Russian engineer, inquiring about American machinery for saving labor on construction work. He goes on to explain that the war has compelled them (in Asiatic Russia) to change entirely their construction methods, which heretofore were like those of India and Egypt. Manual labor was very cheap and the use of machinery was practically unknown. Now labor is scarce and the engineers are promptly learning all they can about labor-saving devices. Naturally they turn to this country. The inquiry indicates what a large field is being opened in Russia for American enterprise.

New York Buildings Restricted

NEW YORK'S building restriction ordinance which has been under discussion for three and a half years, and has involved an exceptional amount of investigation, including a study of the restriction experience of foreign cities, was finally passed on July 25 and at once became law. It marks a great forward step in American city planning. Other American cities have had building height restrictions and some even have had industrial segregation. The New York ordinance includes both, and in very detailed form. It recognizes the many factors that necessarily exist in a grown city, and imposes the restrictions with due regard to these factors. Height limitations vary from the width of the street in strictly residential districts to two and a half times the street width in the financial district. Tenement and apartment houses, in their proper zones, may go up to a height of one and one-half times the street width, while a rule of twice the street width applies to a large part of the more intensively developed commercial and industrial sections. Those who want further details regarding the restrictions will find them in the Engineering Record of Feb. 26, 1916, page 284.

Road Bill Not a Pork Measure

SOME NEWSPAPERS, though not many, have referred to the federal road-aid act as a pork-barrel measure. Far be it from this journal to defend the odious system of trading for votes which has made the river-and-harbor and the public-buildings bills notorious. In the ordinary sense of that term the road-aid bill was not a "pork" measure. Trading for the advantage of one's own district was out of the question, for the apportionment of funds was made by general rule and not left to the whim of Congress or to that of any government department. Furthermore, the expenditures are to be subject to close government scrutiny; the money is not freely turned over to the states to do with as they wish, as was proposed by some congressmen. The Engineering Record has not altered its position on federal aid—namely, that it were better to have the states do their own work without the aid of federal funds. Road-aid appropriations, however, were inevitable, and the act as passed seems to have provided all the safeguards needed.

Congress and the Railroads

APPROVAL of a Senate resolution by the House of Representatives on July 15 gives assurance that there will be an inquiry, by a congressional committee, into the railway transportation problem of the country. It will be remembered that in his last annual message the President suggested a commission to investigate "the exceedingly serious and pressing transportation problem." Though the House made certain amendments to the Senate resolution, they are of a minor character and there is but little doubt that the measure in substantially its present form will go to the President and that he will sign it. The house resolution requires that the report be rendered next January, a very short time for a very broad inquiry. The resolution indicates the scope of the investigation. It covers not only the matter of government regulation, but also the protection of the rights of shippers and carriers, incorporation of the transportation companies, and government ownership not only of railways but also of telegraph, telephone and express lines. It is gratifying to know that Congress has accepted the President's suggestion and will try to understand the railroad problem clearly before attempting further legislation.

Hogs as Waste Consumers

TO many municipal officials and to some engineers the disposal of garbage by feeding to hogs may seem like a simple process and one beneath the careful study of technical men. The article on page 135, describing Denver's successful hog-feeding plant, should convince them to the contrary. Thousands of dollars have been spent in Denver in experiments on comparatively unimportant details. Few methods of procedure or types of construction are now retained as they were originally planned. Economy and efficiency have, of course, entered into all of the experiments. If a water supply, for example, required a laborer's full time to clean out a time-honored V-trough, a more sanitary one was devised and the laborer's wage capitalized to put it in. Moreover, such structural problems as the best type of, and material for, feeding troughs and sleeping floors needed careful attention, for a poorly fed or uncomfortable hog puts on fat slowly. These details are mentioned here and in the article to impress upon municipal officials and engineers that hog feeding is no less a scientific technical problem than is the operation of a reduction plant or a sewage disposal works. The hogs are just as hard to handle and require just as much care and scientific treatment as a bacteria bed. In Denver there seems to be money in the business, too. The sanitary end in a more humid climate may not be so simple as in the arid regions of the West, a point that should be carefully considered by Eastern men who may be attracted to the possibilities of the hog method of disposing of garbage.

A Shock-Absorber

"AMERICAN industry is being equipped with a shock-absorber." This expression, introducing the leading article in this issue, describes graphically the big idea back of the industrial survey being made under the auspices of the Naval Consulting Board. The military side of the work—adequate preparedness for a conflict—has been widely advertised, but Mr. Tomlin's article, this journal believes, is the first clear-cut expression of the industrial side of the problem. The majority of Americans have applauded the military purpose of the census. They have seen how England and Russia courted defeat through their lack of industrial preparedness, and that it took fully a year and a half after the declaration of war before these countries had the manufacturing side of their warfare on a satisfactory basis. Our citizens, though, have given little thought to what would happen, on the declaration of war, to the man with a factory. Would he be obliged to close his doors over night because of the collapse of the market and the enlistment of his men? Could he, in the face of powerful competition, get war orders or men to execute them should he get the contracts? These questions are to be solved in advance, and if that terrible contingency, war, ever comes, the industries of the country are to slip quietly from ways of peace to those of war. Not least among the important features of the plan is the creation of an industrial reserve force so that the men whose greatest value to the country is at the lathe, and not in the trench, will be kept from the firing line. England had to learn at bitter cost the folly of letting skilled mechanics and foremen enlist. Thanks to the work of Mr. Coffin and his organization we may expect to avoid that disaster. The work, organized and carried out by engineers, is one in

which the engineering profession should be especially interested. The Engineering Record takes great pleasure, therefore, in presenting an authoritative account of what is being done.

The Nation's Business

THE TITLE used for this note, "The Nation's Business," is that employed for the journal of the Chambers of Commerce of the United States. It aptly describes the activities of this organization, which, while comparatively young, has already made a strong impress upon the business life of the country. The chamber and the journal afford a forum where the business men of the nation can express themselves on large public problems. The latest number of the journal, for example, discusses the resolution proposed by the chamber, and introduced in the Senate by Senator Newlands, which would direct the Interstate Commerce Commission to make an inquiry into the wage controversy pending between the railroads and their employees, and also gives the results of a vote on the question of universal military training. The vote on this question, by the way, was overwhelmingly in favor of such training. These activities of the business men of the country promise well for future legislation. While the views expressed cannot alone be governing, they should have great weight with the members of Congress. At least, the Senate and the House of Representatives will have no doubt where the business interests of the country stand on important questions.

Civil Engineering After the War

AS NOTED in these pages July 15, the European Allied Powers are carefully studying the problem of economic recuperation. They are, however, not alone concerned with export-trade conditions. They realize that internal readjustment is just as important. In fact, internal disarrangement, if it exist, is sure to render abortive much of the Allied co-operation that has been planned.

An editorial in our esteemed British contemporary, *Engineering*, is indicative of the careful consideration which is being given all phases of the expected industrial situation. It points out that preparations must be made well in advance for the reception of the skilled and unskilled workers coming back from the front. There will be available a large army of men accustomed to open-air life, full of the virility "engendered by the simple and strenuous life of the trenches and eager for physical work of a remunerative character." Civil engineering works, it rightly contends, should afford the openings which the returning veterans will seek. It, therefore, urges that broad schemes be now planned and taken in hand even before hostilities cease in order that the places may be open when the army returns. It especially urges that comprehensive railroad and highway schemes be set on foot. In many of the large cities, and in the neighborhood of London particularly, there is great need for new street-opening work and new rural highways to relieve congestion. If their construction is under way at the termination of the war not only will the workers be available but the immense fleets of motor trucks now in service at the front will be available for the necessary transportation work.

If it be objected that the financial situation does not permit such anticipatory measures *Engineering* replies that the "government must afford assistance on the principle that it is better to advance loans to municipal authorities and to public corporations for the prosecution of work of a profit-yielding character rather than to organize benevolent schemes for the help of men and their families who are unable at once to find employment."

While in this country we do not face identical post-bellum labor conditions, there is every reason for feeling that there will be a most acute labor situation here when Europe stops fighting. While it may be possible to prevent inroads of cheap imports from Europe it is not to be expected that we will be equally successful in maintaining our foreign trade. Could we maintain or increase that, we should have prospects of employing the labor released from munitions making. As it is we are almost certainly facing a labor surplus. That will mean that men now getting enormous wages must accept a reduction. Reduction will be taken with bad grace and industrial conflict must be expected.

It is apparent, therefore, that while conditions here are not identical with those in England there is just as great need for a careful consideration of the disposal of our labor after the war as there is of that abroad. We should have one great advantage over England in that money will likely be plentiful here. That should stimulate domestic activities, and in a domestic revival, since we cannot hope that our foreign trade will save us, lies the only prospect of relief. But relief even from that source could be only partial. The readjustment of the wage scale would still give trouble. The country, however, would be the gainer by whatever extent we were able without disturbance to transfer our energies to the activities of peace.

Practical Significance of Yield Point in Steel

IN AN EDITORIAL on the elastic limit of steel in the last issue of the Engineering Record reference was made to the definition of yield point proposed by one of the committees of the American Society for Testing Materials. The term was defined as "the load per unit of original area at which a marked increase in the deformation of the specimen occurs without increase of load." In a recent discussion of the relation between yield point and proportional limit of steel, abstracted in the Engineering Record of July 15, page 78, to which allusion was also made in the before-mentioned editorial, a prominent testing engineer asserted that the term yield point is essentially "vague and uncertain," and that "the most that can be said about it is that a structural member loaded up to its yield point will suffer a certain amount of permanent strain." If that is in reality the only physical significance that attaches to yield point, it may pertinently be asked why it should continue to be, as it has long been, the only requirement relative to elastic strength in nearly all specifications for structural steel.

Amid the bewildering discussion of "what we don't know about the elastic limit," directed essentially to its strictly scientific aspects, with which the engineering profession has recently been regaled, it may be profitable to consider briefly, by way of practical orientation, what engineers do know about the yield point.

Aside from the ease with which the tensile yield point can be determined in commercial testing, for materials possessing a true yield point, it may be rightly claimed that there is no physical constant which furnishes a more reliable criterion of what may be called, in a practical sense, the extreme life limit of structural steel, both in tension and compression, when used for structural purposes.

Thus, while a tension member "will suffer a certain amount of permanent strain" under stress even far below the yield point, the strain or deformation that a member of average length will exhibit at or slightly above the yield point becomes one of inches, so that the practical usefulness of the member is at an end, even though its stretch should not prove the indirect cause of the immediate failure of the structure. Obviously, this consideration does not apply to tension members, such as chains, used as separate units, which are commonly subjected to proof loads above the yield point for the detection of defective welds, and to improve their elastic behavior. In such instances the permanent initial elongation of the member may not only be unobjectionable, but beneficial, insuring increased rigidity under service conditions.

Again, for steel compression members the yield point in tension is approximately equal to the maximum unit stress that such members are capable of developing momentarily before failure, though only under the most favorable circumstances. These circumstances are that their slenderness ratio must not exceed the limit beyond which this factor will influence their ultimate strength, and that they must be so well designed that premature failure through faulty details will not occur.

The essential identity of yield point in tension and ultimate strength in compression, though long evidenced by tests of columns of carbon steel of relatively small cross-section, was strikingly confirmed in the recent report of tests of columns with relatively large sectional areas made under the direction of the Bureau of Standards. In these tests, reported in this journal July 1, which embraced columns of high-carbon steel and various alloy steels, the ultimate strength of the columns which failed as integral units differed by only one-half per cent from the average yield point of the material in tension. Moreover, the individual results fell invariably within the observed range of the yield point.

While our knowledge of the practical significance of the remarkable physical change which occurs at the yield point is

concededly imperfect, there can be no doubt that its observance in commercial testing is abundantly justified, irrespective of any future trend toward greater refinements in testing.

The Failure of Government Railway Ownership in Canada

ENGINEERS on this side of the Dominion boundary are acquainted in a general way with the sad experiences that Canada has had with the public financing of railways. The case of the National Transcontinental, which so greatly exceeded its estimated cost of construction that the Grand Trunk refused to carry out its agreement to lease the line, is still fresh in mind. Much less is probably known by our engineers regarding the lines which the Dominion has long owned and operated. In the June number of the *Journal of Political Economy* Samuel O. Dunn, editor of the *Railway Age Gazette*, presents a study of the finances of these lines under the title, "The Failure of Government Ownership in Canada." In his usual lucid and convincing style, he analyzes and weighs the figures, not drawing his conclusions until he has examined the subject from every angle so that all modifying factors are given proper consideration. His study is particularly interesting just now because the congressional resolution directing an inquiry into our railroad situation requires a report on the merits and disadvantages of government ownership. And Canadian conditions, be it remembered, are more like our own than are those of any other country.

There is one point fundamental in Mr. Dunn's argument. We have no doubt that all thinking men will readily concede it. He maintains that in order to learn what the government owned and operated railways of Canada have cost the people of the Dominion the deficits and interest thereon must be charged into the cost account, for evidently the investment represented and the losses incurred appear in the government debt and the interest paid on it. If the earnings of the railways had sufficed to pay their expenses and interest, the government debt and the interest charges would be proportionately smaller.

A second point of great importance is that in any comparison of privately owned with government-owned railways it should be remembered that the privately owned lines pay taxes, while publicly owned lines pay none. In other words, a government-owned line to be equally successful, compared with a privately owned line, should earn more than the latter by the amount of taxes it would have to pay if not owned by the state.

The railways owned and operated by the Dominion are the Intercolonial, the Prince Edward Island and the National Transcontinental, having a total length of 3803 miles. The Intercolonial has been owned for 47 years, the Prince Edward Island for 43 years, while the National Transcontinental has only recently been built. The last named is eliminated from Mr. Dunn's study, since the experience with it, from the operating side, has been so brief. Moreover, of the remaining roads the Intercolonial is the more important. It has 1457 miles of line, while the Prince Edward Island has 279 miles. The latter, further, is a narrow-gage line serving a restricted territory and may not be representative. For that reason the comparisons with privately owned lines in Canada and the United States are based on the Intercolonial's showing.

Official reports of the Intercolonial and the Prince Edward Island railways show the cost of the lines to be $112,351,000, or $64,718 per mile. Mr. Dunn maintains, however, that their cost to the Canadian public has actually been $381,000,000, or $219,000 per mile. This figure has been obtained by charging as part of the cost the successive deficits and the interest thereon. This enormous unit cost exceeds the average capitalization of any railways in the world except those of Great Britain, despite the fact that the lines are almost entirely single-track railways, are not very well constructed, maintained or equipped. Assuming that the physical value of the roads is equal to their officially reported cost, the difference between their present value and the total amount they have cost the Canadian public is $268,000,000, or $134,378 per mile, and this, as Mr. Dunn aptly puts it, "represents the absolute loss they have inflicted on the taxpayers of Canada." And this estimate is really an under estimate, for it makes no allowance for the taxes the government would have collected from them if they had been privately owned. If the Intercolonial and Prince Edward Island were taxed at the same rate as the railways of the United States, their taxes would be $600,000 a year.

The total deficit during the entire operating history of the lines is $12,800,000. A striking commentary on these losses is offered by the Windsor branch (32 miles long) of the Intercolonial, which has been leased to operating companies since 1881 and since 1911 has been operated by the Canadian Pacific. In every year but one since 1881 the government has received net earnings from it.

Having set forth the end results of the operation of these lines, Mr. Dunn inquires as to the reasons for the deficits. His discussion of rates is entirely too intricate to be touched on here. Suffice it to say that while those of the Intercolonial are lower than the rates of privately owned lines in the same territory, there are competitive and other conditions which are largely controlling. The principal reflection on the management on account of the rates is that under private ownership the length of the Intercolonial would probably have long since been reduced by means of a cut-off so as to place it on a competing basis with other lines in the same territory.

When the distribution of the operating revenues is studied, however, the reasons for the unfavorable showing of the Intercolonial become very apparent. The eastern lines of the Canadian Pacific operate through territory in every way similar to that served by the Intercolonial, and a comparison with it is therefore fair. While the Intercolonial spent 16.66 per cent of its total operating expenses for maintenance of way and structures, the Canadian Pacific eastern lines spent 21.87 per cent. On the other hand, though the Intercolonial's total traffic is only about 6.5 per cent heavier than that of the Canadian Pacific eastern lines, its cost of maintenance of equipment per mile is 11.5 per cent greater, its cost of conducting transportation per mile 13.5 per cent greater, its traffic expenses per mile 16.5 per cent greater, and its general expenses per mile 30 per cent greater. The smaller expenditures for maintenance of way and structures are partly due to the fact that, on the whole, its roadway and track are not kept in as good condition as those of the Canadian Pacific, and partly, Mr. Dunn suspects, because its low figures for maintenance of way expenses are largely fictitious, items that ordinarily are charged to maintenance going into the additions and betterments accounts.

And fundamentally, what is the cause of the Intercolonial's unfavorable showing? It comes back in the end to the politicians and the people. The officers in direct charge of the property have had little incentive to manage it well. The public and Parliament have not demanded this as the stockholders and directors of a railway company do. Consequently there has been a feeling of indifference regarding results on the part of officers. With reference to these lines the *Montreal Gazette* said on Oct. 21, 1915:

"Almost every abuse known to railroading took root and flourished, such as underbilling—that is, permitting a favored shipper to load the cars with a larger quantity of goods than he paid for, while his competitors on the other side of politics were restricted to a standard load and mulcted for any excess; the granting of secret rebates; the maintenance of an excessive number of stations and employees in order to swell the political influence of the road at election time; absurd classifications; unjust tariffs; the acquisition of more or less useless branch lines to serve partisan ends, and so on."

Mr. Dunn makes it clear that the present management is trying hard to eliminate the abuses and that it is not responsible for the conditions that have persisted in the past and that have resulted in the deficits above discussed.

Taken all in all Mr. Dunn's study is a most illuminating revelation regarding government railway operation under conditions substantially the same as our own. Canada's experience should give pause to those who look forward to a regime of government ownership and management in this country. Calm thinkers believe that we are surely drifting in that direction. Every sane man, however, will hope that long before that end is reached the public at large will have learned how difficult it is to expect efficiency from government management of large projects. With our shameless exhibition every year of a greedy scramble around the river-and-harbor and the public-buildings pork barrels, we have not even reason for turning to Canada to find out what will happen if the railways of the United States are thrown into the political arena.

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"SKILLED MECHANICS MUST BE KEPT FROM ENLISTING IN THE ARMY AND RETAINED IN THE MUNITION PLANTS"

Industrial Inventory by Engineers Will Stabilize Nation's Business in Crisis, Says Howard E. Coffin

Chairman of the Naval Consulting Board's Committee of Civilian Engineers, in Engineering Record Interview, Explains Method of Collecting Data on 35,000 Manufacturing Plants as National-Defense Measure

By ROBERT K. TOMLIN, JR.
Managing Editor of the Engineering Record

AMERICAN INDUSTRY is being equipped with a shock-absorber. It is in the form of the country-wide inventory of manufacturing resources which members of the five national engineering societies—civil, mechanical, electrical, mining and chemical—headed by Howard E. Coffin, chairman of the Naval Consulting Board's committee on industrial preparedness, are completing not merely as a measure of national defense but as a stabilizer of the nation's business in the event of a crisis. Primarily, of course, the object of the work, as explained to me by Mr. Coffin last week, is to insure for the Army and Navy an adequate supply of munitions and the countless other manufactured products which would be needed in the event of a war. This is the popular conception of the committee's task. But in providing in advance for these war-time demands the consummation of the committee's plans will insure the continuous employment of labor under any conditions which may arise and relieve the economic structure of the United States from strains which the impact of impending hostilities would ordinarily create.

IN ITS ESSENCE the problem which the industrial-preparedness committee of engineers is solving resolves itself into a nation-wide readjustment of production for war-time conditions and a consequent reallocation of labor from one industry to another. It is a case of determining, prior to a declaration of hostilities, the character and volume of manufactured products needed in the United States for both military and civil consumption, of providing plant and equipment for their output, and of recruiting for a vast army of industrial reserves the men best qualified to carry out the program contemplated—men whose services would be far more valuable at the lathe than in the trenches. Thus the effect of the work will be to create a huge mold into which the nation's business may be poured at quick notice and allowed to cool, without cracking, instead of surging at white heat in the crucible of an industrial crisis. From the data on the organization and output of the country's manufacturing plants, now partly collected by the Naval Consulting Board's committee, the size and shape of this vast mold and the plan of filling it are being accurately determined.

Interwoven with the activities of the committee are important legislative provisions already enacted or now pending. They relate to such vital matters as the creation of a permanent Council of Executive Information, to which members with wide experience in the several branches of industry will be appointed; an analysis of manufacturing facilities; the conversion of plants for war-time production and the obligatory filling of government orders; the procuring of a supply of gages, dies, jigs and tools needed in the production of munitions; the construction of a federal nitrate plant; and the filling of small "educational orders" by manufacturers in time of peace. While the committee at present is, in name, an advisory arm of the Navy, three-quarters of its work has been with the War Department.

"Our inventory," said Mr. Coffin, "is being confined to manufacturing plants of all types which are doing a gross annual business of $100,000. Certain smaller organizations are on our list, but the $100,000 concern is, in general, the criterion by which the scope of our work is controlled. On this basis our canvass will include about 35,000 industrial establishments. As to organization, we are backed by the resources of the five national engineering societies, representing a membership of about 30,000 technically trained men, and the work is apportioned by states, each state having a board of five members, one from each of the five engineering societies. These men are responsible for getting results in their territory. They are doing this work, at large personal sacrifices, without remuneration of any sort and are calling upon the fellow-members of their several professions for such assistance as they need.

"Our first task was to determine what information was most needed by the Army and Navy, and we have devised a blank form of eight pages calling for data under eight general heads, as follows: (1) Business and administrative; (2) plant; (3) manufacture and production; (4) labor; (5) transportation; (6) possible future arrangements; (7) inventory of manufacturing and producing equipment; (8) field notes (to be supplied by the Naval Consulting Board's representative). There is also included with the blank form a supplemental sheet for special data not provided for under one of the eight headings."

Mr. Coffin drew one of the industrial blank forms from a drawer in his desk. Under the "Business and Administrative" heading it calls for such items as the character and scope of the organization, the names and addresses of its executive officers and the names of the directors and principal stockholders. There are questions, also, concerning the physical value of the plant and the banks at which its business is done. The committee is evidently attaching great importance to the nationality of the plant personnel, for the questions "American citizen?" and "If not American citizen, country of birth?" appear several times in the inventory, referring both to the executive officers and to the employees in the lower grades.

Under the second item of the inventory,

"Plant," the questions relate to location, number and size of buildings, fire-protection system, power and water-supply service, capacity, housing of employees, facilities for plant enlargement, telegraphic and telephonic communication, etc.

Details regarding materials used and products manufactured are called for under the third classification. Inquiry is made regarding the normal slack season each year and the general system of marketing the product. An important question in this section is "Has plant facilities for construction of jigs and tools?"

In its queries regarding labor the blank form inquires as to the general labor conditions and the history of the plant's experiences with the union. There are also questions relating to the percentage of skilled and unskilled workers and the possibility of replacing men with women in certain departments. Information as to the possibility of night work is called for, and there is a query pertaining to the nationality percentages of the employees.

The fifth subdivision of the blank form deals exclusively with data on transportation facilities.

EDUCATIONAL ORDERS

Under the heading "Possible Future Arrangements" questions are asked regarding the plant owner's willingness to bid on government contracts and to accept what the committee terms a "minimum annual educational order." This feature Mr. Coffin emphasized as one of the most important elements of the committee's work. "In any large manufacturing plant," he explained, "it takes about a year to change models. Take the case of an automobile factory, for instance. To equip it for manufacturing shrapnel shells would require not only an analysis of the machinery and a large supply of special gages, jigs and machine tools—and these take a long time to produce—but also the development of a skilled working force familiar with the detail of making the new product. Using the data from our industrial inventory we might decide, for example, that the plant of Jones & Smith, manufacturers of farm machinery, could be adapted to the production of 6-in. shells. We would then place with this concern an order for ten of these shells a year, payment to be made on the basis of actual cost of production plus a reasonable profit. All special gages, jigs, etc., would be supplied by the government or made up and held subject to government order. Jones & Smith would fill the educational order and, in so doing, train a few of their men in the duties of this special service."

Thus would be produced a nucleus, in actual plant and personnel, around which could be built up on short notice an organization for handling large orders under conditions of urgent need. The manufacturer agrees that the minimum annual educational order shall be put through his factory in regular course and in such manner that foremen and those holding positions of responsibility shall become familiar with the peculiarities incident to the manufacture of these goods. In the event of war the manufacturer would be expected to concentrate upon this same product, and it is essential, therefore, that his entire organization, including purchasing, manufacturing, inspection, shipping, engineering, cost-keeping and administrative departments, be made familiar with the work. Minimum orders are not of sufficient size to interfere with a manufacturer's regular production.

INDUSTRIAL RESERVE NEEDED

Closely associated with the minimum educational-order scheme is the organization of a great industrial force capable of supplying the material needs of the armies in the field. "England's colossal blunder at the outbreak of the war," said Mr. Coffin, "was to allow many of her skilled mechanics to go to the front. Some of her shops which could, with a slight readjustment, have been converted into munition-producing sources were almost entirely stripped of their labor force. France did not make this mistake in the same degree. She had a close record of her labor through her system of universal military service and soon had most of her skilled mechanics back in the shops. Getting down to a more recent case, we have the example of the mobilization of the National Guard of the United States which was begun a month or so ago. The munition and tool-making plants in New England, I have been informed, have lost many foremen, department heads and skilled workers who were members of the National Guard and were called out for field service. Thousands of these expert workers planned to enlist in case of a further call for volunteers. Here, as in England, the best men are sure to be the first to volunteer. We are embarking on the same suicidal policy that England followed. Its effect in the mobilization of only about 100,000 members of the militia for service on the Mexican border is, of course, not serious, but our present lack of system in segregating the men who should fight from those who should produce the materials of warfare would demoralize our manufacturing organization in the event of a call for even half a million men. Think of the absolute wreckage, industrially, in our manufacturing, transportation and communication systems should we call for three or four million men, as will be necessary in case of trouble with any first-class Power. Skilled mechanics in all lines of production must be kept from enlistment in the Army and must be retained in the factories, mills and mines for the production of munitions. They must be kept on the job also on the railways and in the telegraph and telephone services. It is essential, therefore, that the names of these skilled workmen be listed and that the men themselves be enrolled in the Industrial Reserve."

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HOWARD E. COFFIN
Chairman of Naval Consulting Board's Committee and Directing Genius of the Nation-Wide Industrial Census

It is proposed that a button or other distinguishing mark shall be supplied by the government in the event of war to skilled workmen enrolled in the Industrial Reserves. Such enrollment shall be considered to carry with it honors equal to enrollment in the fighting army.

The last two pages of the industrial-inventory blank forms are devoted to manufacturing and producing equipment—calling for a description of work for which the equipment is best fitted and a summary of the classes of tools and machinery available—and field notes embodying explanations of special details given by the Naval Consulting Board's local committee members.

HOW INVENTORY IS MADE

Information for the industrial inventory is collected both by mail and by personal visits of local committee members to the plants. Each case is handled according to its own requirements. There is no standard form of procedure. The inventory forms, as soon as they have been properly filled out, are forwarded by the state heads of the survey to the main office in New York City. Then begins the work of analyzing the data, classifying them and reassembling them in a form best suited to the purposes they are intended to serve. In this work the civilian members of the committee are being assisted by a special board of officers consisting of Colonel Abiel L. Smith of the Quartermaster Corps, Major William E. Connor of the General Staff, Major Douglas MacArthur of the General Staff, Captain Richard H. Somers of the Ordnance Department and Captain Charles S. Wallace of the Signal Corps. These men are working in close co-operation with W. S. Gifford, whom Mr. Coffin has appointed supervising director of the survey. Captain Somers has direct charge of the work, in the office, pertaining to the analysis of inventory returns.

The information on the inventory forms is, obviously, of a strictly confidential character, and the first task of the headquarters office is to reduce it to code form. The work has been so completely systematized that all the information about a large manufacturing plant can be transferred to a card $7\frac{1}{2}$ in. long and $3\frac{1}{4}$ in. wide, of which

a sample is shown on this page. On this card are printed 45 columns of code numbers, the proper ones being punched by a special machine to convey information regarding a specific detail from the inventory blank. Thus a punched mark in the tenth column of the fifth line of printed numbers on the card might indicate that a certain foundry was well equipped to turn out tools and machinery for small arms and ammunition. A second punched mark might convey the information that 75 per cent of the employees were American citizens. A third hole in the card might mean that the transportation facilities at the works were not sufficient for handling a large output. The card, in reality, is the entire plant inventory in capsule form.

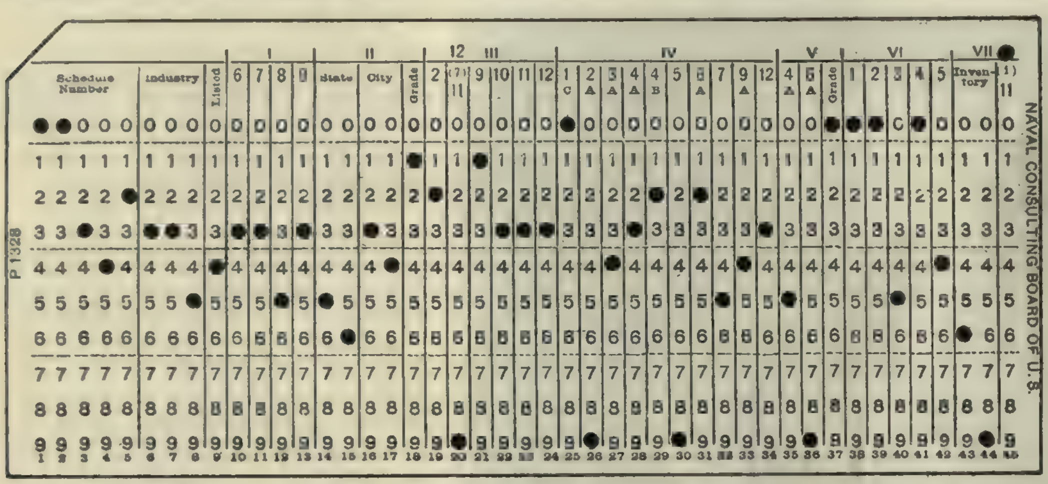
Cards Sorted Automatically

After Mr. Coffin had explained the scheme by which the inventory-form data were transferred by code punch marks to the small cards I asked him to describe the system by which the cards were filed so that detailed information could be available for quick reference. "The cards are not filed according to any system," he answered; "that is, no orderly arrangement or classification is followed except that all cards referring to one state are grouped together. Later we may still further classify by cities if found advantageous. That machine over in the corner is our automatic filing clerk. Suppose, for example, that we want to discover what plants in Michigan employ toolmakers. We merely set our automatic sorting machine to the code number corresponding to toolmakers and run the cards through the machine. Its mechanism picks out the cards we want and discards all others. One of these machines will sort cards at a rate of about 260 a minute. It's just like running a perforated music roll through a pianola."

Of the 35,000 industrial plants scheduled for inventory, reports have already been received in the office from about 15,000. A great many more are still in the hands of the state boards. In view of the fact that the field work was started only June 1 this achievement is a great tribute to the efficiency of the nation-wide system for collecting the statistics and to the men who devised it and placed it in operation.

Surprises in Plant Output

The results of the census have brought to light some surprising facts concerning the adaptability of plants to the manufacture of products for which they were never intended. A jeweler of national reputation, whose products are popularly associated with weddings, has the equipment to produce bronze castings for high-speed submarine destroyers. A manufacturer of threshing machinery expressed the belief that he could make 600 6-in. shells per day. A foundry agreed to turn out tools and machinery for rifles and ammunition, and a maker of pocket knives volunteered to produce various lines of munition supplies. A maker of underwear saw an opportunity to use his plant for the manufacture of bandages and other Red Cross supplies, while a steel-spring manufacturer stands ready to supply bayonets and sabres. A crushed-stone company saw where it could play a large part in maintaining good roads against the wear and tear of modern military transportation, while a tailoring concern expressed a desire to make up uniforms. A gas-manufacturing plant finds that it can supply pure refined benzol and tuluol and can be extended to work up coke byproducts. A famous linotype company stated that it had a large quantity of lathes, drills, milling machines and other tools adapted for the production of shells, fuses, accurate machine tools and small metal parts requiring extreme precision.



THIS CARD, PROPERLY PUNCHED, CARRIES IN CODE FORM ALL THE INFORMATION ABOUT A LARGE MANUFACTURING PLANT

Co-operation Imperative

The committee on industrial preparedness has been instrumental in demonstrating to manufacturers the desirability of hearty co-operation in the census work. There are, according to Mr. Coffin, four reasons which have combined to make the census a success. In the first place, all interests concerned in this work are actuated by patriotic motives. Secondly, manufacturers who can adapt their output to the needs of the Army and Navy are effectively insured against a shutdown in time of war. Thirdly, every large employer of skilled labor will know in advance what work he will be called upon to do and will therefore be able, in large measure, to hold his labor organization together. Last, but far from least, that manufacturing plant which cannot or will not put its equipment into the government service, either in the production of Army and Navy materials or supplies for the civilian population, must, of necessity, be stripped of its labor and tools for use in other fields. From the standpoint of labor the industrial census has a tremendous significance. It means that skilled men will be kept at work in the shops and will not be mustered into active service. "Sweat, not blood, must be labor's contribution to war," according to Mr. Coffin.

"The whole foreign struggle," Mr. Coffin concluded, "has been one of production. Germany was organized for it, and to this she owes the military successes she won early in the war. The Allied Powers were totally unprepared and are just beginning, now, to reach a condition of industrial efficiency. Our Army of the United States is exceedingly small. To make it effective we must back it up by organized industry. Our resources are great, but they must be organized on definite lines if they are to be of any real use in an emergency. A close-working organization of our industrial resources by the nation's engineers and manufacturers is what we need most today, and it is, in the end, the cheapest kind of preparedness."

Federal Road Allotments as Listed Incorrect

Apportionment Provided in Bill Reported in Issue of July 8 Correctly Tabulated with Percentage and Amount to Each State

Owing to the use of a table conforming to the provisions of a previous bill, the allotment to the various states of the appropriation in the federal good-roads bill passed June 28 and signed by the President July 11, reported in the issue of July 8, page 42, was incorrect. The apportionment is to be made to each state according to area, population and mileage of rural delivery and star routes. The table herewith shows the per cent allotted to each state and the correct total amount for 1917, after deducting 3 per cent for administrative purposes. The amounts for each state for the succeeding years 1918, 1919, 1920 and 1921 will be respectively two, three, four and five times the amounts given in the last column of the accompanying table.

Allotment of Federal Road-Building Funds to States—1917

State	Per cent of apportionment	Amount of apportionment
Alabama	2.144	$104,000
Arizona	1.435	69,600
Arkansas	1.697	82,300
California	3.115	151,100
Colorado	1.736	84,200
Connecticut	0.638	30,950
Delaware	0.166	8,050
Florida	1.121	54,350
Georgia	2.773	134,500
Idaho	1.255	60,850
Illinois	4.576	221,950
Indiana	2.812	136,400
Iowa	3.014	146,200
Kansas	2.975	144,400
Kentucky	2.012	97,550
Louisiana	1.359	65,900
Maine	0.975	47,300
Maryland	0.883	42,800
Massachusetts	1.520	73,700
Michigan	3.013	146,150
Minnesota	2.921	141,700
Mississippi	1.828	88,650
Missouri	3.511	170.300
Montana	2.017	97,850
Nebraska	2.214	107,400
Nevada	1.339	64,950
New Hampshire	0.433	20,600
New Jersey	1.216	58 950
New Mexico	1.647	79,900
New York	5.170	250,750
North Carolina	2.328	112,900
North Dakota	1.568	76,150
Ohio	3.874	187,900
Oklahoma	2.365	114,700
Oregon	1.629	79,000
Pennsylvania	4.781	231,900
Rhode Island	0.241	11,700
South Carolina	1.482	71.950
South Dakota	1.675	81.250
Tennessee	2.365	114,700
Texas	6.021	292,000
Utah	1.159	56,200
Vermont	0.472	22,850
Virginia	2.040	98.950
Washington	1.465	71,050
West Virginia	1.101	53,400
Wisconsin	2.644	128,250
Wyoming	1.275	61,850
Total	100.000	$4,850,000

Plank Roadway Laid Across Shifting Desert Sands

Road Near Holtville, Cal., Built of Units Assembled in Yard and, When Placed, Surfaced with Oil and Sand

BETWEEN the Imperial irrigation district and Yuma, Ariz., a distance of about 50 miles, the greater part of the country to be traversed by the state highway is an arid desert. About midway of this section a range of low sand hills crosses the route selected, forming a belt about $6\frac{1}{2}$ miles wide, through which travel has been practically impossible on account of the character of the soil. These sand hills are from 20 to 200 ft. in height, and are composed of a very fine, uniform-grained sand, similar to that used in an hour-glass. This sand is so fine and dry that when a handful is picked up, and the hand turned over with the palm down, the sand cannot be grasped tightly enough to prevent nearly all of it escaping through the minute crevices in the closed fist. Under the action of the wind, it drifts like huge snow banks, the hills generally having a flat slope toward the direction from which the wind comes and a very steep slope on the opposite face. This steep slope is so unstable that by scooping with the hand a small hole in the bottom of the slope the entire face above will be affected.

YARD WHERE UNITS ARE BUILT—THREE ASSEMBLY TABLES ON LEFT

WIND MOVES HILLS

The wind does not blow constantly from one direction, but the general movement of the hills is in a southeasterly direction, the average advance being apparently only a few feet per annum. Some of the smaller hills and drifts, however, will move a number of feet during a single windstorm, and on this account the location of a standard type of concrete pavement would be inadvisable because of the impracticability of successfully combating the movement of the sand.

Under plans prepared by the California Highway Commission, 6 miles of portable plank roadway are now being constructed through the worst sections of this desert. This roadway will be 8 ft. wide, with double-width turnouts every 1000 ft., where two cars can sidetrack to allow others to pass on the main line. The roadway is built of 4-in. planks, solidly spiked to three stringers underneath, and, in addition, three strips of steel, $1\frac{1}{2}$ in. wide by $\frac{1}{4}$ in. thick, are placed on top of the spikes to prevent the latter working loose, and are bolted through at intervals of 2 ft. One-half-inch carriage bolts are cinched up tight by means of nuts and washers under the bottom of the stringers.

The individual units are 12 ft. in length, weighing about 1500 lb. each, and are rigidly joined together by bolts and iron straps to prevent displacement. The only work done on the foundation before placing the plank units was to level off the sand with fresnos and road machine. When the units are placed, each one is worked back and forth so that the stringers settle in depressions and the planks rest directly on the sand crowded up between. Shoulders will be scraped up level with the top of the roadway for a width of 4 or 5 ft. on each side, and the planks, together with the narrow strip of leveled surface on each side, will be coated with hot road oil and then covered with coarse sand or fine gravel, as is customary in the case of the standard concrete roads. The planks will have two coats of road oil and sand, which should effectively prevent slivering and wear of the wooden surface.

SHIFT ROAD TO AVOID DRIFTS

A small force of men and teams will be stationed in the vicinity of the plank road to clear away promptly small drifts as they occur, and to make, from time to time, such minor repairs as may be necessary. Whenever it is found that there is advancing across the road a sand hill of such size that it cannot successfully be removed, a short piece of the roadway will be taken up and shifted to one side to avoid the drift. A traveling crane has been built for use in laying plank units on the original location, and this will be available after completion to make such changes as experience shows to be necessary. One of the illustrations shows the crane in operation. After placing each unit it is moved along by hand on the plank runners provided for that purpose.

In ordinary locations, the life of a plank roadway of this type would probably be limited to four or five years, on account of rotting of the plank and timber sills; but on the desert, where the rainfall averages only 2 in. per annum, there is practically no moisture on the surface soil, and it is believed that the roadway, with proper care, will last at least 15 years.

CONSTRUCTION YARD EMPLOYED TO ASSEMBLE LUMBER

About 1,200,000 ft. of lumber was required for the 6 miles of roadway which is now being constructed, and to assemble this large amount of timber into units a construction yard was laid out, so that the work might be done with the greatest possible economy. At Ogilby, Cal., which is 4 miles from the nearest portion of the roadway to be constructed, but which is the nearest point where water could be had for the use of the men and teams, a fabricating plant was erected near the Southern Pacific Railroad. An overhead tramway was built to handle the lumber, and several hundred feet of trolley, with triplex chain blocks, were provided to pick up the completed units and transfer them from the three construction

OVERHEAD TRAMWAY DELIVERS TO PILE OR WAGON

CONNECTING THE UNITS UP TO FORM THE ROADWAY

GANTRY CRANE UNLOADING UNITS ON DESERT

tables, shown in one of the illustrations, to storage piles, and later to load them on the wagons for hauling to the work. Approximately 40,000 ½-in. holes, 8 in. deep, had to be bored, and for this purpose a small gas engine, operating from an overhead trolley, was provided at the yard and connected by a flexible shaft with hand drills. Ten-horse teams were used, which could haul nine units per load, including the capacity of the trailer, which was usually attached. The average haul was 7 miles.

A. B. Fletcher is chief engineer of the California Highway Commission. The work described in the foregoing was located in Division 7, of which W. W. Patch is division engineer and S. V. Cortelyou principal assistant.

Thirty-Seven Wells for Irrigation Project

Supplementary System in Tulare County, California, Is Planned to Supply 15,775 Acres of Citrus Lands

THE Lindsay-Strathmore irrigation district in Tulare County, California, has laid out an irrigation system planned to supply 15,775 acres of citrus lands. Of this total about 8000 acres, which are now producing crops, include some of the choicest orchard land in the state, valued at $2,000 per acre. The present water supply for the tract having become inadequate, it has been decided to sink wells in the delta of the Kaweah River, about ten miles north of the district, from which to procure a larger and cheaper supply.

The delta of the Kaweah River comprises an area of about 12,000 acres, which is believed to be an enormous subterranean reservoir, the material consisting of gravel and boulders. It is planned to sink 37 wells in this delta and to depend upon the underground storage accumulated during the period of maximum runoff, at which time the reservoir is filled to the point of saturation. It is expected to secure a total of 75 sec.-ft. from these wells and a seasonal delivery of about 26,000 acre-feet.

Turbine Pump for Each Well

Each well will be equipped with a direct-connected, motor-driven, deep-well turbine pump, operating under a total head of 100 ft. The water from all the wells will be delivered through a 60-in. reinforced concrete pipe a distance of 3½ miles to a ditch on the hills above the district. The ditch will have a length of 6¼ miles, will be lined with reinforced concrete and is to deliver 85 sec.-ft. on a grade of 1.92 ft. per mile. At the lower end of this ditch the water will be lifted by pumps to a high level ditch 160 ft. above.

This pumping plant will be equipped with three 16-in. horizontal, single-stage, centrifugal pumps direct connected to 500-hp. motors, and two 10-in. pumps of similar type driven by 200-hp. motors. The high level ditch will be built along the hills on the east side of the district and will have a total length of 5¼ miles. It will also be lined with reinforced concrete and is expected to deliver the same quantity as the ditch already mentioned, although its grade will be 5 ft. per mile. From its terminus the water will be delivered by gravity direct to the farmers. An additional booster station will be installed for raising water to the high level ditch No. 2, which is to supply the highest lands of the district. This station will be equipped with two 8-in. pumps arranged similarly to those in the larger stations, driven by 125-hp. motors. These will operate against a head of 160 ft. The system of mains and distributing pipes supplied by the ditches will range in size from 36 in. to 6 in. in diameter with a total length of about 95 miles. These pipes will be laid so as to deliver water under pressure at a designated point opposite every individual tract of land. All pipes up to 12 in. in diameter will be either of reinforced concrete or protected riveted steel. The latter type will be used exclusively for diameters exceeding 12 in.

The total cost of the work is estimated to be approximately $1,400,000. The entire plant is to be constructed during the present season; contracts are to be awarded, it is announced, about the latter part of June. C. W. Wright of Lindsay, Cal., is the secretary of the district, and Stephen E. Kieffer of San Francisco is the chief engineer.

Abandoned Bridge Difficult to Destroy

Heavy Charges of Dynamite Are Required to Demolish Reinforced-Concrete Structure Put Out of Service by Levee Extension Work

By J. H. WEATHERFORD
City Engineer, Memphis, Tenn.

IN connection with a levee system protecting certain low property in Memphis, Tenn., against floods of the Mississippi River, described in Engineering Record of June 10, page 775, a three-span concrete bridge 40 ft. wide and 120 ft. long, built in 1908, was abandoned and the old channel beneath filled up. This fill had its crown at a point about 10 ft. east of the concrete bridge and extended west along the bed of the old bayou to a junction with the levee fill described in that article. Fig. 1 shows the original levee, the concrete bridge destroyed, and a plate-girder railroad bridge also taken out. When the original levee fill was made, dirt which ordinarily would take a 1½ to 1 slope continually slid until it took the line indicated in the drawing as "top fill after slides," and it appeared to be necessary to quit on this fill until a later period, which was done.

Bents Under Railway Bridge

The two bents under the railway bridge each consisted of sixteen piles. The south one of these bents, which was almost directly in the channel, was shoved east and over half of the piles broken, so that it became necessary to cut them off and put in a temporary frame bent. The concrete bridge was carried on two abutments, extending well down into the bayou banks, and on two bents, each of four concrete columns 20 x 20 in. and 20 ft. long. These in turn were supported by a concrete sill 4 ft. square and 40 ft. long on wooden piles. These bents were apparently not disturbed by the original slide.

About 1912 it had been noted that the abutments were settling slightly and moving toward the center of the bayou, owing to the sliding of the banks. This settlement may be plainly seen on the north span in photograph 2. At the time the photograph was taken—May, 1916—the north abutment had sheared off under the end of the bridge and decided cracks had opened up north and south of the center columns, showing that these columns were carrying loads considerably greater than those for which they were designed.

High Water Changes Plans

At the time the first settlement was noted it was determined to underpin the two abutments, so as to prevent further movement; but the high water of 1912 in the Mississippi River made it apparent that a protection levee and pumping station would have to be built and extensive work be done to protect the city against overflow. It was decided as a part of this work to abandon the bridge and fill the bayou under it. No attempt was made, therefore, to protect the abutments or stop the sliding.

The work of filling under the bridge was begun about May 1, and, in order to check the effect of the sliding from the west, the fill was first made east of the bridge with old concrete and brick, as shown in Fig. 1.

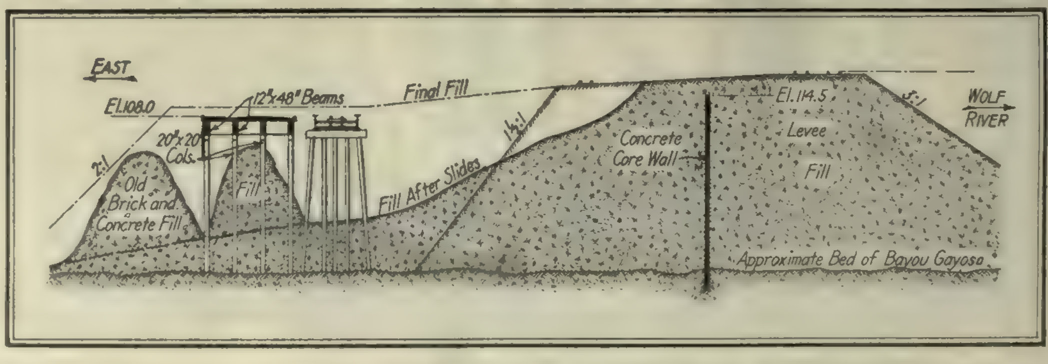
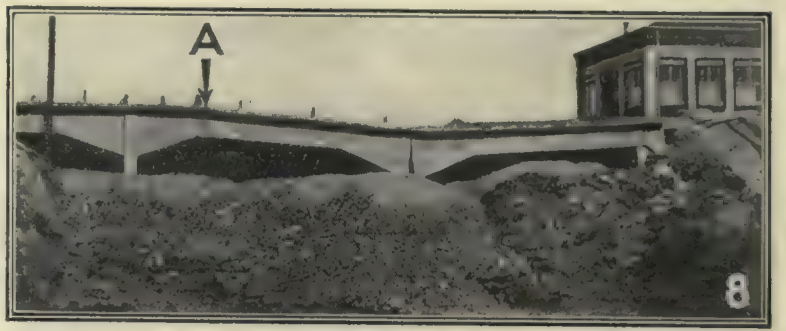


FIG. 1— FINAL FILL WILL ENGULF SITES OF BOTH CONCRETE BRIDGE AND RAILROAD STRUCTURE



Concrete Bridge Stubbornly Resists Dynamite

1—ORIGINAL LEVEE FROM WHICH EARTH SLID DOWN TOWARD CONCRETE BRIDGE, CAUSING CRACKS IN COLUMNS

2—SLIDING OF FILL CAUSED SETTLEMENT OF NORTH SANDS

3—THE OUTSIDE COLUMNS EITHER SLID ON THE CONCRETE FILL OR BROKE NEAR THE BOTTOM, MOVING OUTWARD

4 AND 5—FURTHER MOVEMENT OCCURRED AS THE FILLING PROGRESSED

6—RESULT OF SHOCKS OF TEN STICKS OF DYNAMITE ON SOUTH COLUMNS OF EACH SIDE

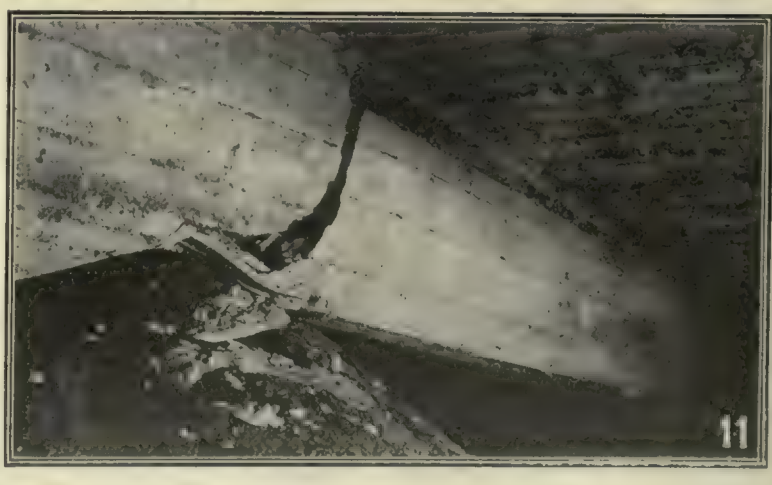
7—EFFECT OF SECOND SHOCK ON SAME COLUMNS

8—CRUSHED POINT IN EAST GIRDER BETWEEN NORTH AND SOUTH COLUMNS

9—CLOSE VIEW OF BREAK AT "A" IN PHOTOGRAPH 8

10—AN EXAMPLE OF LACK OF LONGITUDINAL BARS IN BRIDGE FLOOR AND IMPERFECT BOND BETWEEN FLOOR AND BEAMS

11—INTERIOR BEAMS WHICH FAILED



Numerous holes were cut through the bridge and the work of filling under the bridge proceeded as rapidly as possible. In spite of the previous heavy fill made on the east, the dirt underneath shoved three columns of the north bent of the concrete bridge eastward and one column west. The interior columns apparently held at the bottom and crushed near the bottom of the bridge girder. The outside columns either slid on the concrete sill or broke at some point near the bottom and moved out as shown in the two photographs, 2 and 3. Further movement occurred as the filling progressed, as shown in photographs 4 and 5. As the condition of the bridge then appeared to be extremely dangerous, dynamite was resorted to and an

endeavor made to break it down. Photograph 6 shows the result of a dobey shot of ten sticks of dynamite on the south column of the east side, and photograph 7 the effect of a second shot on the same column. Dynamite was then extensively used to complete the destruction, it being found necessary to put from four to ten shots against each girder before it would entirely collapse. The bars were slightly bent, but none was broken.

The column reinforcement is clearly shown in photograph 7. Vertical bars only were used, without hooping.

The most interesting feature developed is shown in photograph 5, in which it will be seen that the four smooth bars, although they were embedded fully 8 ft. in concrete above the point of the break, slipped without developing any apparent reduction in area. The twisted bar, however, which does not show in the photograph, pulled in two, thus showing that the full strength of the twisted steel was developed, but not the full strength of the smooth bars. It is to be noted, however, that the smooth bars had not been anchored at the top or the bottom as the best practice requires. While this photograph shows the concrete broken away around the bars above the break, this did not occur until they had pulled out of the concrete and continued sliding had broken the beam away from the column at that point. So far as a careful examination could determine, the break in the column was a clean break at the point shown in the photograph.

The concrete used in the bridge was proportioned six sacks of Portland cement to a cubic yard of Mississippi River sand and gravel, and the extreme difficulty in destroying the structure, as shown by the amount of dynamite necessary to demolish it, shows the wonderful tenacity and power of resistance of reinforced concrete.

Photograph 8 gives a view of the bridge corresponding to photographs 4 and 5, and shows a crushed point in the east girder between the south and north columns. Photograph 9 is a close view of this same point, which also shows in photograph 10. Photograph 10 also shows the lack of longitudinal bars in the bridge floor and imperfect bond between this floor and the beams. This, however, was developed largely by the dynamite. Photograph 11 is a view of one of the interior beams which failed at the same time that the outside beam failed.

After two of the columns in the south bent had been dynamited, and the north bent had entirely failed, an endeavor was made to crush the bridge by piling up a dirt load, but although approximately 6 ft. of dirt was spread over the entire structure, it did not even then fail until dynamite was extensively resorted to.

Gasoline Tractor Developed in Power Ditching

New Machine Hauls Itself and Equipment Over Soft Ground and Draws Plow Cutting Ditch of 21 Square Feet Cross-Section

By FRANK C. PERKINS
Buffalo, N. Y.

THE LATEST development in cable-drawn plows for excavating drainage ditches of sizes too small to be economically handled by a dredge is the gasoline traction engine, mounted on caterpillars, shown in the photograph.

About 40 years ago a ditching plow was invented for such work and used in western Indiana. It had a double mold board and cut a ditch about 4 ft. wide on top, 2 ft. deep and with a bottom width of less than 1 ft. In making a ditch at one cut 80 oxen were used to draw the plow. The next step in the development of this type of ditching machine was the use of home-made wooden capstans and manila rope to draw the plow. Later wire rope, with better built capstans having self-anchoring devices, was introduced. Horses were used to haul these outfits and to turn the capstans. As more powerful equipment was developed, the plows were enlarged and built of steel. A standard outfit of this type consists of one plow drawn by two capstans using several thousand feet of steel cable. The plow cuts a ditch 8 ft. wide on top, 3 ft. deep and 18 in. in bottom width. It is equipped with wings on each side which push the earth back so as to leave a clear berm of 3 ft. Two ¾-in. steel cables, one to each capstan, are used. To the 14-in. vertical drum of each capstan is attached a 24-ft. sweep, to the end of which four horses are hitched abreast. The horses describe a circle almost 50 ft. in diameter to wind in 3 to 4 ft. of cable. Relays must be used, and ordinarily about 20 animals are necessary for each outfit. In ground free from stumps and rocks such an outfit can cut 100 rods or more of ditch per day. Frequently 50 miles of ditch in a season are cut at contract prices ranging from $1.25 to $2 per rod.

The gasoline machine which is replacing these outfits consists of an engine supported on two long caterpillars 30 in. wide, which carry a 16-in. diameter cable drum 24 in. long. This drum is driven from the main shaft of the 60-hp. engine and is geared to give a rope speed of 14 to 18 ft. per minute, depending on the amount of cable on the drum. About 1000 ft. of 1⅜-in. wire rope is used. When, on account of difficult ground or for other reasons, the tractor must be set at greater distance from the plow, removable lengths of 500 or 600 ft. of wire rope are attached between the plow and the end of the cable.

In operation, the plow, removed from its four wheel carriage, is left at the starting point of the ditch, the cable attached to its beam. The tractor moves ahead to the proper point on the line of the ditch, paying out the cable as it advances. The traction gear is then released and the drum thrown in. As soon as a strain is taken on the cable, two anchor flukes, visible in the photograph at the forward end of the machine, drop to the ground and bite in as the tractor moves backward until the latter is securely anchored. When the plow is drawn to the end of the cut, the drum is thrown out of gear and the traction thrown in. As the tractor advances, the anchors ride up from the ground and are hooked up in the clear by power.

TEAM DITCHING OUTFIT AND 60-HORSE-POWER GASOLINE

TRACTOR THAT IS TAKING ITS PLACE ON DRAINAGE WORK

One man and a helper are required to operate the tractor, while another man rides the plow. A team and driver are employed in hauling supplies, and a cabin on wheels, presided over by a cook, furnishes food for the crew. The plow, weighing 4 tons with its removable truck, a wagon loaded with cable and supplies and the cook wagon are hauled by the tractor over ordinary country roads at the rate of 2 miles per hour. Although the tractor weighs 15 tons, its large bearing surface enables it to travel over swamp lands too soft to support a team. A plow of increased size, which will cut ditches 2 ft. in bottom width and 3½ ft. deep, is used with the tractor.

It is said that the first tractor has proved so successful that several others are to be put in use during the summer by ditching contractors.

Highway Commission Exonerates Contractor in Part for Poor Workmanship

Contractors are not always entirely to blame for poor workmanship, in the opinion of Clinton Cowen, state highway commissioner of Ohio, as expressed in a paper presented at the last annual meeting of the Ohio Engineering Society. "His methods and manner of carrying on work," he added, "are based a great deal upon precedent. If he has been allowed by the engineer, on job after job, or year after year, to employ methods and carry on his work in a manner detrimental to the best construction, it must be expected that he will base his future work on such procedure, and I cannot see that he is to be censured for this so long as the engineers permit him to violate approved methods."

Five Thousand Hogs Eat Denver's Garbage

Successful Piggery Keynote of Solution of Garbage Disposal by Feeding Process—How Hogs Are Kept Immune

WHY the garbage-disposal problem in Denver has been solved, with apparently so little friction has been a mystery to many an Eastern city official. Successful disposal by feeding to hogs has generally been considered a process restricted to comparatively small cities; nevertheless, the garbage of Denver, with its 225,000 people, has gone to a hog ranch for the last ten years, and the process is more of a success to-day than ever before. With these questions in mind, and many others, a representative of the Engineering Record made an inspection recently of the hog ranch to find, if possible, the "key." A successful hog ranch of enormous proportions, on which garbage is not the only diet, seemed to be the answer.

CONCRETE FEEDING SLAB ON LEFT AND FARROWING PENS AND SHED ON RIGHT

City Put to No Expense

Probably no other city of the size of Denver has such a contract as it has. There is no money consideration, but the city has no investment even for collection. The Denver Hog Ranch Company agrees to collect and dispose of the garbage in an efficient manner. Every day the downtown district is covered. Twice and three times a week the residential districts are served. This frequency is reduced during the coldest winter months. The company pays an inspector to handle complaints, but his authority comes from the city. Twice a day he gets records of complaints from the complaint clerk in the City Hall. He is furnished with a Ford truck, which enables him to carry two garbage cans. His business is to remedy the immediate condition, carry away a can, if necessary, and then adjust the matter so that the collector will do his work satisfactorily in the future. Perhaps a route is too large, or the collector is indifferent, for angels do not drive garbage wagons. The point is that there is a definite check, quickly applied. There are eighteen teams, fifteen of them serving the more congested districts, making two trips per day. The drivers are paid $40 per month plus board and bunks at the ranch.

Steel tanks holding 600 gal. are mounted on ordinary running gears. The rear end slopes up at an angle of 45 deg., and provision is made, if desirable, to dump the tanks by lifting the front end and rotating over the rear axle.

The horses and mules are kept in a barn at the ranch. The stable is of wooden construction, with haymow above. There are two rows of stalls facing a 12-ft. concrete passageway, down which an industrial track is laid for the distribution of feed. The comfort of the horse is conserved by letting him stand on a clay floor. Back of the stalls is a runway of concrete 6 ft. wide. Whether or not goats will prevent horses from getting sick, it is an old observation that they will. Nevertheless, since one has been allowed the privileges of the stable the horse mortality has been reduced to practically nothing.

Pen Arrangements

In the plan of the hogpens, the various grades are separated for the purpose of feeding the balanced ration considered best, from experience, for the particular age and period of the hog's life. The farrowing shed, 504 ft. long, is a wooden structure 30 ft. wide, with 8 x 10-ft. pens on each side of a 10-ft. passageway. Connected with the inside pen is an outside 8 x 16-ft. feeding pen. These pens are all floored with 2-in. plank. As a harder floor makes the hog uneasy, the floors in all the pens where the animal sleeps are of wood. Garbage is fed direct from the tank wagons to the outside pens of this shed, as shown in one of the photographs, driveways being provided on both sides of the shed. On the opposite side of the driveways are 50 x 200-ft. fattening pens, where the feeding is done on concrete slabs. There is a fence on each side of this slab, with gates across the slab. Hogs being fattened will not entirely clean up garbage, so lean pigs and recently bred sows are let in to clean up the whole runway after the fatteners have finished. The sows are then driven out into a pasture. Each day the residue on these slabs is cleaned off into pick-up wagons, which deposit the material on a filling dump about ½ mile from the ranch. This is not a refined process of cleaning, shovels only being used. One other set of pens—those where the young pigs are weaned and then vaccinated—completes the different classes. They are 8 x 30 ft. outside, floored with concrete, and a 6 x 6-ft. shed floored with plank. When the young pigs are removed, the pens are cleaned out and sterilized with creolin.

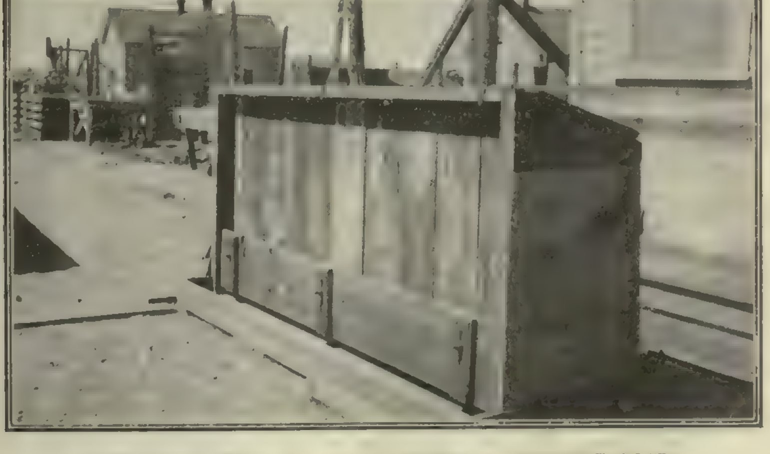
Cholera Cure Found

One of the principal things which make the system a success is that of keeping the hogs free of cholera. The whole herd of 5000 is immune, and a laboratory where serum and virus are prepared under the direction of skilled operators has been in operation six years. A new commercial serum plant, with twenty rooms in the laboratory and numerous outside pens for 500 hogs, was built this summer to afford a supply to hog growers throughout the country. This is a byproduct of the piggery, but it is one which made it a success financially. Cholera kills $50,000,000 worth of hogs per year in this country; the ranch company loses none, and sells guaranteed immune stock.

Another point is the balanced ration. Garbage alone will do, but a balanced ration is much preferred, as it makes better pork. Alfalfa is fed to excess in all the pens. Corn, swill, and finely cut alfalfa are used for fattening.

Water Supply

Water arrangements have been given much thought. Formerly a V-trough ran down the front of all the pens. This is still the system in the farrowing shed, but a



CONTINUOUS FEED BOX HAS SLOTTED ADJUSTMENT BOARD

WATERERS ARE SET IN CONCRETE—NOTE SLIDE FOR INSERTING LAMP

board is placed over the whole length, except for a space about 10 in. long, so that the animal can only get her nose into the trough, and thus not foul the stream or clog the trough. Outside, the troughs have been abandoned, as it required one man's time to keep the troughs clean, especially in winter. Two hundred Ideal hog waterers have been installed. These are patented, but the scheme was brought to perfection on this ranch. They consist of a circular galvanized hood with a small sector about 10 in. long indented for the water, which is controlled by a ballcock, to come up from below. In winter, a lamp is placed under the hood to prevent the pipes from freezing. Warm water keeps the hogs contented, and rushes the fattening process.

Do Not Sterilize Garbage

One of the things that could not be done was to sterilize the garbage. Several years ago there was much agitation against feeding raw garbage. The ranch company, therefore, spent $20,000 on a cooking outfit. The hogs did well on this ration for about sixty days, and then began to lose weight. Experts found organic acids were formed which at first stimulated the stomach, but finally irritated it. The plant consisted of a dumping platform, conveyors to tank cookers heated by steam from two 80-hp. boilers, and an elevated storage tank. As the cooked garbage was wet, a tank feeder was built with spouts on each side, through which the garbage could be discharged onto the feeding platforms. Mechanically everything worked out successfully, but the hogs could not stand the cooking.

Little Odor

As to odors, they were scarcely noticeable at the time of the inspection, in June, although the visit was made in the morning, before the pens had been cleaned for the day. However, it was explained that we were at a commercial hog ranch, not at a breakfast-food factory. Within five minutes after entering the grounds no odors at all were noticed. The drying effect of the atmosphere no doubt contributes greatly to this condition. The ranch is 5 miles from the business center of the city and about 2 miles from the outskirts. No complaints of a nuisance have ever been made.

One of the byproducts is the recovery of silverware for the hotels. Bones are put through a crusher driven by an 80-hp. engine. Approximately 21,600 tons of garbage are handled per year, and 150 tons of bone meal obtained. The Denver Hog Ranch Company gets about 60 per cent of the garbage, the remainder being cared for by private scavengers.

Plot Canal Cross-Section Notes in the Field

Cross-section plats of the finished canal sections on the 624 miles of canals in the Little River Drainage District of Missouri are made in the field directly from the observed readings, no other notes being taken. Thin cross-section paper is used and extra carbons are made, one for the chief engineer's file, one for the contractor and one for the resident engineer. William A. O'Brien, chief engineer, states that the method is simple, satisfactory, rapid and enables the engineer to check any unusual condition at once, whereas it might not be found if notes only were taken.

Long Move for 800-Ton Residence

Sharp Curves, Steep Grades and 40-Foot Trestlework Necessary in California House-Moving Job

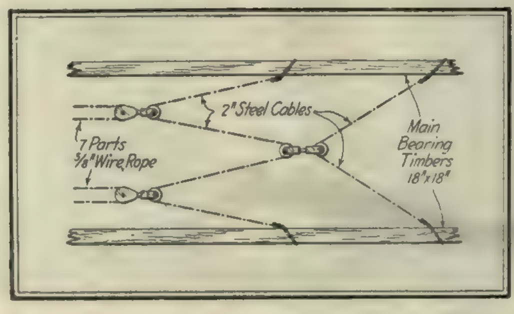
THE OLD Colonel Crocker residence in Hillsborough near San Francisco was recently purchased under the agreement that it would be removed by the buyer without injury to the trees of the estate. The house was built many years ago when massive construction was the custom. It is four stories high and 85 x 135 ft. in plan. There are about 33 rooms, several built-in safes and six large chimneys, one of which is estimated to weigh 45 tons. The total weight of the structure is roughly calculated to be about 800 tons.

800-TON HOUSE DESCENDS GRADE ACROSS GULLY ON 40-FOOT TRESTLE

It was found that the moving operations would necessitate a trestle 300 ft. long across a ravine and a 500-ft. grade down which the house must descend at the rate of 1½ in. per foot. The most difficult condition, however, was sharp curves required to avoid cutting trees. In one case a right-angle turn had to be made in about 400 ft. A runway of standard house-movers' cribs was built ahead of the structure as it advanced. The rollers ran on a bed of 12 x 14-in. stringers resting directly on the cribs and without post supports. Where the runway was highest the cribs were held in place with 12 x 12-in. braces placed every 20 ft.

In raising the structure from its old foundations five rows of 10 x 12-in. beams were placed lengthwise directly under the floor joists of the building. Then 12 x 14-in. crossbeams spaced 3 ft. apart were set directly under these longitudinal beams. Where chimneys or other extra-heavy loads were concentrated at one point the spacing of crossbeams was decreased or extra beams were provided. Seven were placed under the 45-ton chimney. Short 14 x 16-in. spring beams were laid beneath and parallel to the crossbeams, and rested in turn on two lines of 18 x 18-in. timbers running the full length of the building. Thus the load was finally centered on these two 18-in. beams, which bore directly on the 8-in. rollers and to which was applied the pull for moving the structure along the runway.

The pull was supplied by two two-horse teams on capstans operating 7-sheave tackles rove with ⅝-in. wire rope. The tackles were attached to a 2-in. cable fastened to the 18-in. beams in such a way as to equalize the strain and prevent a greater pull coming on one tackle than on the other. The dead end of the hauling rig was secured by digging a 10-ft. trench 30 ft. long. The trench was bulkheaded with 8 x 10-in. timbers and in it were placed four upright 14 x 14-ft. posts 10 ft. long. Around these posts at the mid-point a 2-in. cable was wrapped and led thence to a convenient point for attaching the tackle. The building traveled usually at the rate of 20 ft. per hour, attended by a crew of 18 men.



HITCH PREVENTED UNEQUAL PULL ON TIMBERS

Eight Circular Runways Beneath Shoring

Just before descending the steep grade it was necessary to swing the house through a half turn. This was done by building up eight circular runways beneath the shoring and providing each with rollers. A plumb line was hung at the center of the shoring, and each roller was pointed toward this so as to bring it to a true radial position. When this improvised turntable was ready the pull was applied at opposite corners in opposite directions, and by changing the direction of pull from time to time the half revolution was successfully completed.

The building was purchased from the Crocker estate by Charles J. Lindgren of Burlingame. Ellis Anderson, a Burlingame house-moving contractor, superintended the work.

Tests Show Activated-Sludge Process Adapted to Treatment of Stock-Yards Wastes

Sanitary Engineers of Armour & Company Report Results of Experiments Conducted at Union Stock Yards in Chicago

THE activated-sludge process of sewage treatment will satisfactorily purify the industrial wastes from the Packingtown factories of Armour & Company. The space required will be small and, if the sludge can be dewatered cheaply, the cost will be comparatively low. These, in short, are the conclusions arrived at by the officials of Armour & Company after an extended investigation by their sanitary engineers, M. D. Harding, assistant superintendent; G. L. Noble, engineer, and Paul Rudnick, chief chemist. From Mr. Harding the following information regarding the work has been obtained:

Packinghouse Sewage Complex

This sewage is very concentrated and varies widely in its composition, as may be judged from the various manufacturing departments where it originates—beef slaughtering, sheep slaughtering, rendering, cold storage, stick plant, fertilizer works, degreasing plant, wool house, chemical laboratory, lard refinery, oleo plant, butterine factory, soda-fountain supplies factory, hog killing, pork curing, canned meats, power plant and the domestic sewage from 10,000 employees. According to the report on industrial wastes from the stock yards and Packingtown, made to the Board of Trustees of the Sanitary District of Chicago in October, 1914, the minimum analysis showed 58 parts per million of suspended solids and the maximum 2760.

Taking an average of all analyses made by the Sanitary District for each of the three Armour sewers and computing from records held by the mechanical department regarding the flow through each, the results show the average suspended parts per million for the day-and-night flow to be 700.

Analyses made by Armour & Company in recent investigations, however, show a slight reduction from this figure. This sewage, which originates from so many different sources and which contains so much solid material, is necessarily a difficult sewage to treat.

Preliminary Experiments

Armour & Company were the first packinghouse firm to experiment with concentrated industrial wastes, and there was some speculation as to whether the effect would be the same as that produced in more dilute domestic sewage. To determine this, sewage from the beef-slaughtering house was aërated in a tank 5 ft. long, 1 ft. wide and 12 ft. deep, with an open-air jet. In about twelve days the sludge took on a flaky appearance and settled fairly rapidly, although the clearer portion was still a yellowish color. The red color of the sewage was also changed to a brown. The vat was allowed to settle, the clear portion was drawn and fresh sewage was added every 12 hours. In this way, a clear, stable effluent was almost always obtained.

Occasionally it was difficult to get the desired result. Then it was decided to aërate a vat until a chemical analysis showed that the reduction of the complex nitrogen bodies was complete. Approximately 15 per cent of the volume of the tank was filled with previously aërated sludge containing about 99 per cent moisture and fresh sewage from the beef slaughtering was added to make up the remainder. The whole was then aërated with the following results:

Aëration of Beef-Slaughtering Wastes

	Nitrogen as				
Time	Albuminoid Ammonia	Free Ammonia	Nitrites	Nitrates	Putrescibility
Fresh...	153.1	27.9	...	...	Positive
2 days.	129.0	34.0	0.5	...	Negative
4 days.	90.8	44.0	1.5	...	Negative
6 days.	55.9	69.8	6.4	...	Negative
9 days.	41.0	45.4	35.0	...	Negative
11 days.	9.3	26.4	44.0	0.7	Negative
16 days.	6.5	0.8	130.0	2.7	Negative
18 days.	2.8	...	0.1	9.8	Negative
19 days.	0.8	...	0.4	13.5	Negative
20 days.	0.8	0.6	0.3	16.0	Negative
21 days.	1.2	0.4	0.5	14.0	Negative

The foregoing analyses were all made according to the standard methods of the American Public Health Association. The first result was obtained by analyzing the entire sample. The other analyses were made on the clear portion after the sludge had settled out.

Repetition Brings Quicker Results

Three facts stand out clearly in the table, according to Mr. Harding. First, oxidation was complete in 18 days; second, there was a loss of nitrogen in the effluent; and third, the methylene-blue test or the putrescibility, recommended by the American Public Health Association, gave a negative result after only two days' aëration, and long before the effluent was clear.

As soon as the composition became constant, the aërated sewage was allowed to settle for 45 min., the clear portion was drawn off, fresh sewage added and the mixture was again aërated until the process was complete. After repeating this a few times the period required to get the desired result was wonderfully shortened.

On adding fresh beef-slaughtering sewage to an equal amount of sludge containing about 99 per cent water a nonputrescible effluent was obtained after 2 hours' aëration, although the reduction of suspended solids was not as great as would have been obtained with a longer period of aëration.

A Small Continuous-Flow Plant

In the foregoing experiment the contained sludge would flake quickly and settle rapidly. These two facts—a quick settling sludge and a stable effluent—were enough in themselves to indicate great possibilities and to justify further research and experimentation. In other words, the bacteriological and chemical action involved was proved to be sound and unfailing, and the next step was to develop a continuous-flow plant so that the raw sewage, properly screened, would flow in at one point and a clear, stable effluent be continuously discharged at the other with suitable arrangements for disposing of the excess sludge accumulated.

The first continuous system used by Armour & Company for experimental purposes consisted of a box 4 x 3 ft. by 5 ft., built with horizontal, corrugated baffles in the aërating chamber and having the settling chamber in the same compartment, separated by a vertical baffle and built with a steep, sloping bottom so that the sludge would gravitate back to the bottom of the aërating tank. The idea was to give the sewage and air a longer flow by the use of corrugated baffles and at the same time trap some of the air in the corrugations, the supposition being that greater oxygen absorption would result. The air also gave a greater head to the water in the aërating side, causing it to flow into the settling chamber where the sludge was to settle and automatically return to the aërating tank and the clear portion overflow the edge. The results gained with this tank were not very satisfactory because it was so small that the flow of influent often clogged the small pipes.

The settling chamber was satisfactory from the standpoint of being undisturbed by the aëration. The sludge returned readily to the aërating chamber and a clear effluent was obtained. No data could be obtained as to air economy, but experiments on this point are now being conducted on a larger scale.

A 30,000-Gallon Tank

The necessity of a larger system was at once apparent, so the next step was to build a tank with a capacity of 30,000 gal. per day of 24 hours. It is this system, with additions made from time to time, that is in operation at present, and from which data are being collected that will enable the intelligent design of a plant large enough to purify the 5,000,000 gal. of sewage passing from the company's factories daily.

The data following are largely those obtained from operating the previously described system up to the present time. The plant consists primarily of five units: (1) Air pressure producing unit; (2) aërating tank; (3) settling chamber; (4) sludge storage; (5) sludge dewatering apparatus.

The air-producing unit at present consists of the air-compressing apparatus already in use in the power house. Whether a blower or a small compressor will be used eventually depends on the depth the aërating tank is built. If the aërating tank is built rather deep—say 20 or 25 ft., which, from data at present in hand, seems to be a desirable depth—then a compressor will be necessary. A blower would probably make the air cost more, considering the pressure necessary, and the load would be too great for a blower. The deeper tank will give a chance for greater absorption of oxygen from the air, which will help to offset the extra cost as the result of the extra pressure required. Of course, the depth of the tank will be determined by the space available, the nature of the footing, etc.

How Should Air Be Distributed?

The tank in which the sewage is aërated is 10 x 20 ft. by 10 ft., and is divided by a central partition lengthwise of the tank, with an underflow at one end. The sewage thus enters at one end of the tank, flows the full length, returns on the other side of the partition and is discharged at the same end at which it enters. This is probably the style of tank which will be considered standard for this purpose, as it provides for few changes in the sewer lines.

Manufactured porous plates were first used for distributing the air, being placed in the trough of a sawtooth shaped false bottom, but they were of uneven porosity

and gave a poor distribution. They were abandoned very soon and 1-in. galvanized iron pipe, perforated with 1/25-in. holes, 2 in. apart and staggered, were used instead. These pipes, Mr. Harding reports, give a very good distribution and have the advantage that they can be taken up and cleaned without shutting down the system. It is probable that a better method of distributing the air will be developed.

The sawtooth bottom in the aërating tank has also been abandoned as unnecessary. The specific gravity of the sludge is so nearly the same as that of water that the air keeps it thoroughly mixed with the sewage without the irregular bottom designed to bring any settling sludge back to the point of air discharge. This would probably not be true if the sewage were not well screened or passed through an effective grit chamber previously.

Underflow and overflow baffles are placed in the aërating tank about 6 ft. apart and are designed so that the sewage must take a zigzag course in addition to flowing up and down, thereby insuring a thorough mixing and preventing short-circuiting.

The settling chamber is built with a conical bottom so that the sludge will be concentrated at one point and easily siphoned off to the sludge storage. The settling period is about 40 min.

The sludge storage may be any shape tank where the sludge can be stored and aërated.

Dewatering Machinery

At present the dewatering machinery consists of small experimental machines, such as filter presses, centrifuges and driers. The company has not definitely decided what method of dewatering will be advisable.

The plant is now operating on the continuous-flow plan. It requires about 10 to 12 hours' aëration in the presence of 25 per cent of activated sludge to complete the action and make the continuous flow permanent. Then the sludge is further aërated for about 3 hours before being returned to the sewage chamber.

The amount of air used is 3 cu. ft. per gallon, or at the rate of 0.3 cu. ft. to a gallon per hour. The air is measured by means of an orifice and differential monometer and the water flow is gaged by a triangular weir.

The sludge resulting from this process has the following composition based on a 10-per cent moisture basis:

	Per Cent
Ammonia	5.57
Fat	5.54
Total phosphoric acid	2.05
Bone phosphate of lime	4.50
Water soluble potash	0.43

The value of the sludge as a fertilizer, therefore, depends upon its ammonia contents.

Much work has been done toward finding a practical method of dewatering the sludge. This material, not unlike activated sludge from domestic sewages, is light and flaky—having a specific gravity of about 1.02. The sludge which is siphoned from the settling chamber will average 99.5 per cent of water.

The first step in dewatering the sludge is further settling. The time of settling is naturally limited by two things—capacity and the fact that the sludge will become septic upon standing too long without air.

It has been found that the sludge can be reduced from 99½ to 99 per cent moisture with from 4 to 6 hours' settling, provided it is in the proper condition. This reduces the volume which must be handled 50 per cent. In other words, the sludge becomes so much more concentrated that there is just half as much moisture to handle. Experiments have shown that settling under hydrostatic pressure takes place with more rapidity, but seems to have but little effect in the reduction of moisture. What other steps will be employed remains yet to be determined. Centrifuges appear to be a possibility in reducing the greater bulk of this moisture. By this means the moisture may be reduced to 92 per cent or 90 per cent. The solid bowl pipe has been found preferable.

A drier preceded, possibly, by the use of a Worthington type filter press may be the other two steps in reducing this sludge to a 10-per cent moisture basis. These remarks are of necessity only tentative, as they are based on the experimental work accomplished to date. It is possible a better method than any here suggested may later be found.

Cost of Treatment

At present it is very difficult to estimate what the cost of operation will be, as it is not known what the expense will be to dewater the sludge. Following is an estimate by Mr. Harding of the cost per 1,000,000 gal. as judged from the data available to date:

Air 3,000,000 cu. ft. at $0.003 per M	$9.00
Drying and preparing sludge for fertilizer (2 tons at $6)	12.00
Labor (considering capacity of 5,000,000 gal.)	2.00
Total	$23.00
Byproduct 2 tons fertilizer (5 units ammonia at $2)	20.00
Probable cost per 1,000,000 gal. exclusive of interest, depreciation and repairs	$3.00

The cost of air will vary depending on the price of electricity. Depreciation, repair and interest will probably remain fairly stationary. It is hoped that the sludge dewatering cost may be materially reduced.

A rectangular plant seems to be the most feasible plan of construction. Aërating chambers, settling chambers, and sludge storage tanks may all be included in the plan to advantage, as has been done in the experimental plants of several cities. The amount of space required will be about one-tenth to one-eighth of an acre per 1,000,000 gal., depending on the depth of the system.

The problems yet to be solved present themselves in about the following order of importance: (1) Dewatering of the sludge economically; (2) best method of distributing the air; (3) the relative length of time of aëration of sewage and sludge; (4) unfavorable influence of rapidly changing temperatures of the sewage.

230,450 Tons of Explosives for Industrial Purposes Produced in 1915

The production of explosives in the United States, excluding exports, during the calendar year 1915, according to figures that the U. S. Bureau of Mines has received from manufacturers, was 230,450 short tons, as compared with 225,126 short tons in 1914. The report covers only the explosives used in coal and metal mining, and other industrial enterprises.

Railway to Haul 225,000 Tons to Hetch Hetchy Dam

Comparing Auto Trucks and Steam Railway Results in Selecting the Latter for 60-Mile Haul

IN PLANNING the general construction scheme for the Hetch Hetchy dam, which is a feature of the new water-supply system being built for San Francisco, a comparative study was made of costs of handling construction materials by auto truck and by specially constructed steam railway. The distance from the nearest railroad to the dam site, following the general line of the aqueduct, is about 60 miles, and about 225,000 tons of construction materials will have to be hauled in. After a study of the conditions, M. M. O'Shaughnessy, city engineer of San Francisco, under whose direction the entire project is being carried out, reported that the immediate construction of a railroad from Rosasco to the dam site would mean a saving in freight bills to the city of about $1,000,000.

Improvements Estimated at $600,000

Surveys were made of both highway and railroad routes, and it was found that grading, bridges, culverts and surfacing on the 29-mile stretch of highway between Hetch Hetchy and Hamilton would total, including all costs, approximately $600,000. This stretch of road the city is obligated to build, under the terms of the Raker act, regardless of the method adopted for transporting materials. Detailed estimates on the construction of the 60-mile railroad as a whole showed the cost of the entire line to be $1,665,000. Thus, subtracting the cost of the 29-mile stretch, the outlay expressly for the railroad would be $1,065,000.

The cost of operation and maintenance of the railroad was figured at 7 cents per ton-mile, or $4.20 per ton for the 60-mile haul. At this rate the cost for 225,000 tons would be $954,000, and this, added to the $1,065,000, would make a total of $2,019,000, or 14.9 cents per ton-mile. This railroad is figured as a line with a maximum grade of 4 per cent, and after the construction period ends it is intended to remove the track and open the route to automobile traffic.

Cost of Hauling by Motor Truck

As to the cost of hauling by motor truck, a portion of Mr. O'Shaughnessy's report reads: "During part of the work on Contract No. 1 for building the road between Hog Ranch and Hetch Hetchy dam site motor trucks were used to haul the contractor's supplies from Chinese to Hog Ranch, a distance of 46 miles. The distance from Hog Ranch to Hetch Hetchy dam site by the new road is 9 miles, making the total distance from Chinese to Hetch Hetchy 55 miles. If motor trucks are required to work over the existing roads between Chinese and Hamilton there will be considerable expense incurred for maintaining those roads in a condition fit for such traffic. The grades are very heavy in many places. Under these conditions it is hardly possible to predict on any logical basis what the cost of hauling will be, but it is quite safe to say that it will not be less than 25 cents per ton-mile, or $13.75 per ton for the 55-mile haul. Cost of transporting 225,000 tons of material at this rate will be $3,095,000. It therefore appears that there is a balance in favor of the railroad haul amounting to $1,085,000."

Economical Precast Stairway Design Developed for Panama Canal Lighthouse

Stair String Treads and Radial Supporting Beams Were Made at a Central Plant, the Newel Post Only Being Cast in Place

By WALTER F. BEYER
Former Assistant Engineer, Isthmian Canal Commission

SPIRAL STAIRWAYS of reinforced concrete built by the unit method have been successfully and economically tried out in lighthouses on the Panama Canal. It is believed that when they were designed and built in 1911 no other similarly constructed stairways were in existence. A number of spiral stairways of the monolithic type have been built, but as far as is known the cost on account of the elaborate forms required has been excessive as compared with the unit method of construction. For example, one of the former type, about 30 ft. high, described in the Engineering Record of Nov. 6, 1915, page 574, was recently built in connection with a concrete bridge at Glens Falls, N. Y., at a cost slightly less than $4,000. This included a bronze handrail, the cost of which is not known. By the unit method of construction the actual cost in place of the stairways on the Canal Zone varied from $81.79 for a stairway 12 ft. high to $525.75 for one 60 ft. high. These costs are exclusive of a $1\frac{1}{4}$-in. iron-pipe handrail, the estimated cost of which for the 60-ft. stairway is $200, but inclusive of division cost, which would be about equal to a builder's profit.

STAIRWAYS BUILT OF PRECAST REINFORCED CONCRETE UNITS

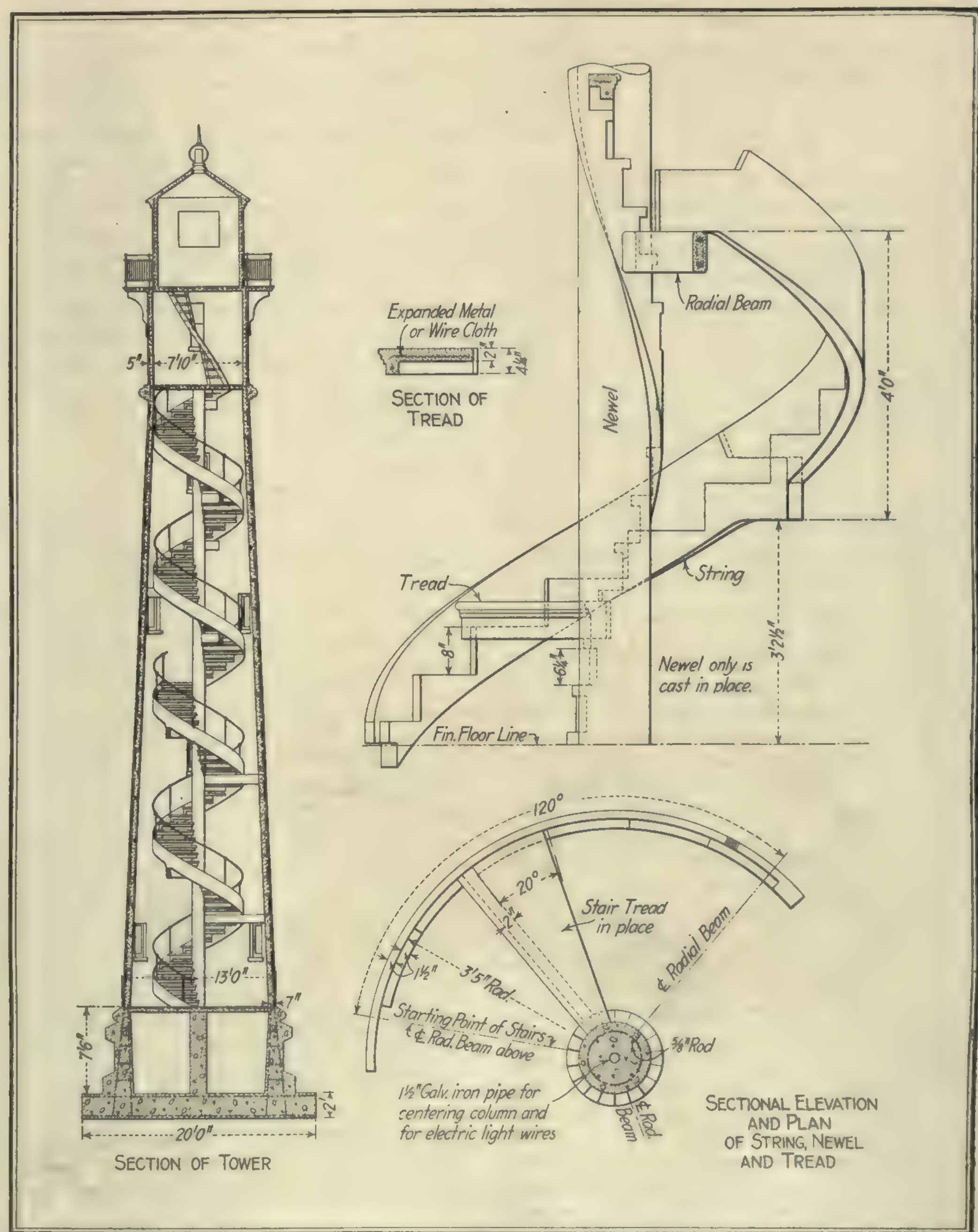
The stairways are built up of reinforced-concrete units precast at a central plant, and consist of stair string, treads and radial supporting beams, the newel post alone being cast in place as the tower was being constructed. The stair string, in the shape of a warped surface, was cast in 120-deg. sections about 9 ft. long, measured along the curve of the string, which is provided with rebates forming seats for the outer end of the stair treads. The inner end of the treads is supported by similar seats cast on the newel post. The string is 3 x 15 in. in cross-section and is reinforced with two $\frac{3}{4}$-in. rods, wrapped with No. 11 B. W. G. galvanized wire, having a 6-in. pitch. The upper and lower ends of the string are so shaped that one type of unit will serve for the starting unit, the terminating unit and the intermediate units. The heel of the starting unit is embedded in the concrete floor to prevent any slip, while the upper end rests on a support. In this case the support is a beam extending radially from the newel post to the tower wall.

The stair treads are cast in the shape of 20-deg. sectors, having a radius of 3 ft. $5\frac{3}{4}$ in., and are provided with nosing and apron. They are reinforced with a $\frac{5}{8}$-in. rod placed in the lower part of the apron, and with woven-wire cloth laid about $1\frac{1}{4}$ in. from the top surface, extending to within 1 in. of the inner and outer edges of the tread. By using 20-deg. sectors an easy run is obtained, the average width of the tread being about 12 in. As will be seen from the drawing, the apron comes to within $1\frac{3}{4}$ in. of the top of the tread below it.

In the construction of the newel post a $2\frac{1}{2}$-in. black iron pipe was used for the purpose of centering the column and for use as a conduit for electric-light wires leading to the lantern.

In erecting the stairway the matter of first importance is properly to orient the newel post and the starting unit of the stair string with respect to each other and to the final landing. As the newel post is cast in place it is oriented either by means of the slots provided for the radial beams or by the stair-tread seats. Similar slots are provided in the tower wall, their centers being 120 deg. apart horizontally and 4 ft. above one another vertically. In order to set the radial beams in place the wall slots are made about 2 in. deeper than is required, which permits the outer end of the beam first to be inserted into the wall and then, by sliding horizontally toward the center the inner end of the beam is inserted in the slot provided in the newel post. After the radial beams are in place and the mortar joints are sufficiently hard to carry the load, the starting unit of the stair string is set up, the heel is embedded in the floor and the upper end is rested on the first radial beam. Until the second unit is set in place it is necessary rigidly to shore the string so that it will maintain its proper position, which by virtue of its shape will, if not shored, have a tendency to lean out from the center. The second unit is then set up, its lower end resting in a mortar bed at the upper end of the starting unit. As soon as it is in place a shoulder of concrete between the outer face of the string and the wall is cast on top of the radial beam to keep the string permanently in place, thereby preventing any outward slip. The stair treads are then laid in mortar joints, preferably working from the top of the second stair-string unit down, in order to give the mortar sufficient time to set before being required to carry the weight of a man. The third, fourth, fifth and succeeding units of the stair string are similarly set up to convenient heights and the treads laid without the use of any scaffolding.

In high stairways an intermediate landing, as shown in the section of the tower, may be provided at any of the 4-ft. elevations by swinging the slots for the successive radial beams and the newel post stair seats as many degrees as are required for the platform.



SECTIONAL PLAN OF STRING, NEWEL AND ONE TREAD

PANAMA CANAL RANGE TOWERS HAVE UNIT-BUILT STAIRWAYS

A stairway thus built permits the use of treads and stringers of only one type in all conical towers, in spite of the fact that the higher towers have a greater diameter at the base than the lower ones. The only parts of those stairways which must vary in dimension to correspond to the batter of the tower are the radial beams, and they, too, are precast to the desired dimensions. Where towers are cylindrical, concrete lugs cast in the tower walls at their proper places may be used in place of the beam supports. If the height from floor to floor is not a multiple of four, the top stair-string unit may be cast to the desired length by using a cutoff in the forms.

The stairway in its simplest form presents a pleasing appearance, but this, however, may be enhanced by adding elaborate reinforced-concrete balustrades constructed by the unit method and mortared in place.

This type of construction also permits the use of a stairway of any desired diameter, for the cost of the forms is small, in many cases not more than $75.

Subsequent to the construction of the stairways described certain refinements in the design have been made by the writer, so that similar stairways can be built in the United States practically as cheaply as was done on the Panama Canal, where inferior colored labor was employed in the construction and where the cost of the forms was excessive.

Cement Production Decreases Slightly

An advance statement of final statistics of the Portland cement industry in 1915, compiled by E. F. Burchard of the U. S. Geological Survey, confirms the estimate, published Jan. 1, that there was a slight increase in shipments and a slight decrease in production and stocks as compared with 1914. The total shipments were 86,891,681 bbl., an increase of only 0.5 per cent over 1914, and the total production was 85,914,907 bbl., a decrease of 2.6 per cent. The average factory price, including all sections of the country, was $0.86 per barrel, as compared with $0.927 for 1914. Slight increases in the shipments and production in the Lehigh district are reported—24,598,950 bbl. and 24,876,442 bbl. respectively, representing 2.6 and 1.1 per cent increases over 1914. In New York State both shipments and production decreased—3.6 and 14.3 per cent respectively. Natural cement shipments decreased 442 bbl., but increased $7,257 in value compared with 1914.

Three-Hinged Arches and Curved Cantilever Roof Trusses Used in Recreation Building

Details of Steel Structure on Outshore End of New Chicago Municipal Pier Simplified by Avoiding Arch Action in Radial Trusses

BY SHIFTING the point of support in designing the radial trusses supporting the hemispherical roof in the recreation building on the new Chicago Municipal Pier, cantilever instead of arch action, with corresponding simplification of the detailing, was obtained. In this way, by utilizing the framing outside of the main structure, arch thrusts at the semicircular ring used to connect the radial girders to the main arches were entirely avoided. Another special detail of this building is the unusual riveted trusses and curved steel framing used above the proscenium to support the roof and the plastered ceiling. In the Engineering Record of June 19, 1915, page 778, the general features of this record-breaking 292 x 3000-ft. pier were described, including the substructure and the pier sheds with elevated boardwalk leading to the recreation building at the extreme outshore or eastern end of the pier. This steel-frame building, which is here described, contains a public hall about 135 ft. wide and 150 ft. long, with arched roof and hemispherical end.

General Dimensions

The span of the three-hinged arch trusses is 136 ft. 8 in., with a rise of 74 ft. 4 in. The rectangular part of the building on the west end is about 105 ft. long, consisting of four panels at 20 ft. with a 25-ft. end panel back of the proscenium. To support the arched roof there are four main three-hinged arch trusses and the special truss over the proscenium near the brick wall of the west end. On the east the semicircular end has a radius of about 59 ft., with a 24-ft. two-story outside extension carrying the promenade deck at the roof level. This two-story frame with its loading was utilized by connecting it with the curved radial trusses to insure cantilever action instead of arch action, as already mentioned.

The accompanying drawing of half-sections of the main trusses and this framing gives the principal dimensions and the materials used. A monitor 45 ft. wide and 7 ft. high extends over four panels and is carried around the semicircular end as indicated. The copper roof is attached to the $1\frac{1}{2}$-in. cinder concrete slab spanning the 5 ft. between curved channel rafters. These rafters are supported by plates above the longitudinal struts shown in the various sections and braced by the short bent rods at the ends, as indicated in the detail sketch.

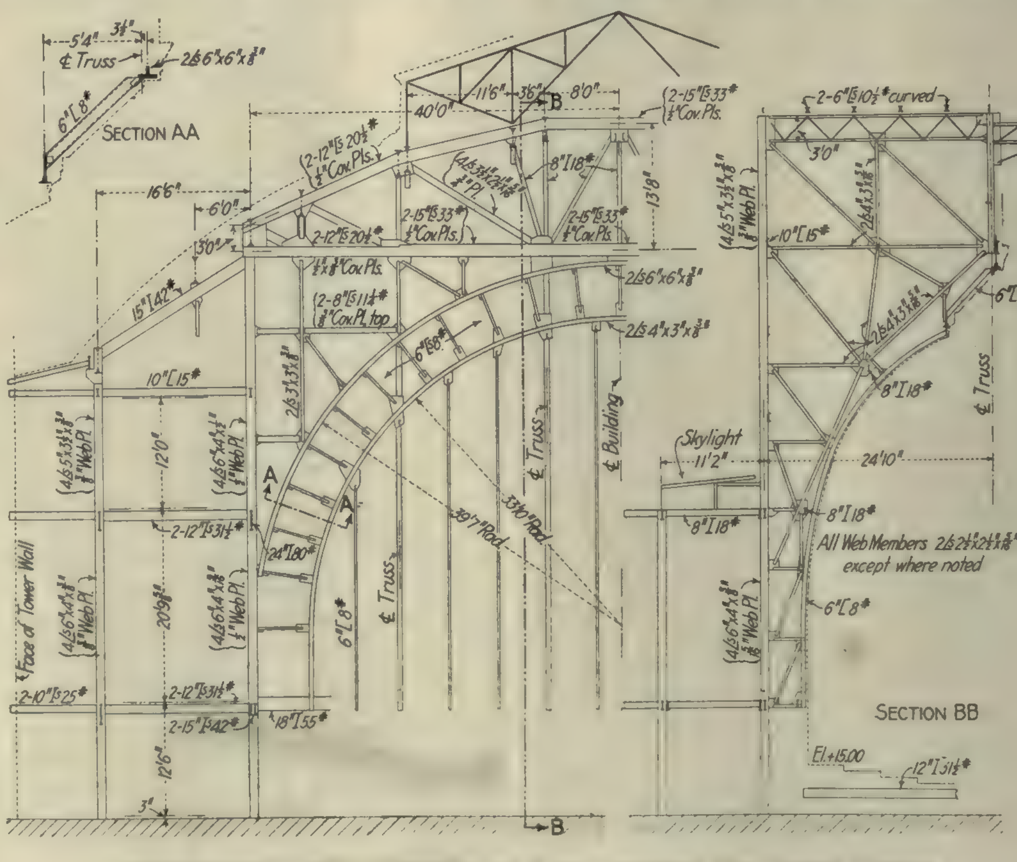
Three-Hinged Arch Truss

True arch action for the main roof trusses is obtained by the use of $2\frac{1}{4}$-in. round rods, with turnbuckles, placed below the floor. Built-up channel chords and four-angle web members with batten plates are used in these trusses. Stiff bracing of the knee-brace or portal type shown in the sections is placed in vertical planes 11 ft. 6 in. apart at the upper joints to stiffen the lower chord, while special braced struts are placed at the lower joints of this chord.

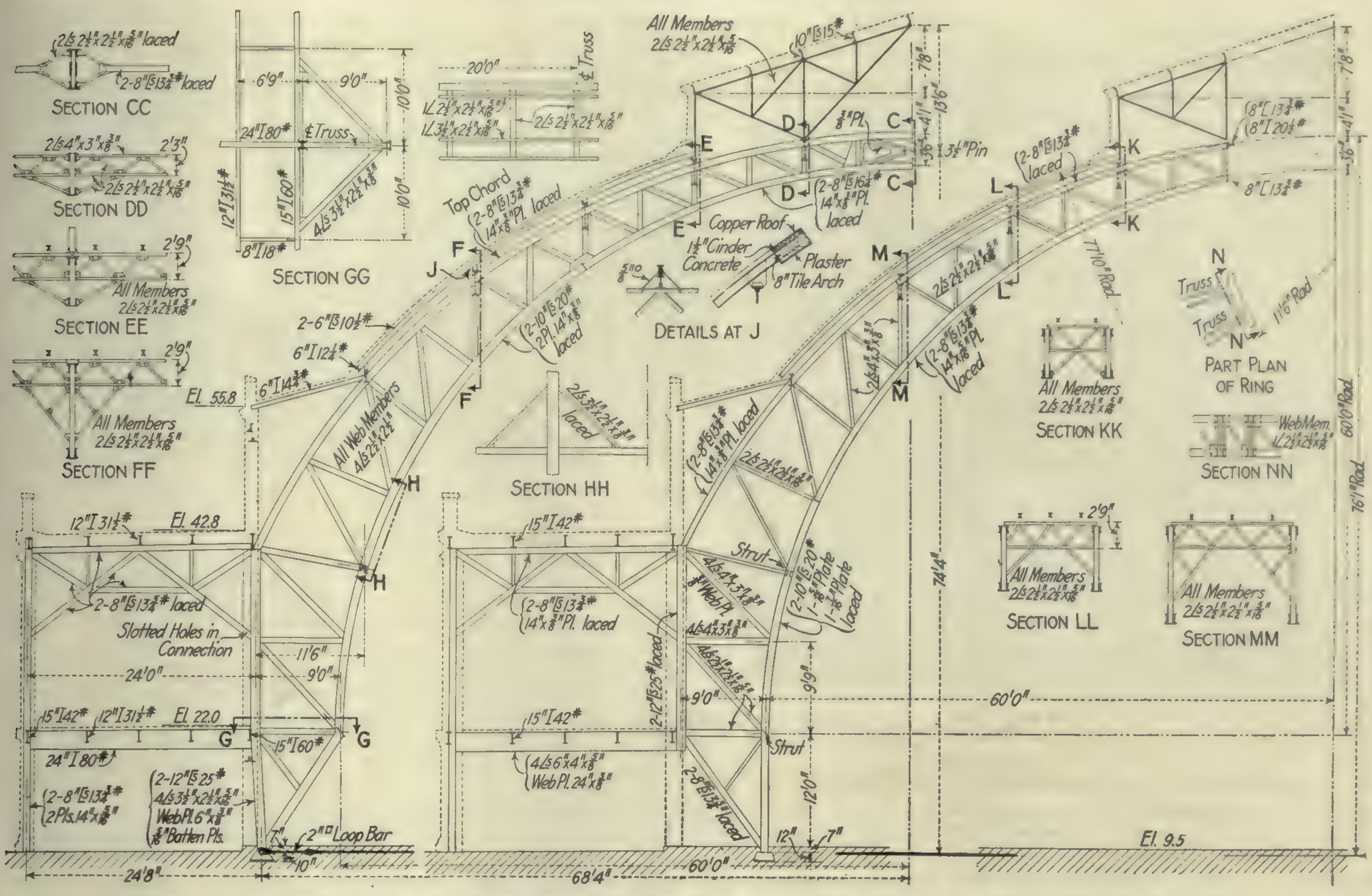
Although the stresses are small, the relatively heavy truss shown below the roof of the two-story extension for the promenade on the side of the building was designed to conform to the cantilever trusses in the circular portion, where these trusses form part of the trusses.

Cantilever Radial Trusses

On the same drawing with the half-section of the main three-hinged arch trusses is shown the modified truss used for the



HEMISPHERICAL ROOF SUPPORTED BY RADIAL TRUSSES AND CURVED RAFTERS



RADIAL CANTILEVER TRUSSES DIFFER FROM THREE- HINGED ARCH TRUSSES IN HAVING PEDESTAL AT INNER-CHORD LINE

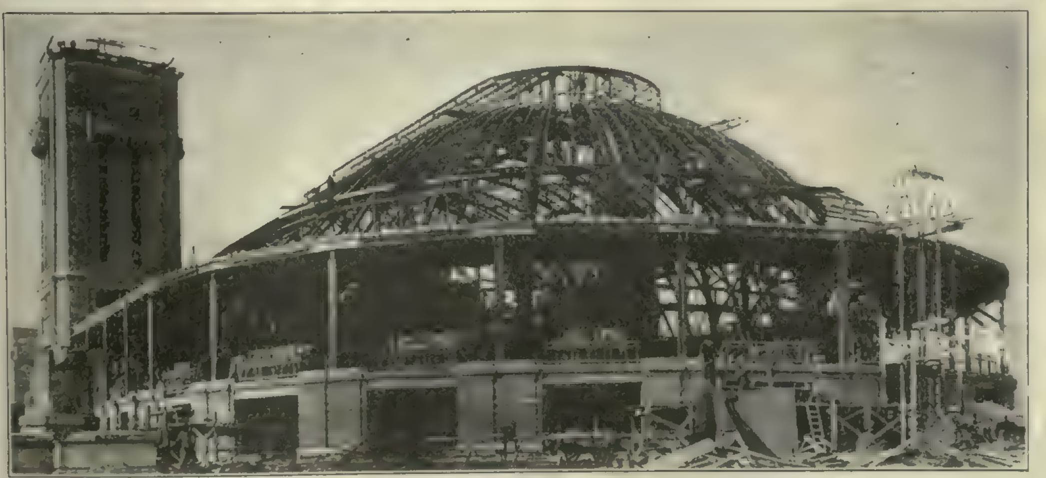
hemispherical roof support. The simple expedient of combining this truss with the exterior two-story frame, with its loading, and placing the main pedestal at the inside or lower chord of the curved trusses, brought the center of gravity outside of this point. As a result the curved truss acts as a cantilever and is connected at the inner end to a ring truss about 4 ft. deep, as shown in the drawing. The stresses in the truss below the roof of the outside extension are much increased in comparison with the previous case, although the same sections are used except for the top chord, where a cover plate is added to the two-channel member.

Except for the three lower panels, the main web members of these radial trusses are of the two-angle type with tie plates, instead of the four-angle type used for the heavier main trusses. The stresses decrease rapidly toward the crown. The ring girder at the crown is used primarily to connect the ends of the cantilevers. It was realized that if the ends of these cantilevers deflected, a horizontal thrust would be thrown into this ring girder, which was designed to transmit it. The struts in the roof opposite the ends of the ring girder carry this thrust to some specially designed bracing back of the proscenium.

Proscenium Truss and Framing

The special truss near the west end of the building over the proscenium arch or domed ceiling is supported on columns about 60 ft. high, and carries the framework to which the plaster-on-metal lath is attached. Four light truss frames similar to that shown in section BB of the accompanying drawing frame into this truss at the main panel points, their top struts supporting the curved rafters for the roof of the main building. The upper-chord panel lengths vary quite irregularly in order to support the standard monitor truss similar to that used above the main arches. The use of I-beam web members should be noted.

The design of the recreation building was made by G. Edward Gustafson under the direction of E. C. Shankland, chairman of the Harbor and Subway Commission of Chicago. W. A. Artingsall was harbor engineer, Earl Van Voorst was superintendent in charge of construction, and Charles S. Frost was the architect for the commission. The contractors were Paschen Brothers, of Chicago.



PROSCENIUM TRUSS SUPPORTS FRAMING FOR CURVED PLASTERED CEILING

A Slip Scraper Romance

Buried treasure was found in excavating for the 7,500,000-gal. reservoir for Dubuque, Iowa, described in the Engineering Record of May 6, page 616, to the extent of $150 in silver coins, all more than fifty years old. The reservoir is located on Kelly's Bluff, the land formerly being owned by a miser of that name who for many years mined the limestone rock for lead, zinc and silver. Gold to the extent of $10,000 is reported to have been found several years ago in a cache left by the close-fisted Kelly. A short time before his death he sold ores to the value of $55,000 in Pittsburgh. He was paid in gold, but it still remains undiscovered. Many people have made unsuccessful attempts to discover his hoarded wealth. When, therefore, someone caught the glitter of coin in the earth being removed by an unromantic slip scraper, there was a rush and a scramble, and all who could reach the spot were soon busy picking up "pieces of eight." Dabney H. Maury, the consulting engineer who designed the reservoir, tells the story of a young miss who filled both hands with coins and then wept bitterly because she had no pockets.

Western Engineer Comments on Eastern Roads

Condition of Macadam, Concrete and Brick Roads and "Carpet Coats" in Maryland As They Appeared to an Experienced Observer

IT IS A QUESTION how much information about road systems, types and surfaces can be obtained by the layman riding in an automobile; that is, beyond a hazy recollection of a smooth or rough surface. T. R. Agg, professor of highway engineering of the Iowa Engineering Experiment Station, in May made an inspection of roads in Maryland and of the Chevy Chase Road in Washington. An account of what he saw appeared in the May-June *Iowa Service Bulletin*. It indicates what can be seen by an experienced observer. The following extracts from his notes relate to features of special interest:

"We left Baltimore over the main highway between Baltimore and Philadelphia, and as may be expected the portion of this highway near Baltimore is as heavily traveled as many city streets. The first 6 or 8 miles is asphaltic concrete constructed under open specifications with coarse mineral aggregate, which in this case was traprock quarried and crushed in the vicinity of the work. This surface is giving excellent service, and it is apparent that by renewing the seal coat from time to time the roadway will have a very respectable length of life. The remainder of the roads traversed were either water-bound macadam with carpet coats of asphalt or concrete.

"The entire distance traveled, which was approximately 250 miles, was on the state-road system, with the exception of one gap of 8 miles, which, however, is under contract. On all the roads the workmanship, especially on the wearing surface, is excellent. The surfaces are remarkably free from unevenness and depressions and have been maintained in a very commendable manner. The ditches and back slopes did not seem to be quite up to the standard of the wearing surfaces. This was perhaps due to the fact that the soil itself is quite unstable and that the trip was made so early in the summer that there had been no opportunity for the patrolmen to get the earthwork trimmed up. On many sections the shoulders along the traveled way had been dragged and were in excellent condition.

Breakers Stop Erosion

"An interesting detail of construction was noticed on many hills. Apparently the soil erodes quite readily, and in order to prevent the ditches from gullying, breakers or weirs had been constructed at frequent intervals so as to prevent erosion. Some of these were of concrete and others were merely planks. They seem to be very effective.

"The entire state-road system of Maryland is maintained by patrolmen, each patrolman caring for a section of from 4 to 8 miles of road, depending on the character of the surface. These patrolmen are permitted to employ additional help for certain kinds of work, and several fair-sized gangs were passed.

"The macadam surfaces are maintained by coating them with a bituminous material into which stone chips are rolled, and a feature of the Maryland work has been the use of 1-in. coarse-stone chips for this purpose. These carpet roads seem to be satisfactory for about two years and must then be renewed. But our observation leads us to believe that eventually the coat will be of sufficient thickness and stability to last three years. The cost per year for maintaining the 16-ft. macadam by this method is about $350 per mile, and the original cost is about $9,000 per mile. This includes the repair work done by the patrolmen, the upkeep of shoulders and ditches and the maintaining of the traveled way. Water-gas tar, native asphalt and oil asphalt have been used in the surfaces. It is apparent that the 16-ft. width is too narrow for many of the roads.

Mud Shakers

"Wherever the unimproved earth roads lead into the improved state roads, mud shakers are provided by constructing 100 ft. of rough macadam down the unimproved road. Most of the mud shakes off on the rough surface before the vehicle gets on to the improved road.

"The portion of the system cónstructed during the past two years has been of concrete, the roads being 16 ft. wide, some of them constructed with gravel concrete and some with broken-stone concrete. On all of these later roads the workmanship is excellent, the surfaces being remarkably free from unevenness that would impair the riding qualities. Expansion joints are constructed with a single thickness of tar paper, and are spaced 35 ft. apart. The roads all had a good many transverse cracks in the concrete, but relatively few longitudinal cracks. There are more cracks in the gravel-concrete roads than in the broken-stone concretes.

"Limestone aggregates have been used successfully in the concrete, but the limestone is a tough blue stone much better than anything found in Iowa. Gravel has been much more widely used than has the broken stone. On account of the system of maintenance the concrete along the cracks is not breaking down and the cracks do not impair the riding qualities. In a number of places we found sections of concrete pavement upon which an attempt had been made to construct a carpet coat. On some of the roads the coatings were in a very good condition. This is particularly true over a 6½-mile stretch of tar-coated concrete on the Berlin Road which was constructed in 1912. Since that time only 2 bbl. of tar have been used in patching. The surface is in excellent condition. Good tar was applied soon after the concrete was completed, the surface being coated with about ¼ gal. of tar broomed on, another ¼ gal. of tar applied and chips spread and rolled in. In other words, a carpet coat was built up in the same manner as was employed on the macadam roads. This road will need a new carpet coat this year. These roads show clearly the possibilities of maintaining the surfaces in excellent condition by systematic maintenance.

"An interesting development of traffic is the motorbus service along the roads on the 'East Sho'.' Railroad service is not very good in this district, and the motorbuses have regular schedules all the way down the East Shore roads.

"In addition to good construction, these roads throughout show what can be accomplished by the application of correct principles of engineering. They are uniformly well designed, generally with long-radius curves, always with a clear view ahead, and the provisions for drainage are for the most part entirely adequate. Probably 25 per cent of the road is underdrained, a great deal of it having two lines of tile, one under the side ditch. Guard rails have been very widely employed, and in some instances guard fences of substantial construction have been used. The concrete surfaces of the single-course type cost about $10,000 per mile.

Chevy Chase Road Experiment

"One of the most important sections of experimental roadway that have been constructed in this country is the Chevy Chase Road, constructed by the U. S. Office of Public Roads. On this road there are a number of sections of concrete construction and a number of sections of brick. The concrete is three years old, and a number of sections were coated with bituminous material soon after construction. Most of these bituminous coatings are entirely gone at this time, but no attempt has been made to maintain them. The concrete is cracked transversely at intervals varying from 20 to 120 ft., but about 60 ft. seems to be the average distance between cracks.

"The gravel concretes have more transverse cracks than the limestone concretes. So far as the wear is concerned there is as yet no apparent difference between the limestone and gravel, but here, as in the case of Maryland County roads, the limestone is a tough blue stone. The cracks are not being maintained, and the concrete along them is breaking down somewhat. The paving carries mixed traffic, a part of it consisting of heavy loads on steel tires drawn by shod horses. In general this experimental road shows conclusively that with proper maintenance the concrete will have very long life. One-course construction was employed for the concrete.

"The sections constructed of brick are all in excellent condition, although the brick varied in quality from those having a rattler loss of 16 to those having a loss of 30 per cent. The latter, of course, show more wear than do the former. There are a few longitudinal cracks on both the concrete and the brick sections of this road, but none of them is serious."

Cement Company Uses Shell Deposits

The extensive shell deposits along the Gulf Coast are being utilized by the new plant of the Texas Portland Cement Company at Manchester, near Houston, Tex., in the manufacture of cement by a wet process recently developed by the F. L. Smidth Company, of New York City. Difficulty in using shells, which when properly prepared contain the purest lime constituent possible for cement making, has been heretofore experienced because no successful process had been discovered whereby the shells could be pulverized preparatory to mixing with the alumina and silica constituents. The new plant, which is one of the most modern cement plants in the country, has turned out in the first two months of operation about 50,000 bbl. of cement. Shipments under the direct supervision and re-check of the engineers of the Pittsburgh Testing Laboratory have recently been started. By using oil for fuel and kaolin from the numerous deposits in Texas it will be possible to produce pure white cement. Plans and contracts for the plant were prepared by H. Struckmann, of Kansas City, Mo., the company's consulting engineer.

Photos by Overbey's Studio, Mobile.

107-Mile Gale and Terrific Floods Make Mobile a Tangle of Trees, Ships and Débris

THE TROPICAL STORM sweeping over Alabama and Mississippi July 5, driven by a 107-mile-an-hour gale, carried away bridges, destroyed railroad and telegraph lines and turned the streets of many cities into miniature Venices. The storm centered over Mobile, where the damage is estimated at $2,212,000. Ships were driven from the bay 2 miles up river; heavy coal and lumber barges were tossed around like chips and driven ashore on the tracks of the Louisville & Nashville Railroad. A section of the Pinto drydocks, with a tugboat still on the ways, was found nearly 2 miles from its home. Telephone poles and sturdy trees were uprooted and tossed about with the result shown in picture 1. A fitting caption for 2 might be "Cotton and Lumber Everywhere." The cotton and lumber loss at Mobile is given at $160,000. Picture 2 was taken near the Southern and Mobile & Ohio railroad piers. The U. S. dredge Hennen, in picture 3, was driven ashore at Choctaw Point and further damaged by the ships in the background. The vessels are in 1 ft. of water; they draw 11 ft. The wreck at the Mobile & Ohio Railroad wharf at Government and Dauphin Streets (picture 4) helped to bring the total damage to wharves and ships to $454,000. Picture 5 was taken at Dauphin and Front Streets after the storm. It shows a small part of the $960,000 buildings loss.

MAKING A QUICK TRACK SHIFT WHERE STREET RAILWAY CROSSED STEAM ROAD

Drainage Drifts Have Apparently Stopped Slides at Hillside Grade Separation

Elimination of Rookwood Grade Crossing of Pennsylvania Lines and Eastern Avenue at Cincinnati Introduces Variety of Problems

By H. G. WRAY
Pennsylvania Lines West of Pittsburgh, Cincinnati

DRAINAGE DRIFTS of coarse rock have apparently stopped the slides on a clay hillside along the Ohio River, precipitated by the shifting of tracks and avenue into the hillside to eliminate the Rookwood grade crossing of Eastern Avenue and the Pennsylvania Lines West of Pittsburgh. Because of the great skew of this crossing, the presence of a street car line on the avenue, the existence of a 60-in. water main that had to be bridged by the masonry, and the necessity for keeping the avenue as well as the steam and electric railroads open at all times, the separation of grades at this crossing was a complex problem, even without the slide difficulty.

The breaking of the water main necessitated a change in the design of a neighboring sewer and delayed the work in general, and other minor adjustments had to be made to meet the conditions that arose. The slide trouble was the main problem, but it is believed that the drainage drifts have solved it, and without the use of expensive masonry or makeshift piling.

One Avenue Crossed Tracks Three Times

The tracks of the Southwest system of the Pennsylvania Lines West of Pittsburgh, after leaving the Pennsylvania Station at Cincinnati, parallel the Ohio River for several miles to the northeast and cross Eastern Avenue, the main thoroughfare to the eastern part of the city, three times. The first of these crossings is located about 1.3 miles east of the station, and is known as Rookwood crossing. This crossing was considered very dangerous on account of the enormous amount of street car, pedestrian and vehicle traffic. The railway-transfer and classification yards, shops and roundhouses were located east of this crossing, and railway traffic to and from these facilities was exceedingly heavy. Accordingly, when grade-separation work was taken up by the city in 1904 it was decided to eliminate the Rookwood grade crossing first.

In connection with the elimination of this grade crossing it was thought desirable to provide a foot subway at Brooklyn Street, about 1500 ft. east of Rookwood, as this street had connection with the suburban district on the hilltops by means of steps.

The first ordinance authorizing the elimination of these grade crossings was passed in 1905. Plans were prepared by the railroad company in co-operation with the city engineering officers and were approved and accepted by the city, and invitations were out to bidders in 1906.

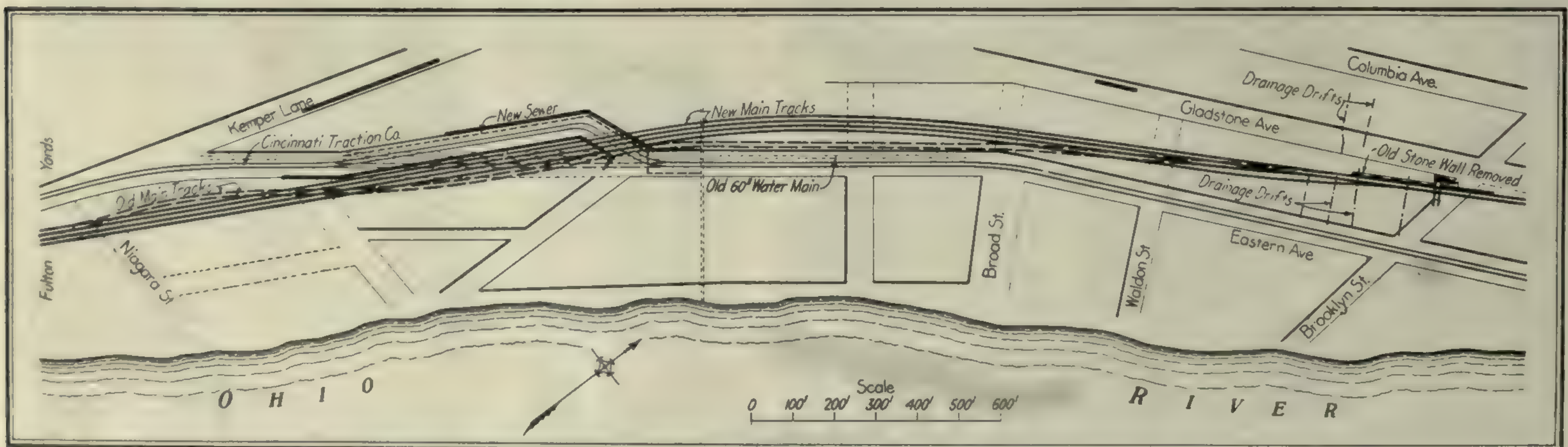
Because of the small angle of intersection of Eastern Avenue with the present tracks it was practically out of the question to carry the avenue under or over the tracks in its present location, as this would have necessitated the building of a very long bridge, probably of viaduct construction, with several rows of columns offering an obstruction to traffic. In order to avoid the necessity of a bridge of this type the plans for the proposed improvement provided for a relocation of Eastern Avenue and the present tracks, making it possible to carry the avenue under the tracks at a better angle, with only a single row of columns in the center of the roadway.

In the spring of 1906 a corps of engineers was in the field preparatory to starting the construction work, when the citizens of the East End raised objections to the proposed relocation of Eastern Avenue, and also to the row of columns supporting the bridge in the center of the roadway, and by means of city council proceedings secured an annulment of the ordinance authorizing the proposed construction. No further action was taken in the matter until the spring of 1916, at which time it was decided to start the work as provided for in the original plans of 1906.

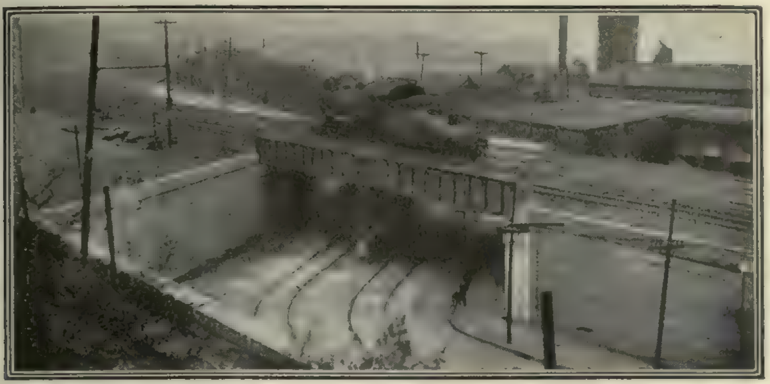
Shift Both Tracks and Avenue

In order to relocate this part of Eastern Avenue to secure a more desirable intersection with the railway tracks, it was necessary to cut away the foot of a steep hillside rising to the northwest from the present main tracks. The plans called for a heavy mass wall along the entire length of Eastern Avenue, as relocated to protect it from the encroachment of the hillside. It was found to be impossible, however, to construct this wall for the entire length as called for on the plans, because of the excessive cost entailed by extending it to meet a solid foundation, which could be found in some places only at a very great depth.

All the residence property along the hillside was acquired and removed previous to the starting of this improvement, for it was believed that the entire hillside would be affected by the removal of such a large part of its base. Shortly after steam-shovel excavation had started along the foot of the hill large cracks began to appear in the surface of Kemper Lane, which, as the plan shows, is up the hill from Eastern Avenue. In order to hold up this street and protect the property along its north side from future damages, a reinforced-concrete retaining wall was built along its south side, as shown on the general plan. This wall was extended to overlap that part of the mass wall along the north side of Eastern



RELOCATION OF TRACKS AND AVENUE MADE IT POSSIBLE TO AVOID PROHIBITIVE SKEW—NOTE LOCATION OF WALLS AND DRAINAGE DRIFTS



NEW UNDERCROSSING GIVES 15 FEET HEADROOM FOR STREET CARS

LOOKING UP SOUTH APPROACH—BUTTRESSED MASS WALL ON RIGHT

Note Kemper Lane retaining wall in right background of left-hand view

Avenue previously constructed at the foot of the hill, where solid foundation was found at a reasonable depth below the surface.

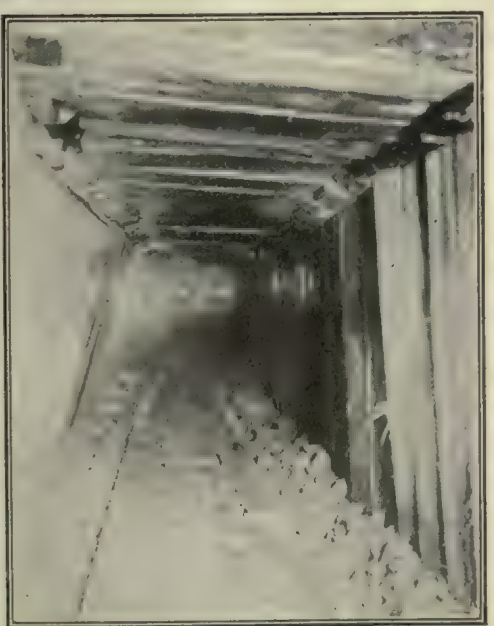
A retaining wall was built along the south side of Eastern Avenue to hold the embankment for the railway tracks. This wall and the mass wall along the north side connected with the bridge abutments on either side.

By beginning at a point 1500 ft. west of the crossing and raising the tracks on a 1 per cent grade, it was found possible to secure a rise of 6 ft. at Rookwood. Continuing northeast from Rookwood on a 0.38 per cent grade, the old grade and alignment were intersected in the vicinity of Brooklyn Street. The street profile was determined largely by the necessary depression of Eastern Avenue to give an underclearance of 15 ft. to allow for the passage of trolley cars and the minimum feasible floor depth of 3 ft. 10 in.

Bridge Floors and Waterproofing

Columns in the center of the street at the Rookwood crossing divide the bridge into two separate spans of 30 ft. 6 in. each. A trough-floor bridge with fascia girders was used with a floor depth of 3 ft. 10 in. The longitudinal troughs running perpendicular to the abutments were filled with concrete and covered over to a depth of 3 in. The waterproofing material consisted of four-ply asbestos waterproofing felt and one layer of waterproofing fabric thoroughly cemented together with a waterproofing asphalt. This material was placed on the top layer of concrete and covered over with a 1½-in. coat of sand mastic.

Three layers of hydrex felt coated with a hydrex compound were placed on the barrel of the Brooklyn Street arch extending down to the springing line on either side. The backs of the stairway walls at Brooklyn Street, as well as the backs of the retaining walls and abutments at Rookwood, were waterproofed with two coats of tar paint.



DRIFTS WERE SHEETED WITH 2-INCH OAK

Handling Traffic

It was necessary to keep Eastern Avenue open to traffic at all times during the progress of the work, as this street was practically the only available outlet to the eastern section of the city. Because of the extremely hilly character of the surrounding territory it was impossible to reach the numerous industries located in the East End by any other route.

As may be seen from the general plan, it was possible to build the greater part of the two abutments in the clear of the existing main tracks, which were trestled over the new location of the street to provide for its depression. The walls on the north and south sides of Eastern Avenue were also built without interfering with traffic. However, a section of the wall on the south side was omitted where it crossed the existing street, and was filled in later when traffic was diverted over the new relocated street.

CRACKS THAT OPENED UP IN KEMPER LANE

The approach and subway grades were established and the street railway tracks were laid in their new location up to points on either approach where they could be conveniently connected to the old tracks.

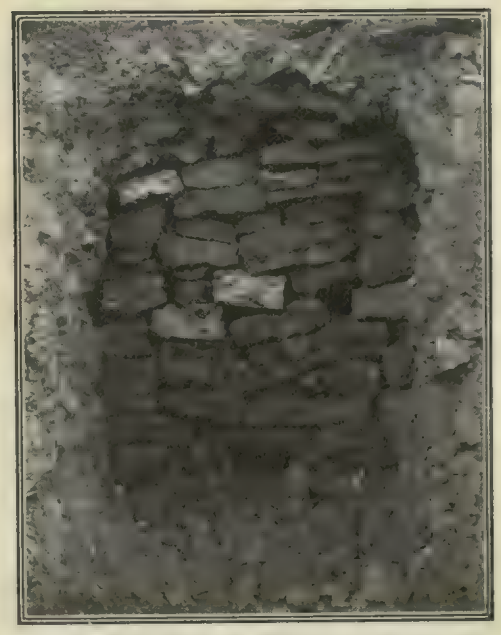
The north half of the Rookwood bridge was erected and the railway company laid its track on the new alignment where it was possible to do so in the clear of its present main tracks. It was possible to lay the track on the new alignment from Brooklyn Street to Niagara Street, except that part intercepted by the street railway tracks in their old location.

It was decided to shift traffic to the new work at night time, as all traffic was considerably lighter at that time. The railroad company with three gangs of track workmen cut the present main tracks at Brooklyn and Niagara streets and shifted them over to meet the new tracks previously laid. The street railway company's forces connected its old tracks with the new at the top of each approach, and took up the section of its old tracks intercepted by the railroad tracks on the new alignment. The railroad company's forces then closed this gap in its new tracks, making a continuous route from Brooklyn Street to Niagara Street over the new alignment.

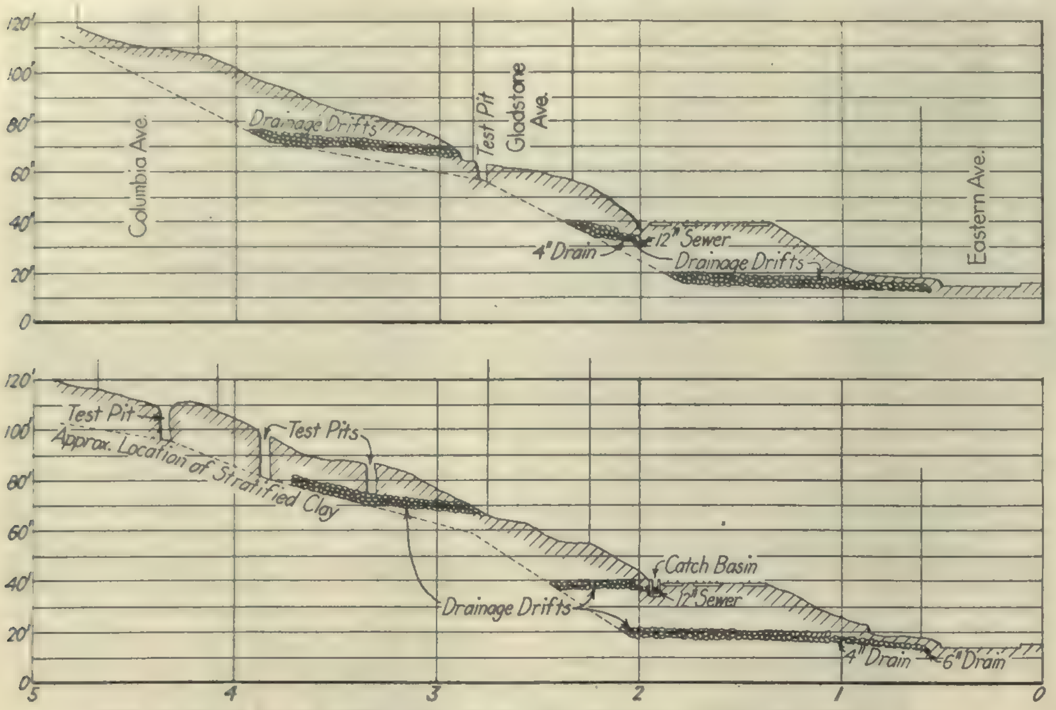
The shifting of traffic from the old to the new work was accomplished in approximately 10 hr., with little or no hindrance to railway or street traffic.

60-Inch Water Main Makes Trouble

The 60-in. water main shown in the plan and profile proved to be a very troublesome and costly factor in the prosecution of the work. Notwithstanding that provision had been made for future improvements of this nature when the main was first laid, it was necessary to make special provisions for crossing it with the masonry in two places and the main tracks in another. At the



COARSE ROCK USED TO BACKFILL DRIFTS



THE DRAINAGE DRIFTS WERE RUN IN TO THE SURFACE OF THE STRATIFIED CLAY

masonry crossings concrete walls were carried down to rock on each side of the pipe, and a reinforced concrete slab was built over the top of the pipe to relieve the main from additional pressure caused by the masonry above it. A covering of heavy creosoted timber was placed over the main where it was crossed by the main tracks, in order to avoid any shocks that might be transmitted by heavy trains.

The original plans called for the construction of a 24-in. sewer along the north side of the east approach in close proximity to this main to drain the subway. Every precaution was taken in the performance of this work to protect the water main from the possibility of settling.

In December, 1913, only a few months after the work had been in progress, this main broke, flooding the sewer trench previously mentioned. Three workmen, who were unable to escape the enormous quantity and force of the water pouring from the break, were drowned. This unexpected catastrophe caused great damage and subsequent delay to the work in general. The sewer layout had to be revised and was constructed, as shown on the general plan, so as to cross on top of the main, where it was not necessary to excavate to any great depth. Two prominent consulting engineers made separate investigations as to the cause of the break in the main, and their reports exonerated the contractor and railroad company from contributing to the cause of the disaster.

Trouble from Slides

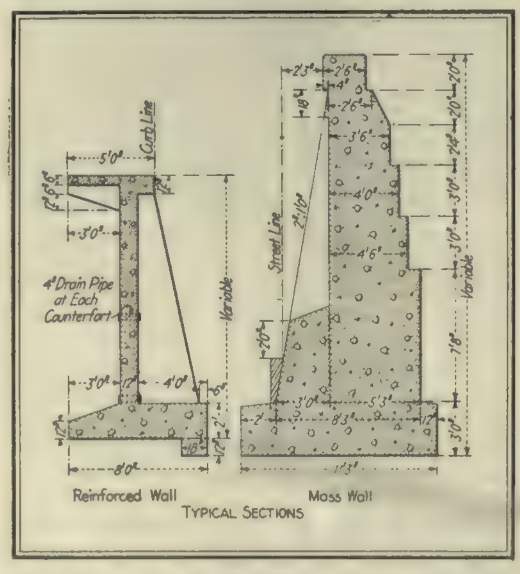
From Rookwood crossing to Brooklyn Street the new tracks were located to the northwest of the existing tracks. This new location again necessitated the cutting away of part of the hillside, which rose rather abruptly from the existing main tracks. Several test pits dug into the hillside disclosed a peculiar formation. The entire hill consisted of a soft clayey material resting on a layer of stratified clay mixed with limestone, which dipped at a very abrupt angle toward the river.

At the first cut of the steam shovel, in preparing the new subgrade for the railway tracks, serious cracks developed in the hillside, endangering the block of houses near Brooklyn Street. The plans called for a new concrete retaining wall to replace the stone gravity wall just west of Brooklyn Street. Previous to this new improvement this old stone wall had been moving toward the tracks, and on several occasions had to be cut away in places to clear the existing main tracks. From test pits dug in the vicinity of this old wall it was discovered that this layer of stratified clay was more than 20 ft. below the surface, and to build a wall of such depth would be very expensive.

Meanwhile the foundations of ten or fifteen houses began to give evidence of the sliding action of the hillside, as large cracks began to appear in them, damaging the property to a considerable extent. In view of these houses being damaged when the construction had barely begun, it was decided to buy the property and omit the construction of the retaining wall.

Cracks Appear in Columbia Avenue

During the rainy season of the next year following the purchase of this property the sliding action of the hillside increased and cracks developed in the surface of Columbia Avenue, making it necessary to take steps to protect the street. A retaining wall was first considered along the south side of this street, but it was found possible to secure a good foundation only by extending it to a depth of 35 ft. or more, and the cost of such a wall was considered excessive. Preparation was made to pin the hillside down with piling, but it was agreed finally that this method was only a temporary expedient at best.



MASS WALL ALONG EASTERN AVENUE AND REINFORCED-CONCRETE WALL ALONG KEMPER LANE

After a thorough investigation into the cause of this sliding of the hill it was concluded that insufficient drainage was responsible to a great extent. The ground water, finding no outlet through this layer of stratified clay, had a tendency to spread out over it and saturate the clay-like material above, causing the latter to break loose and slide in great volumes over the surface of the substrata. It was decided, therefore, to drain the hillside to see if this would stop the sliding.

Drainage Drifts Decided Upon

Drainage drifts were driven through the hillside at frequent intervals to provide outlets for the ground water and to eliminate as far as possible its spreading out over the surface of the substrata. These drifts were driven in the form of miniature tunnels, as shown in accompanying cross-sections of the side hill, and were 4 ft. high by 3 ft. wide. As the digging progressed each drift was sheeted at the top and sides with 2-in. oak plank. Two men working in each drift were able to drive between 2 and 4 lin. ft. of tunnel per day. One man removed the material, while the other hauled it to the mouth of the tunnel by wheelbarrow.

In order to provide light for working an electric conduit was threaded through the drift as the work progressed. Lights were tapped off this line at easy working intervals.

After the completion of the drift it was backfilled with coarse rock in order to allow the ground water to flow through it.

These drifts were of varying length, owing to the character of the material encountered. They were, however, driven in each case until the underlying stratified clay was reached. As shown on the general plan, some of them are below the tracks and extend up into the hillside north of the tracks. Each drift was given an outlet to a sewer by a 4-in. drain-pipe connection. They were driven at an average cost of $5 per linear foot. This scheme of underdrainage has materially relieved the situation, and it is believed that it will be a successful undertaking.

Two years after the work was started, and while the drainage drifts were under construction near Brooklyn Street, a surface talus of 5-ft. depth started to erode and slide from Gladstone Avenue, between Broad and Waldon streets. It was decided more practical in this case, since the slide was of comparatively shallow depth, to build a retaining wall to hold the hillside in place.

The concrete masonry work at Rookwood crossing and Brooklyn Street, and all street grading and paving at the former place were done by the Marquette Construction Company of Chicago. Half of the Rookwood bridge was erected by the Ketler Elliot Construction Company, also of Chicago. The Rookwood bridge was waterproofed by the Johns-Manville Company of Cincinnati. The railway company's forces did all the track work in connection with the improvement and erected the remaining half of the Rookwood bridge.

The work was carried on under the supervision of Thomas Rodd, chief engineer, Pennsylvania Lines West of Pittsburgh. E. E. Stetson was the engineer in immediate charge of the work.

Device Maps Route of Boat in Sounding Operations

Autoplanograph, as Instrument Is Called, Is Useful Where Fine Degree of Accuracy Is Not Essential

IN an article in the Engineering Record of July 22, page 109, attention was called to three devices developed by Agustin Mercau, an engineer of the Argentine Republic, to facilitate hydrographic work. The Profilograph, for taking and recording profiles of underwater surfaces, was described in that article. This article describes the Autoplanograph, which maps to scale the route traversed by a boat. The apparatus consists of a system of horizontal axles, two in number, 90 deg. apart. One, marked *AB* in the accompanying illustration, is shorter than the other, and carries two wheels—one at each end—of equal diameter, that can rotate freely. They are placed in such a manner that they support a small platform, upon which is located a sea compass or an electric gyroscope.

The other, of greater length (*CD*), carries on one of its extensions a wheel (*E*) of greater diameter, so placed that it can rotate freely. It rests on two cushions, through which it passes under the platform, and is provided with a regulating screw. One of the cushions can be made to serve also as a regulating screw by means of a small metal sheet (*F*) provided with a compression screw (*I*).

Apparatus Placed on Table or Planed Board

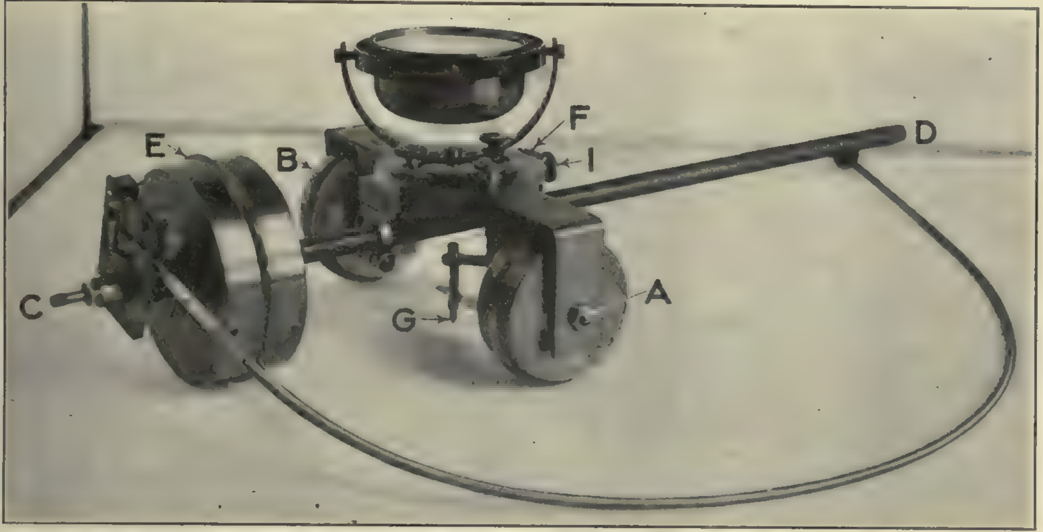
The apparatus is placed above a table or a planed board that serves as a support for it. Upon this is placed the sheet of paper on which the journey is to be sketched.

Attached to the lesser axle, and corresponding with the point of intersection of the two, there is a pencil (*G*) that is so placed that it can be raised at will from contact with the paper. The border of the wheels is cut in such a manner that the apparatus can not stop above the paper. Corresponding with the extremity (*N*) of the magnetic needle is an index fixed to the case that contains it. It is therefore possible to keep the greater axle of the apparatus in one fixed direction, the north magnetic in the case of the compass and the true north in the case of the gyroscope. By means of a flexible transmission (*H*) like that used by dentists (activated by a velocimeter, the movement of the boat or other means) it is possible to give the greater axle a movement of continuous rotation, which, in turn, places the pencil in movement parallel to the greater axle.

Under these conditions the lesser axle, and, in consequence, the pencil, is given a velocity proportional to that of the boat, and the greater axle is kept in a fixed direction—that of the north magnetic or of the true north. The journey recorded by the pencil, and its angular displacement, will be in accordance to that of the boat. The scale of the map so obtained will depend solely on the relation of the two velocities, which is easily obtainable with the simple features that are provided with the apparatus for such an object. The scale may be of any design whatever, or one determined in advance.

Maintained in Constant Direction

In order to maintain the apparatus in the constant direction before mentioned, the operator, when he uses a compass, should move the large wheel so that the fixed index coincides constantly with the north end of the needle.



AUTOPLANOGRAPH GRAPHICALLY RECORDS THE ROUTE TRAVELED BY BOAT

When the journey is so extensive that the pencil and the lesser axle of the apparatus have advanced near to the extremity of the greater axle, the small compression screw makes it possible to quickly disengage the metallic binder and to bring them back to the beginning. Likewise, when the plane to be covered is extensive and exceeds the dimensions of the paper, and, for this reason, the apparatus has to be lifted, it can be raised and placed in another position without any inconvenience whatever, since it remains always oriented and the two parts of the journey can be tied together easily. There is also attached to the apparatus a small telescope that permits it to tie in to points on the coast or fixed marks.

The instrument has been used by the inventor with excellent results on the River Plata and in the canals of the delta of the Parana, and has been found very useful for work in which a fine degree of accuracy is not necessary.

Correction for Drawing of Details of Brooklyn Elevated Railway

The drawing of details of the Brooklyn elevated construction on page 83 of the issue of July 15 contained an error in stating the size of main flange angles for the 50-ft. longitudinal girders. These angles are 6 x 6 x 7/16 instead of 6 x 6 x ⅞.

Tree Planting Would Give New York a Park System

City's Parks Can Be Connected by Utilizing Existing Streets in Such a Manner as to Give a Unique Park System

A PARK SYSTEM is an important feature in most modern American cities. Though the pioneer among American cities in creation of public parks and the owner of some of the most magnificent individual park areas in the land, New York City possesses neither a park system nor a definite plan for the creation of such a system. These facts are brought out by Prof. L. D. Cox of the New York State College of Forestry at Syracuse University, in a report on a street-tree system made to Cabot Ward, park commissioner for the boroughs of Manhattan and Richmond. As a remedy it is suggested that certain streets be selected and so planted that they would co-ordinate the existing scattered park areas and give to the city a park system unique among American cities.

Careful Selection of Streets Needed

In all the boroughs of the city save Manhattan the opportunity exists for working out a park system with the usual park connections, and doubtless all of these boroughs will some day possess, in a greater or less degree, such systems. In Manhattan, however, due to the intensive use of all available real estate, a park system by means of the ordinary forms of park connections appears to be practically impossible. If a system of connecting ways is to be secured at any reasonable outlay, the existing streets must be utilized in some form.

By choosing streets which will permit of successful tree growth, and by securing in the planting design a reasonable degree of interest and individuality, a park system exceptional among American cities may be secured. Such a scheme of street planting would not only co-ordinate the existing scattered park areas of the borough into a comprehensive system, but would also impart that peculiar or individual character and beauty which is necessary if Manhattan, the heart of New York City, is to take its place among the beautiful cities of the world.

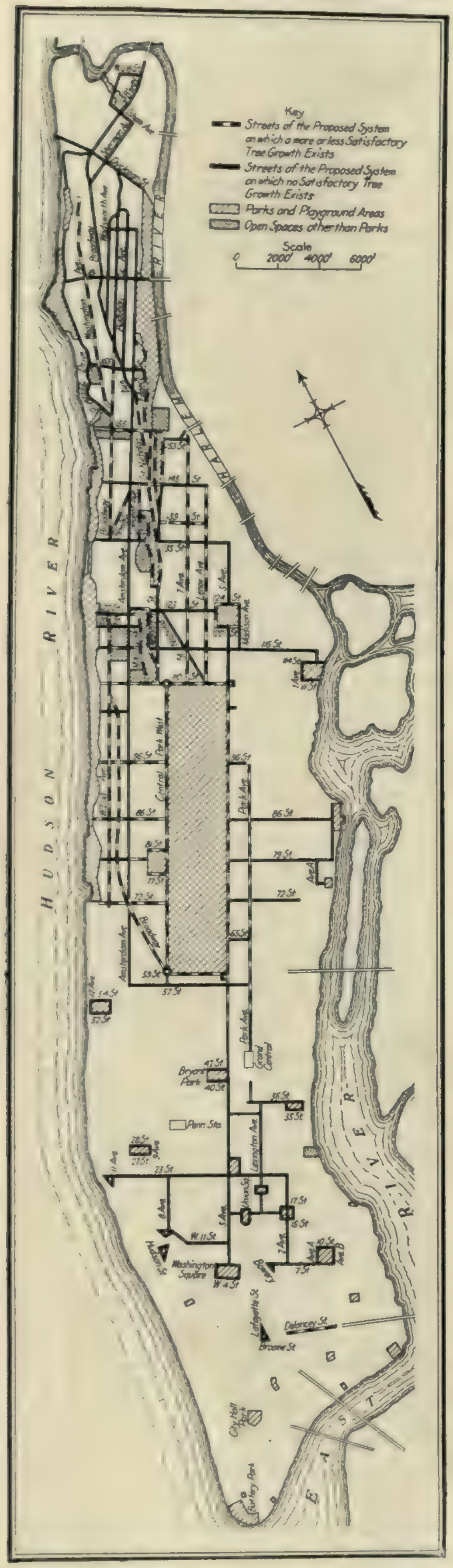
It has been found possible, after a careful study, to select streets suitable for interpark connections upon which successful tree growth of one form or another may be secured. These streets are suggested for the proposed street-tree system, and are shown in the accompanying map. By concentrating upon certain streets it will be possible, with a reasonable annual expenditure, to secure a condition of tree planting in Manhattan which will give it the appearance and charm of a tree-shaded city.

Consideration Given to Future Conditions

In selecting the streets to be used, careful consideration was given not only to the existing conditions of the streets in question but also to their future development. The latter was largely determined by the proposed scheme of districting being worked out by the City Planning Commission.

The streets of the proposed street-tree system are confined almost entirely to those streets which lie in the districts limited to residential or restricted business—retail stores, offices, etc.—and residential pur-

poses. Several streets which it would be very desirable to include in the system, and the present condition of which would permit of tree growth, have not been so included because they lie within the proposed unrestricted districts, where the ulti-



STREETS WITH SATISFACTORY TREES AND OTHERS WHERE THEY ARE NEEDED

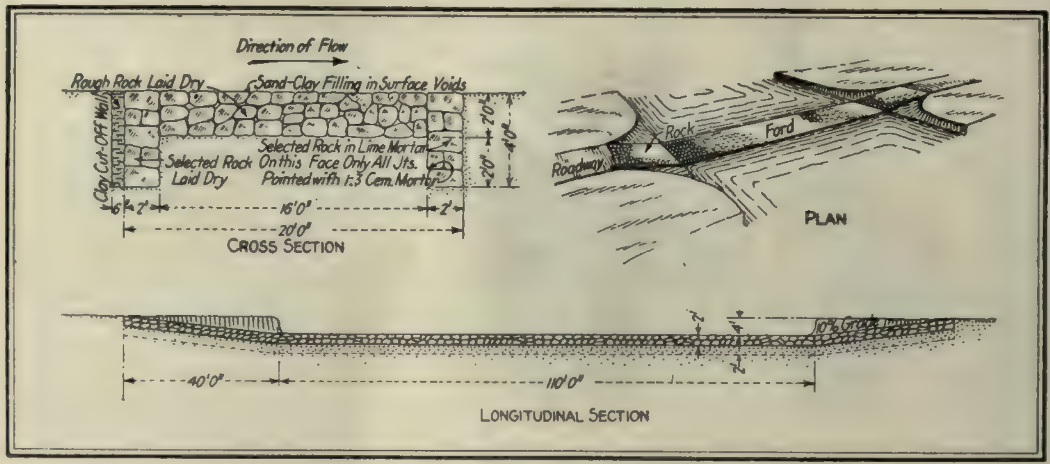
mate development would probably render tree growth either impossible or at least unsuccessful. These few streets are indicated separately upon the map, and if by any chance the proposed districts could be slightly changed so as to exclude them from the unrestricted districts they should be added to the system.

There are, of course, other streets not comprised in the system of inter-park connections, but upon which trees may be grown successfully. These are streets which will lie in the restricted residential districts. The program should be to encourage tree planting by private owners upon these streets and public planting should be carried out upon them after the main system has been completed.

Ford Crosses Sandy Wash

A BROAD wash in Washington County, Utah, known as the "Two and a Half Sandy Wash," is crossed by a stone ford constructed the full width of the wash. Stone was obtained on the site and was laid in place with cement mortar. In this country, where road construction is difficult on account of the general ruggedness of the topography, and where the people are scattered and funds are scarce, bridges are entirely out of the question for these sandy washes.

The ford was designed in the office of E. R. Morgan, state road engineer.



THIS TYPE OF FORD CAN BE USED WHERE NO FUNDS ARE AVAILABLE FOR BRIDGES

Excavating Machines and Overhaul

Specifications for Overhaul Should Take Into Account the Type of Equipment to Be Used

By G. B. MASSEY
George B. Massey Company, Chicago, Ill.

THE OVERHAUL clause in contracts for ditch and levee work needs careful consideration from the point of view of what actually constitutes overhaul work for the type of excavating equipment to be employed. Overhaul can no longer be accurately allowed for by following the clause evolved in the days when such excavation was done by teams, scrapers and wagons. This outgrown clause would usually state that if the average haul of all the material moved were found to exceed a given distance, the contractor would be paid for overhaul at a certain rate per cubic yard per 100 ft. for the entire mass, for such distance as the average haul might exceed the specified distance allowed as a reasonable free haul.

At present, however, most work of this nature is done by dragline machines, small dipper dredges and other equipment having a definite radius of action. Such machines are able to dig material within a certain area and deposit it at a certain distance without changing the location of the machine. Moreover, in the case of the dragline it is often possible to handle the material once, move the machine to a new location and handle the material a second time, thus depositing it farther from its original location than the radius of action of the machine. In the case of dredges, on the other hand, and of other machines which do not swing through a full circle, the material may only be disposed of by depositing it on the two banks of the ditch or in the levee section directly at the side of the borrow pit.

It is evident that to require the contractor using such a machine to move material a greater distance than can be accomplished in one handling is not conducive to low bidding. With any of these machines it is almost as economical to move material 600 ft. as to move it even a very short distance beyond the radius of action of the machine. Practically, the material must be loaded in wagons of some description and hauled. If it is necessary to use teams, it is rarely possible to bring their carrying capacity up to the handling capacity of the machine, and the work is slowed down. Moreover, additional plant of an entirely different nature from the actual excavating equipment is required.

Consequently, after a decision as to the type and size of machine most suitable for the work has been reached by the engineer in charge, the overhaul clause should be adjusted to include everything beyond the radius of action of the machine. This will tend to reduce the cost per cubic yard of the work. For example, if a dragline machine with a 50-ft. radius is used, the overhaul should start at 100 ft. with a substantial increase, this increase to be further enlarged by small increments for distances beyond 100 ft.

On most jobs the overhaul expense is small compared with the total cost of the excavation. It is therefore manifestly unwise to penalize, by using an outgrown provision, the large yardage of straight work because of the small yardage of overhaul.

Motorbuses for Lincoln Park to Be Low and Light

A new design of motorbus is to be used by the Chicago Motor Bus Company, which is to operate in Lincoln Park, Chicago. The drive will be on the front axle to minimize skidding. The bus will be 1000 lb. lighter than electric or gaso-electric cars usually used for this purpose. There is to be no equipment under the body, thus making possible a car sufficiently low to clear trolleys.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

How Not to Use the Oxyacetylene Torch

By WILLIAM G. BROADHURST
F. R. Long-W. G. Broadhurst Company,
Hackensack, N. J.

UNDER CERTAIN conditions where the heat was dissipated too rapidly, the writer has found that the oxyacetylene flame loses its effectiveness. The experience gained in three instances where circumstances made a proper application of the frame difficult will perhaps be of interest to contractors.

While putting a new set of tubes in an ordinary vertical hoisting engine boiler, out on the job during cold weather, four of the bridges of the upper crown sheet were cracked between adjoining tubes. There was not enough metal to allow a proper boiler patch to be placed. An oxyacetylene welding outfit and operator were obtained from a local garage, and, following the advice of this operator, the crown sheet was welded out in the open. The temperature was about 35 deg. Fahr., and a cold wind was blowing. The weld, made with soft iron, looked rough but solid when finished, except for slight cracks, which the operator said were only on the surface. Next morning when water pressure was applied the weld did not hold. It was found that the metal had not fused and could be picked out. The cracks were from 1/8 to 3/8 in. wide, and the metal was so burned that no further welding could be attempted. The boiler was taken to a boiler shop, but nothing could be done with it and it was scraped. The shop foreman said that the crown sheet could probably have been successfully welded in the shop, where the heat of the flame could be conserved and the crown sheet allowed to cool very slowly to prevent cracking.

In another case, also during cold weather, the valve chest cover of a horizontal steam engine cracked, and an operator, also from a local garage, attempted to weld it with an oxyacetylene outfit. Although the work was done under cover and the steam chest was heated by steam before beginning, the weld was unsuccessful because of lack of proper facilities for conserving the heat. There were no serious results from this failure, however, and the crack was successfully repaired with Smooth-On under a patch fastened with cap screws.

A third experience with the oxyacetylene flame was in cutting off a steel cylinder 3/16 in. thick and 3 ft. in diameter. This cylinder was in the bottom of a circular sewage-disposal tank under construction, where it was used as a sump. After the bottom of the tank had been concreted around the cylinder, the latter, which stood a foot above the concrete, had to be cut off. The cylinder was full of running sand and water, which was slowly overflowing its top. Cutting was started with a sledge and cold cutter, but the striking brought in more material, and was suspended for fear of a run-in. An oxyacetylene outfit and opertor were obtained, but after five minutes of application no appreciable impression had been made on the metal. The sand and water in the cylinder were then shoveled out and kept about 4 in. below the line of cutting. The operation was then quickly and successfully carried out. The sand and water against the inside of the cylinder had conducted the heat away so quickly that the metal would not fuse.

These experiences make it evident that the heat of the flame must be properly conserved in order to get results.

Portable Hoppers on Street, Steam Shovel Underground

HOPPER WEDGED UP IN USE

A REVOLVING steam shovel is at work under Seventh Avenue in New York City taking out a full-depth rock heading on Section 4 of Routes 4 and 36 of the new dual subway system. It drinks only water and is on the job promptly at 8 each morning. The superintendent for the Litchfield Construction Company, contractor for the section, has not worried about the prevailing shortage of muckers since it was installed. It handles rock from the entire face faster than the rock can be shot down, loading with its 5/8-yd. dipper "battleship" skips handled on platform cars by mule. The street over the shovel is supported on 40-ft. girder beams carried by towers built inside of cribbing which could support the load alone, and which amply protects the vertical timbers inside during blasting. The steam shovel is provided with a square shield of 3-in. plank, behind which it takes refuge when blasts are fired.

The heading is advanced by the needle-beam method. As the rock is overlaid by 8 to 10 ft. of clay, the most economical way to operate is to remove the clay first and take the rock out in a second lift. It was not possible, of course, to take out this clay at the construction shafts. To remove it by hand loading as the street was decked would have been very wasteful. Therefore temporary shafts have been opened at convenient points along the curb by cutting a hole in the decking and pulling up one of the derricks and one of the loading hoppers shown in the photograph. They are mounted on wagon wheels for moving, but rest when in use on wedges driven far enough under their frames to raise them off their wheels. It takes but a short while to knock out these wedges, haul the outfit ahead and drive them in again. The derricks dump into the loading hoppers turn-

FORTY-FOOT BEAMS ON TOWERS PROTECTED BY CRIBBING ALLOW USE OF SHOVEL UNDERGROUND

over buckets, which are hauled to the shafts by mules on platform cars running on the upper level.

Only the paving is replaced by this method in the first decking operating, the subsurface structures and the timbering above the level of the needlebeams being taken care of as the excavation to rock is taken out under the decking. The work is being done under the direction of the Public Service Commission, of which Alfred Craven is chief engineer and Robert Ridgway chief engineer of subway construction. J. W. Goodridge, vice-president of the contracting company, has general charge of the construction work.

Big Bridge Caissons Launched from Submerging Pontoon

By A. FREDERICKSON
Metropolis, Ill.

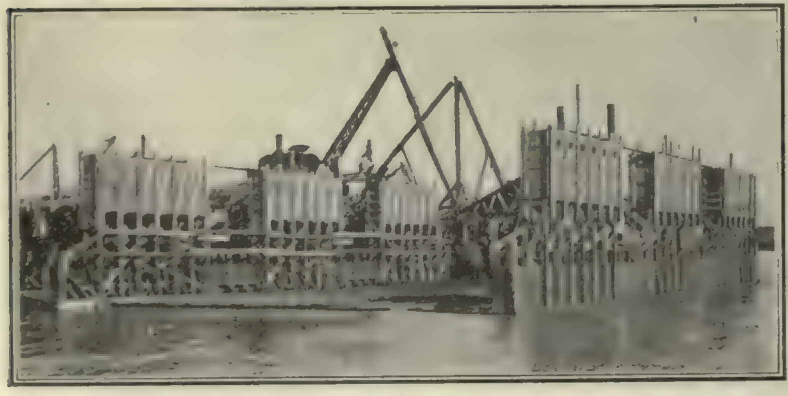
A PONTOON was used to construct the caissons for the Paducah & Illinois Railroad's bridge at Metropolis, Ill., the submerging of which is controlled by water-ballast tanks kept above the surface at all stages of the pontoon. These tanks are taken off while a caisson is being built, and are only put in place before a launching. They are filled by pumps and emptied by gravity.

The pontoon is 66 ft. 9 in. by 120 ft. 10 in. and is 9 ft. 6 in. deep. The largest caisson built in it was 60 ft. 6 in. by 110 ft. 6 in., the portion constructed before launching weighing 67½ tons. On account of the unequal distribution of the load, the pontoon is given transverse stiffness by heavy timber beams on 4-ft. centers. Each of these is made of four 8 x 16-in. timbers bolted together and spliced with steel plates. Under these beams are longitudinal rows of 12 x 12-in. timbers on 4-ft. centers. The pontoon contains 183,120 ft. b.m. of lumber and, allowing for the iron used in its construction, has a net buoyancy of 195 tons. The whole pontoon must, of course, be filled with water to reduce the buoyancy to this figure. This is done just before launching the caisson by removing a wooden gate, made in two pieces, which covers a number of 4-in. holes in the side of the pontoon. The gate is first unbolted and temporarily shored, and comes to the surface when the shores are removed. When the pontoon is raised after a launching, the emptying of the ballast tanks brings these holes above water so that the gate can be replaced.

On a deck of 3-in. plank laid between the transverse timber beams is loaded sufficient gravel to weigh 130 tons submerged. This reduces the buoyancy to a point which allows the pontoon to be sunk free of the caisson being launched when the water boxes are about half full. Each of the six boxes weighs 2 tons, is 23½ ft. long, 3 ft. wide and 7 ft. 8 in. high. Each has a capacity of 17 tons of water, but not more than 9 tons per box is required.

All five of the large caissons for the river piers were launched from this pontoon without mishap, the first being floated on Oct. 9, 1915, and the last on June 30, 1916. The caissons were built up with the pontoon moored at a dock, on which the caisson material was handled by a locomotive crane and a derrick. Derrick boats were used from time to time to assist in the work. The steamboat which towed the caissons from the pontoon to place is shown in one of the photographs.

The bridge is being built for the Paducah & Illinois Railroad Company, for which C. R. Ficks is resident engineer. The Union Bridge & Construction Company has the contract for the substructure. H. K. Seltzer is chief engineer, G. F. Wilhelm is engineer at the bridge and T. T. Newman is superintendent for the contractor.



PONTOON SHOWN DURING AND AFTER LAUNCHING OF ONE OF BIG BRIDGE CAISSONS—WATER-BALLAST TANKS ALWAYS ABOVE SURFACE

Field-Office Accounting: Pocket Pads for Timekeeping

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company, Scranton, Pa.

THE FEWER the books kept in a field office the better. Loose sheets, perforated and indexed in "Shannon" or similar files, facilitate a systematic arrangement of the data that should always be readily accessible. Even the pocket time book, traditionally indispensable, may be superseded to advantage by small pocket pads with detachable leaves in the accompanying form. This form is, of course, shown here in condensed shape. In actual use the blank would be considerably larger, with lines enough to provide for recording the average number of men in a gang.

DAILY REPORT

ARNOLD BROWN & CO.

Weather................ Contract.............. Date................

Class of work........................

Name or No.	Occupation	Hours	Rate	Amount
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	

Total labor cost for day,
Materials used as per memo on back hereof,

Total,

The advantages of the pocket pad over the pocket time book, especially on a large job where many gangs are employed, are numerous.

If the names and numbers are recorded in a book in alphabetical or numerical order, the pages have to be thumbed over repeatedly to find each man's account before checking it. If they are recorded in groups representing each gang, the shifting of men from one gang to another confuses the record. Time-taking in all kinds of weather results, often, in records so badly blurred at the end of the weekly or semimonthly period that they are almost undecipherable. On the pocket pad, names and numbers can be recorded more quickly than the pages of a book can be thumbed over for the check-mark. Each gang's daily record is complete in compact form, and the data are taken in a form already classified for entry on the cost sheets. Furthermore, the time can be just as readily transferred to the payroll as from a time book, and changes in rate payment can be conveniently recorded.

[Following the series of short articles by Mr. Lathrop on economical accounting methods for the contractor's general business, another series on short cuts that have proved valuable in the job office is introduced by the present article.—EDITOR.]

Integral Curb Cuts Paving Cost 11 Cents Per Yard

Bids on paving in Appleton, Wis., recently revealed that an integral concrete curb would save 11 cents per square yard on 9629 sq. yd. of pavement as compared with a separate curb.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Worthless Concrete Responsible for Failure at Cleveland Filter Plant

Four Columns of Clear-Water Basin Break Down Under Weight of Ground Roof Before Earthfill Is Placed Above

(EDITORIAL CORRESPONDENCE)

Concrete that was penetrated with a bull point to the depth of half an inch at each blow of a 12-lb. sledge, that crumbled in the hand and soiled the fingers, that appeared to be innocent of cement to an astonishing degree, was undoubtedly responsible for the collapse recently of four columns and the section of groined roof they supported near the east end of the central section of the new clear-water basin of the Cleveland municipal filter plant. The collapse took place even before the 3-ft. earthfill had been placed on the roof. The basin had been filled once, and was emptied at signs of trouble, the collapse taking place directly afterward.

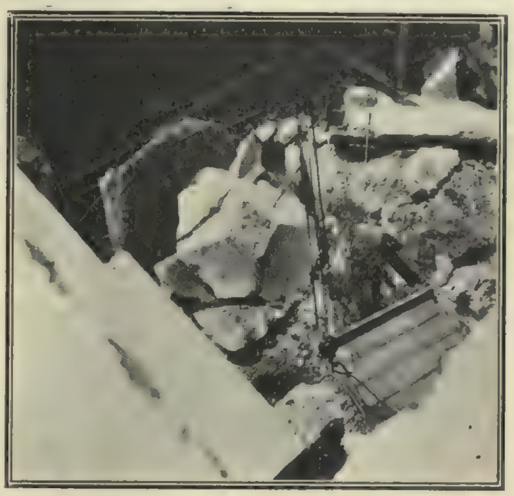
Condition of Concrete

An investigation into the causes of the collapse, which fortunately did not result in loss of life, and into the deplorable condition of the whole structure is being made for the city by James H. Herron of Cleveland, Nathan C. Johnson and Frederic C. Noble of New York. The origin of the aggregate and sand, the inspection methods and the construction details will be gone into to fix the responsibility and to determine more accurately the cause of the faulty construction.

It was evident to representatives of the Engineering Record who examined the collapsed section and the central basin that extensive, if not entire, replacement of the substance that passed for reinforced concrete when the structure was accepted will be necessary. Reinforcing appeared at the surface in more than one column. One 22-in. square column was broken clear across through a layer which contained no stone and which could be whittled with a pocket knife. The soft sandstone pebbles which made up a large part of the aggregate were actually harder than most of the mortar in the structure. Pebbles and sand grains could be separated with the fingers from the broken pieces of columns and roof examined.

Much of the exposed surface of the entire section was in the same condition. The south retaining wall, against which earth is filled to the top, showed a large amount of seepage. A spring which would fill a 3-in. pipe was coming through the floor near the collapsed section. The investigators have already partly cut into a large number of places where the concrete is as soft as in the collapsed portion, and more than one column could probably be cut through with no more formidable a weapon than a table knife.

It is not thought at present that an earth slip could have been responsible for the failure, as there are no visible signs of any lateral or vertical displacement of consequence in the structure. Moreover, the condition of the concrete is more than sufficient to account for the failure.



CORNER OF PART THAT FAILED

It is said at the present time that the only check on the cement used was that kept by the concrete foreman, and that the pneumatic method was used on most of the central section, while a spouting system was also utilized to some extent. Since it is certain that the Walsh Construction Company, which built the clear-water basin, would not risk its reputation by willingly putting up such construction, and that the engineer of the Cleveland Water Department would never knowingly have allowed such work, the failure seems to be an example of what can be accomplished by laxity, ignorance and carelessness. It must be remembered that poor concrete can be placed with any of the methods in use, especially if next to no cement has been put in it, and if it contains more than a modicum of clay and other matter that soils the fingers when rubbed. All the facts surrounding the failure will not, of course, be known until the report of the investigators is made public; but this much is certain, that there is no reason for invoking faulty design or the geology of the foundation site to account for the failure of the sort of "concrete" with which the clear-water basin was built.

[At the time of going to press information was received that the consulting engineers will submit a repair scheme not necessitating tearing out the present structure.—EDITOR.]

CONCRETE COLLAPSED BEFORE LOAD WAS APPLIED

SPECIMEN OF ONE OF THE COLUMNS THAT FAILED

Quick Repair of Dam Saves Charleston's Water Supply

Rainfall of 16.3 Inches in 24 Hours—Floods Earth Dam—Sand Bags Covered with Canvas Successfully Withstand Current

Heavy rains early last week followed by a precipitation of 16.3 in. July 21 and 22 caused the waters of Goose Creek to submerge the Charleston (S. C.) Light & Water Company's earth dam. The swift current rapidly eroded parts of the earth structure and necessitated quick repairs to save the water supply of Charleston. The first damage was done at 7.30 p. m. Saturday. The temporary repair work was completed the following Wednesday.

On Friday, July 14, the gage at the Charleston pumping station showed a rainfall of 3½ in. during the 24 hours. This followed a rainfall of more than 2 in. the early part of the week. During the 24 hours from Friday to Saturday night about 16.3 in. of rain fell. According to observations made by a contractor, the intensity of the rainfall at one time during Saturday was at the rate of 2 in. in 10 min.

Saturday the water began to overflow the spillways and run over the earth dam. Dr. J. M. Worthen, the superintendent in charge of the plant, did everything possible to prevent the erosion of the earth embankment. At 7.30 Saturday evening the water was at the highest point and still rising rapidly. It reached a depth of about 14 in. over the earth dam and the downstream slope began to erode

(Continued on page 152, first column)

Quick Repair of Dam Saves Charleston's Water Supply

(Continued from page 151)

quickly. Within half an hour a breach was washed clear across the dam, which at that point was approximately 50 ft. wide. The breach was longitudinal with the dam, about 100 ft. wide on top and 13½ ft. deep. The top of the embankment was at elevation 13.5 ft. above ocean tide; the bottom, approximately zero. The crest of the spillways was 10½ ft. above tide, and at that point the capacity of the dam was 2,800,000,000 gal.

On Monday morning, July 17, the elevation of the water was 8 ft. above tide and on Tuesday morning 7 ft. The capacity of the dam at El. 7 was 782,000,000 gal. Ordinarily the water in Goose Creek downstream from the dam ranges in elevation from zero to 6 ft. above tide. During the heavy rainfall just before the dam broke the elevation of the water below the dam was approximately 10 ft. above tide.

Cofferdam Constructed

A pile driver and wrecking crew were secured and the first work of building a cofferdam of sand bags at the upstream end of the breach was begun Tuesday morning, July 18. The temporary structure was carried to the opposite side of the creek by 3 a. m., the next day. At that time the water was rising at the rate of 1½ in. per hour. Fortunately the high tide occurred about the time of completion, so that there was little current. However, by 8 o'clock the next morning, when the tide had receded 2 ft., the velocity over the cofferdam was so great that the sand bags began to show signs of being displaced.

For half an hour it looked as if the whole cofferdam would fail. The expedient was then adopted of covering the worst places of the bags of sand with canvas, weighting it down on the upstream side and letting it lap entirely over the structure. This proved so successful that it was decided to cover the whole cofferdam in the same way.

The cofferdam when completed was approximately 25 ft. wide at the bottom, 6 ft. wide at the top and about 120 ft. long. It has withstood successfully a flow of 6 in. of water over the top.

Considerable fear was felt among the inhabitants of Charleston concerning the continuance of the supply of water. It was thought there would be difficulty in preventing the salt tide from backing up into the impounding reservoir. On account of the quick work that was prevented.

Permanent Repairs Being Made

Permanent repairs are now being made by means of heavy piling driven clear across and on both sides of the breach. These piles are spaced 8 ft. apart. Four-inch sheet piling was driven on each side. The space within and on the sides will be filled with sand bags, after which the earth filling will be completed.

The maximum flow of the stream is said to have been nearly 20,000 cu. ft. per second when the break took place. The dam is about 2300 ft. long and built of earth. It is 12 ft. wide at the top with up and down stream slopes 3 to 1. There are a 100-ft. spillway at the east end and another 100-ft. spillway built on cribwork near the west end. The remainder of the embankment was only slightly damaged, although the water had, for a considerable time, run over the entire structure to a depth of over 1 ft.

For several years it has been recognized that these spillways were inadequate to carry off flood flows, as their discharging capacity was only 3500 cu. ft. per second, or 70 cu. ft. per second per square mile. On Sept. 13, 1912, water ran over the dam to a depth of approximately 0.7 ft. without causing damage.

The information was supplied by J. W. Ledoux, chief engineer, American Pipe & Construction Company, Philadelphia.

House Committee Reviews Power Situation at Falls

Impressed with Urgent Necessity for Increased Diversion of Water at Niagara Falls for Power Purposes

Members of the foreign affairs committee of the U. S. House of Representatives on July 13 and 14 reviewed the power situation at Niagara Falls and Buffalo, N. Y., as guests of the Niagara Falls Board of Trade and Buffalo Chamber of Commerce. After informal conferences with officials of electrochemical industries, power companies and city authorities, the committee held a hearing at Prospect House in Niagara Falls. A mass of statistics was presented tending to show the need for the extension of the diversion limit to allow the use of the 20,000 sec. ft. as fixed by the treaty.

Some urged diversion up to 50 per cent of the cataract's flow as possible without impairing the scenic beauty of the river and as necessary for the full development of the industrial arts of the nation. Officials of electrochemical industries and power companies were given assurances that the committee is in sympathy with the movement for increased diversion so long as the scenic beauty of the cataracts will not be impaired.

Diversion of Water Is National Question

It was pointed out to the committee that the Niagara diversion is a subject of national interest and one affecting the industrial life of the United States. Especially important, it was said, has been the part the Niagara electrochemical industries have played in averting a panic that would otherwise have been brought on by the European War. Alloys essential to the manufacture of steel and high-explosive shells, as well as 80,000,000 tons of aluminum a year, are being produced at the Falls, and the supply is said to be far below the demand. Frank J. Tone, manager of the Carborundum Company, also told how his firm had to construct a plant in Canada because of lack of power on the American side.

In discussing the situation informally with Niagara Falls officials Representative Cyrus Cline of Indiana indicated that the sentiment of the foreign affairs committee on the Niagara power question is changing.

"Because of the disposition on the part of Canada to curtail the exportation of power there is a feeling on the part of the committee that the new Niagara legislation should extend the diversion limit to that provided by the treaty," said Mr. Cline.

After the Niagara Falls hearing the committee made an inspection of the properties of the Niagara Falls Power Company and the Hydraulic Power Company. They also visited the up-river districts where all the great electrochemical industries are located.

Name Canada Railroad Board

A. H. Smith, president of the New York Central Lines, Sir Henry Drayton and Sir George Paish have been named as a committee to investigate conditions of Canadian railways. Causes of railroad troubles in Canada are said to be overdevelopment, building lines into undeveloped territory and war conditions.

Agree on Grade Crossing Signal

Committees of the National Association of Railway Commissioners and the American Railway Association have agreed upon a system of signals for grade crossing protection.

The plan is to place at every grade crossing in the country a circular sign 24 in. in diameter, painted white with a large black cross in the center and the letters "R. R." inserted above the horizontal arm of the cross. The sign will be placed on the highway 300 ft. from the tracks.

When necessary, the commission recommends that the sign be lighted at night.

Five Bridges Over Catawba River Swept Away

Water Rising 48 Feet Causes Great Bridge Loss Near Belmont, N. C.—Water Receding—Damage Smaller Than Expected

As the result of the severe storm July 15 sweeping over North and South Carolina and Virginia the rivers in that section have risen to heights rivaling all past records. The depth of water at Mount Holly, N. C., is given as 47 ft. 9 in., which is nearly 20 ft. more than the record. The Congaree River July 18 was reported 31½ ft. above normal. Within a radius of 6 miles of Florence, N. C., practically every bridge has been seriously damaged, eight of those structures having spans between 80 and 150 ft.

The Catawba River rose about 48 ft. above normal, exceeding the record of 1902 by 10 or 12 ft. Probably the largest bridge loss per

PART OF SOUTHERN RAILWAY BRIDGE NEAR BELMONT

unit length of shore line is near Belmont, N. C. Five bridges in that section in a distance of a half mile along the river were carried away. The Southern Railway bridge on the Washington-Atlanta line was destroyed by the flood Sunday, July 16, at 5.30 p. m. Six coal cars had been placed on the structure to save it. About two dozen men were loosening the driftwood when the bridge gave way. Practically every man was drowned. At Mount Holley, one-half mile above the Southern Railway crossing, three more bridges failed that Sunday afternoon. They were the Seaboard Air Line steel bridge, the Piedmont and Northern Interurban lines structure and a steel highway bridge. Those three structures represented an investment of $125,000 and are now a total loss. The last bridge to go was the two-year-old $100,000 reinforced concrete highway bridge at Sloans Ferry.

Build Temporary Line

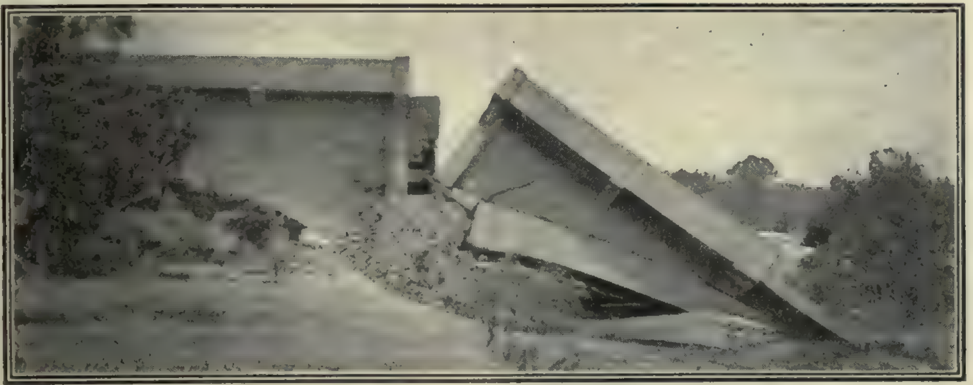
Work on putting up a temporary bridge on the Southern Railway line was started immediately. A steam shovel, three train loads of material and about 500 men were dispatched to this point. Considerable trouble was experienced getting the first few piles driven, as the water kept washing them loose. An extension of about 95 ft. had been built and filled in July 21, and the main piles in the center spans were about ready to place. Crews are working from both ends and a temporary bridge is expected to be ready in two weeks.

Similar work has been started on the Seaboard and on the Piedmont & Northern bridges. The Sloans Ferry highway bridge will be replaced with a temporary structure, although work had not started July 21. Rafts are being built by the railroads to carry people across the river. Passengers and mail get from Washington and points north to all points in South Carolina and Georgia by crossing the river in boats.

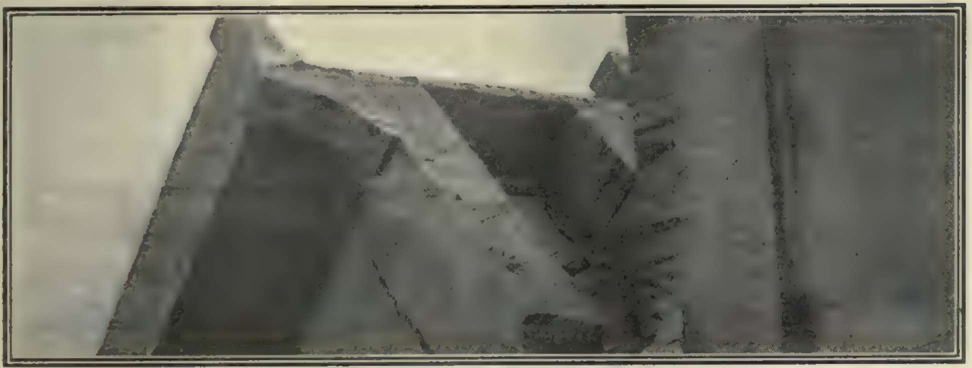
At Union, S. C., the Broad River changed its course after the floods receded, leaving the 6000-hp. water-power plant of the Union Buffalo mills high and dry. A dam will have to be built to throw the water back into its natural channel. The damage to that plant is estimated at $125,000. A 900-ft. trestle owned by the Union & Glen Springs Railroad crossed the river near Union. It is almost an entire loss.

The Engineering Record's representative went over the Southern Railway line from Spartanburg to Herbert, S. C., and walked 20 miles to Columbia. He found the reports of washouts and bridge trouble in that vicinity to be greatly exaggerated. The Broad River bridge was only slightly out of line and other bridges nearby held firm despite the fact that they were all practically submerged.

Reports stated that the Kanawha River at Kanawha Falls was 31.7 ft. above normal and



SLOANS FERRY BRIDGE COLLAPSED SUNDAY, JULY 16



"CLOSE-UP" VIEW OF COLLAPSE OF SLOANS FERRY BRIDGE FAILURE

about 38 ft. at Charles. The New River near Roanoke, Va., was reported 30 ft. above normal and the highest since 1878. At Mount Holly on the Catawba it is said that the flood crest was 47 ft. above low-water mark. The Yadkin River, near Winston-Salem, was reported 25 ft. above normal and 8.5 ft. higher than the record for the past forty-five years.

Philadelphia Engineers' Club Enlarges Its Journal

The *Proceedings* of the Engineers' Club of Philadelphia has been greatly enlarged, conforming with the progress of the club, which has increased in membership within the last year from 500 to nearly 2500 members. The publication, beginning with the July number, is 9 x 12 in. in page size. The first issue contains 112 pages and carries a liberal amount of advertising. Each of the societies affiliated with the club, the national societies of civil, electrical, mechanical, heating and ventilating, illuminating and automobile engineers, has its own section, as has also the Technology Club of Philadelphia.

The chief feature of the first number is a series of three papers by Col. George A. Zinn, Corps of Engineers, U. S. A., on military engineering.

New York Districting Regulations Passed by Board of Estimate

On July 25 the Board of Estimate and Apportionment of New York City adopted, as modified, the proposed districting resolution in the final report of the Commission on Building Districts and Restrictions appointed in 1914, and thus enacted into law the districting regulations which have been the subject of many hearings during the past few months. The new regulations carry into effect the authorization to divide the city into regulated districts, as vested in the board by a law passed by the New York legislature early in 1914 as a result of the work of the previous Heights of Buildings Commission. The new law restricts the heights of all buildings to certain multiples (2½, 2, 1½, 1¼ and 1) of the street width for each specified district, with certain allowable mansards or vertical walls set back from the street line in a prescribed ratio.

Height restrictions and limitations of use or occupation are prescribed in so-called "use districts" and of allowable size of courts and yards in so-called "area districts." Only in the present office-building sections of lower Manhattan is a height of two and one-half times the street width permitted, and in the strictly residential sections one time the street width is made the limiting height. One of the "use district" regulations which will satisfy the public demands recently made is the prevention of further encroachment on the Fifth Avenue and Broadway retail district by loft-building factories. This district is protected between Second and Sixth Avenues as far south as Twenty-third Street. As noted in the construction-news section on another page, a record single day's total for new building permits was made just before the new law went into effect.

Practically all opposition to the general principles of the commission, which were presented in the Engineering Record of Feb. 26, page 284, was overcome, and only local changes in the proposed districts were made. The chairman of the Commission on Building Districts and Restrictions is Edward M. Bassett; Robert H. Whitten is secretary, and George B. Ford is consultant.

Gas Overcomes Many in Compressed Air Tunnel

A pocket of gas encountered late in the evening of July 24 in the landward heading from the lake terminal shaft of the new Cleveland waterworks intake caused the death of twenty-one men.

Gas, commonly encountered in underground work in the vicinity of Cleveland, has been the cause of some of the worst tunnel accidents on record. The precautions of carrying the airline clear to the working face, of providing extra compressor capacity to dilute any gas encountered and of using only the most carefully installed electric circuits for light have been in force throughout the progress of the work on the present tunnel. When the lake heading struck gas in small quantities July 22 extra caution was exercised. A sudden inrush, July 24, from a large pocket overcame the workmen before they could get to the lock. A rescue party which entered the heading was overcome and ten members could not be revived with pulmotors. The foreman of the shift, who was one of the few in the heading to survive, states that there was no explosion.

The heading, 120 ft. below lake level, had about 90 ft. of clay and gravel cover, was in "draw-knife" clay and carried 22 lb. air. It had been driven only a short distance beyond the lock bulkhead, as the lay of the job has made it economical to drive the greater part of the tunnel in one heading from the shore shaft.

The work was being done by day labor. G. C. Van Dusen, superintendent for the city, was overcome and seriously affected in rescue work. F. Farrell, commissioner of public works, and C. P. Jager have been in charge of the project for the city.

Investigate Surface Line Traffic and Capacity in Chicago

An intensive study of the traffic conditions and track capacity of the Chicago surface lines with respect to the possibilities of improved service and rerouting has recently been made by the board of supervising engineers of the Chicago traction interests. The data, which are printed as an advance reprint from the ninth annual report, show the extent and causes of the existing traffic congestion.

Stricter traffic regulations are recommended. Among these are reserved loading spaces marked in white on the pavement; electric semaphore signals; further restrictions on vehicle parking; more rigorous action against vehicles on the tracks and more drastic ordinances limiting the width of trucks and their burdens.

A modification of the standard-pavement-contour that will make it possible for teamsters to use the roadway outside of the car tracks during inclement weather is recommended. Removal of the elevated loop columns from the roadway to the curb is also advocated. In the deductions from data of fact it is stated that the present rate of car movement has exhausted the track capacity, assuming all avoidable vehicle interference removed. Even under any proposed rerouting the relief cannot last much beyond the earliest date that subways or other additional outlets will be available.

Urges Legislation to Help Exporters

The House Committee on Judiciary began hearings last Tuesday on the Webb bill to legalize combinations among American exporters seeking to extend the export trade of the United States. Chairman Hurley and Commissioner Rublee of the Federal Trade Commission advocated legislation to exempt such combinations from prosecution under the anti-trust laws.

Los Angeles Aqueduct Water Used for Irrigation

New Trunk Lines Will Bring Yearly Revenue to Los Angeles of Nearly $250,000—Estimated Cost to Complete System, $4,354,895

Surplus water from the Los Angeles aqueduct amounting to 125 sec.-ft. is now being furnished the San Fernando valley. Of this amount 100 sec.-ft. is used for the irrigation of 20,000 to 25,000 acres and the remainder for domestic purposes. The first irrigation water, delivered through an earth ditch, was supplied May 26, 1915. Plans are being made for the development of the system so that an area of 87,300 acres will eventually be under irrigation from the aqueduct supply.

While the plans for the water supply of this area call for a single distribution system, political conditions required the forming of two geographical divisions—the San Fernando irrigation district No. 3, with an area of 76,090 acres, and the Mission district, with an area of 11,215 acres.

The first named was formed in 1914, voted $2,606,000 worth of bonds in 1915 and, with the sale of these securities in February, 1916, the present work of construction was undertaken. The Mission district did not complete its organization and vote bonds until early in 1916. The issue will be offered for sale within the next few weeks, and as soon as it is sold specifications for the steel pipe required will be issued.

In the present scheme of development the lands are to be served by trunk lines ranging from 54 in. to 30 in. in diameter. It is estimated that 1 in. of water, continuous flow, will be required for every 7½ acres within the district. That is the equivalent of 1 in. to 5 acres for an irrigation season of 240 days. It is expected that when the district is fully served it will use surplus water to the extent of more than 11,000 in., giving Los Angeles an approximate revenue of $250,000 a year. The present sales total approximately $100,000 annually.

Contracts amounting to approximately $559,755 for pipe and materials have been awarded and bids were opened on July 10 for an additional 65,000 tons of steel pipe. In January and February, 1916, contracts for pipe calling for approximately 6890 tons were let to four Los Angeles companies, it being stipulated that deliveries were to continue for 210 days after June 1. To July 1 approximately 25 miles of trunk lines and laterals had been constructed and placed in operation.

The pipe is hauled to the valley and distributed along the ditches by auto trucks. Steam shovels excavate the main trenches, smaller laterals are dug by power excavators and a power-driven machine is used for backfilling. Thus practically the entire work is done without hand labor.

It is estimated that the total cost of completing the system will be $4,354,895. Los Angeles is paying for the trunk lines that would be needed anyway and for the Chatsworth storage reservoir to be used in the development of power. That brings the average development charge to be borne by the San Fernando valley down to approximately $33.50 per acre.

The work is being done under the direction of the Los Angeles Water Department, of which William Mulholland is chief engineer.

Sometimes Photographs Lie

THIS ONE, for instance, might be taken for a picture showing the unbelievable results of a terrific hurricane of unprecedented force. The bridge columns appear to have been bowed beyond any known elastic limit. Even the trees and telegraph poles have assumed marvelously surprising forms. The explanation is simple—the negative was exposed to intense heat in drying and the sensitized coating shrunk in such a way that the above print was obtained.

Charles D. Calley, who is bridge engineer in the King County, Washington, engineer's office, supplied the print.

Will Hold Conference on Co-operation

The third annual Babson conference on co-operation will be held at Wellesley Hills, Mass., Sept. 13, 14 and 15. The purpose of the conference is to discuss co-operation between competing business interests and between employer and employee. Previous conferences have been very helpful, being participated in by responsible officials of such organizations as the B. F. Goodrich Company, the E. I. du Pont de Nemours Powder Company, the Stetson Shoe Company, the U. S. Rubber Company, the Dennison Manufacturing Company and Fels & Company. The sessions on co-operation between employer and employee have been especially helpful.

Washington Water Code Discussed at Conference in Tacoma

At the recent meeting at Tacoma of representatives of commercial, transportation, engineering and industrial bodies of the State of Washington the drafting of a water code was the principal subject of discussion. The morning of the first day of the conference was devoted to the usual preliminary business. That evening and all of the following day were given to the discussion of water legislation in Washington.

The principal discussion was on riparian rights. The feeling on the part of those who had heretofore opposed the code was that if the riparian-right doctrine is to be abrogated due compensation should be made. In this respect the idea prevailed that the state should condemn those rights as required and permit the courts to determine their value. A committee will present a revised code at a conference to be held in November at North Yakima.

In Washington the courts have ruled that the riparian owner has the right to insist that the water continue to flow past his property without any change. That decision has held up several large irrigation projects, as it prevents storing of flood waters or the control in any manner of the natural flow of the stream without first securing the consent of the riparian owners.

They Called It Civil Service

"Ben Estil, of the old civil-service board, held an examination for rodman. The members of the new board had occasion to refer at their meeting yesterday to the eligible list created by that examination. Here is what they discovered:

"An express driver for fourteen years made a grade of 90. A groceryman made a grade of 84. A draftsman, with three years' experience, made a grade of 65.

"'I think we had better abolish that list,' said John E. Wilson, member of the board. That matter will come up for a vote at the next meeting."—*Kansas City Star.*

What Engineers and Contractors Are Doing

WALKER S. GEFVERT, formerly with the Bureau of Standards at Washington, conducting tests on lime and cement, has been appointed to an engineering position with the Bureau of Lighthouses. He is stationed at Tompkinsville, N. Y., supervising the erection and repairing of light stations. Mr. Gefvert was graduated from the University of Pennsylvania in 1911. A brief experience in sewer construction and railway maintenance was followed by his appointment as resident engineer for the Victor Irrigation Company of Kansas City.

LEANDER DORSEY has resigned as superintendent of the Whiting-Turner Construction Company to become manager of the contracting department of the Crann Engineering Company, Baltimore, Md. Mr. Dorsey is a graduate of Rensselaer Polytechnic Institute, class of 1899. For five years thereafter he was connected with the engineering department of the Mexican National Railroad, resigning in 1903 as track engineer, in which capacity he also had charge of the 1100-ft. La Magre tunnel. He returned to the East in 1904 to become chief of party on surveys for the Burnt District Commission of Baltimore. Mr. Dorsey was later made assistant engineer in charge of surveys for the Elk River Coal & Lumber Association.

FRANK L. BOLTON has resigned as assistant engineer for Gardner S. Williams, consulting engineer, Ann Arbor, Mich., and is now resident engineer on the Mill Creek flood-control works at Erie, Pa., reporting to Farley

Gannett, consulting engineer, of Harrisburg, Pa., who has general charge of the work. Mr. Bolton was graduated from the civil-engineering department of the University of Michigan in 1909. Previous to becoming associated with Mr. Williams he was on the engineering staff of the Rochester (N. Y.) Railway & Light Company.

J. H. PIOTROWSKY, formerly with the Akron (Ohio) city waterworks, has been made superintendent of the waterworks at Barberton, Ohio.

JAMES MUNN, superintendent of construction for the U. S. Reclamation Service during the erection of the Arrowrock dam, is now superintending the construction of a multiple-arch dam near Salt Lake City. The structure will be about 150 ft. high and furnish storage for the city's water supply. Parrott Brothers, contractors, of Salt Lake City, are doing the work.

F. L. LACAFF, superintendent of construction of the U. S. Treasury Department, has completed the $2,000,000 Federal Building at Denver, Col. He will be located at Newport, R. I., during the erection there of a $250,000 post office and custom house.

G. C. BROOKING, formerly with the Interstate Commerce Commission, Division of Valuation, Eastern District, has joined the engineering department of the Pennsylvania Railroad. His headquarters will be at Pittsburgh. Before his service with the Interstate Commerce Commission Mr. Brooking was assistant engineer on surveys for the Baltimore & Ohio Railroad at Baltimore.

MILTON B. MORGAN has been promoted from assistant engineer maintenance of way for the Illinois Central and Yazoo & Mississippi Valley railroads to district engineer of the latter road, with office at Memphis, Tenn. Mr. Morgan was promoted in 1912 from roadmaster for the Illinois Central to the position he now leaves.

WILLIAM G. ARN, formerly roadmaster of the Indiana division of the Illinois Central Railroad, has been made assistant engineer maintenance of way of the Illinois Central and Yazoo & Mississippi Valley railroads, succeeding M. B. Morgan. Mr. Arn was graduated from Rose Polytechnic Institute in 1897. After three years' varied experience with different roads he went to the Louisville & Nashville. He rose to the position of roadmaster and left in 1906 to become local superintendent for the Southern Bitulithic Company. After about eight months in that position he again entered railway service as assistant engineer for the Missouri Pacific. He has been with the Illinois Central since 1907.

G. A. HAGGANDER, whose recent appointment as bridge engineer for the Chicago, Burlington & Quincy Railroad was noted in last week's issue, has been with that road since his graduation from Armour Institute of Technology in 1907. He was born at Sioux City, Iowa, in 1885, and before completing his college course was employed on various engineering projects. Upon graduation he entered the engineering department of the Burlington as draftsman. He was later made concrete inspector and his appointment as designer followed shortly. In 1910 he became office engineer. His appointment as assistant bridge engineer of the lines east of the Missouri River followed in July, 1912.

DAN W. THROWER, formerly district engineer for the Yazoo & Mississippi Valley Railroad at Memphis, Tenn., has been made assistant valuation engineer for that road and for the Illinois Central, with headquarters at Chicago. Mr. Thrower entered railway service in 1900. He was assistant engineer on various divisions of the Yazoo & Mississippi Valley Railroad, preceding his appointment as roadmaster on the Iowa division of the Illinois Central. He was later transferred to the Memphis division of the Yazoo & Mississippi and then to the Illinois division of the Illinois Central. In 1913 he was made assistant engineer maintenance of way at Chicago, following which he became district engineer of the Yazoo & Mississippi Valley, with office at Memphis.

F. A. TORKELSON, formerly city engineer of Wauwatosa, Wis., was recently appointed to a similar position at Green Bay, Wis. Mr. Torkelson is Green Bay's first city engineer under the commission form of government. After graduation from the University of Wisconsin in 1910 he was made assistant engineer for the Chicago & Wisconsin Valley Railway, a proposed electric line from Madison to Merrill, Wis. He left the employ of that company to join the Wisconsin Railroad and Tax Commission as assistant engineer. He was later engaged on construction with the Milwaukee County highway commission and on railroad work with the Chicago, Milwaukee & St. Paul. For the past three years he has been city engineer for Wauwatosa, a suburb of Milwaukee.

GEORGE F. WOLFE has left the employ of the Pittsburgh Bridge & Iron Works at Rochester, Pa., to take a position with the Pittsburgh Steel Company at the Monessen office. Mr. Wolfe is a graduate of Lehigh University.

W. H. SIMONS has opened consulting engineering offices in the National Realty Building, Tacoma, Wash. Mr. Simons has had several years' experience with the Northern Pacific and the Spokane, Portland & Seattle railroads.

GEORGE A. RICKER, consulting engineer, of Albany, N. Y., and formerly first deputy commissioner of the New York State Highway Department under the Carlisle administration, has taken charge of the office which the Portland Cement Association has just opened in the Commerce Building in Kansas City.

MOON & BARCLAY, contractors, of Marshfield, Ore., have dissolved partnership. The affairs of the company will be assumed by Mr. Moon.

J. E. JOHNSON has been made highway engineer of Osceola County, Florida. His headquarters will be at Kissimmee.

M. EARLE ROCHFORD, who has been associated with Brown & Tobish for the past three years, has resigned to go to the Trenton (N. J.) Engineering Company. Mr. Rochford is a graduate of Rutgers College. He was formerly engaged in municipal and farm engineering in New York.

FRANK H. TROW, for the past eight years chief engineer for Winston & Company on the construction of the Olive Bridge dam, the Beaver Kill dikes and other contracts in connection with the Ashokan reservoir, is now in charge of grade crossing elimination at Roxbury, N. Y., for which his company has the contract.

JOHN WILLIAMS has resigned as junior assistant engineer for the New York Public Service Commission, First District, to join the New York Highway Department. He is employed on road construction at Canaseraga, N. Y.

J. H. MYERS has been promoted from assistant engineer to assistant superintendent of the bridge and construction department of the Steelton plant of the Pennsylvania Steel Company. Mr. Myers is a graduate of Lehigh University, class of 1896. His first work was as draftsman for the Shiffler Bridge Works, Pittsburgh. He left that position in 1897 to enter the engineering department of Alleghany City, Pa., where he remained for one year. He was later employed by the Carnegie Steel Company and the Keystone Bridge Works.

OLAF LAURGAARD, consulting engineer, of Portland, Ore., has been engaged by the Horse Heaven Irrigation District, at Prosser, Wash., to examine plans for a proposed 300,000 acre irrigation project, involving an expenditure of $15,000,000.

Obituary Notes

ADAM SAAL, a well-known central Illinois contractor, died July 16 at Peoria. He was born in Germany in 1850 and had lived in Pekin, Ill., for sixty years. Besides his contracting business, Mr. Saal was head of the Pekin Cement Products Company, the Smith Wagon Factory and a director of the Farmers' National Bank.

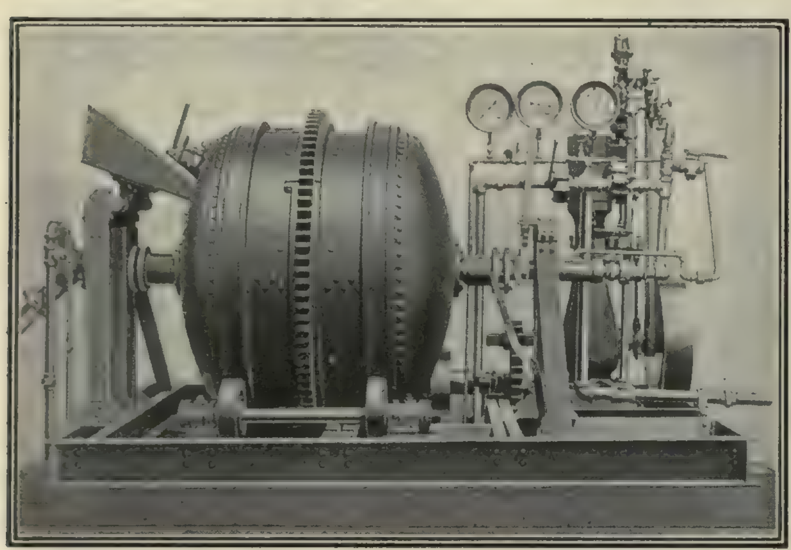
SIR WILLIAM RAMSAY, the discoverer of the transmutation of metals by the use of radium and one of the world's leading chemists, died July 23 at his home near London, England. He was born in Glasgow and received his education at Glasgow Academy and University. After two years in the Young Laboratory of Technical Chemistry he entered upon his career as an instructor. He joined the faculty of Glasgow University, later became professor of chemistry at University College in Bristol and then was made head of the chemistry department of the University College of London. He retired in 1913 as professor emeritus of the last-named institute. In May, 1907, it was announced by Johns Hopkins University that Sir William had succeeded in producing a copper compound from sodium, lithium and potassium by the use of radium. In London, on July 27, 1907, he admitted that he had done this and gave certain details. His discovery is said to be without parallel in the field of chemistry, as it was never thought that scientists would be able to change one element into another. He had received many honors, perhaps the greatest being that of the Nobel prize in chemistry, which was awarded to him in 1904. Sir William was a Knight of the Prussian Order Pour le Mérite, an officer of the Legion of Honor and a Commander of the Crown of Italy.

CHARLES W. H. KIRCHHOFF, for many years editor-in-chief of the *Iron Age*, died July 22 at his summer home at Wannamassa, near Asbury Park, N. J., at the age of 63. He was born in San Francisco, Cal., where his father was established at that time in the German consular service. He was educated at the Royal School of Mines, Clausthal, Germany, from which he was graduated as mining engineer and metallurgist in 1874. After serving three years as chemist with the Delaware Lead Refinery, Philadelphia, he joined the editorial staff of the *Metallurgical Review* upon its establishment in 1877. That periodical had only a brief existence. For a few years subsequently he alternated editorial connection with the *Iron Age* and the *Engineering and Mining Journal*. He was managing editor of the latter paper from 1881 to 1884, when he permanently returned to the *Iron Age* staff as associate editor. He was made editor in chief in 1889. On the death, in 1904, of John S. King, business manager, Mr. Kirchhoff added to his editorial duties those of general manager of the David Williams Company, continuing to discharge the responsibilities of both positions until the change of ownership of the company in 1909. He was elected president of the American Institute of Mining Engineers in 1898, and his fellow members thought so well of what he had done for them in that period that in 1911 they bestowed upon him for the second time the honor of the presidency. He was called upon by the United States Geological Survey to collect the annual statistics of the production of copper, lead and zinc and acted as special agent in that capacity for a period extending from 1883 to 1906. He served in an official capacity on committees organized to receive and entertain the members of the Iron and Steel Institute and of the Verein Deutscher Eisenhüttenleute in visits to this country in 1890 and 1904. He was secretary of the American committee in 1890 and chairman of the committee in 1904.

Machine Combines Mechanical Mixing and Pneumatic Placing

After a week's final test on the new mixer and conveyor the Pneumatic Placing Company, Inc., New York City, announces that 1½-in. stone and gravel concrete has been successfully shot 300 ft. through a 3-in. steel pipe and hose in 7 sec.

The new mixer combines mechanical mixing with the pneumatic process of placing concrete. It consists of an airtight mixing drum rotated by an air-driven engine mounted upon the same base. As is apparent from the illustration, the mixer is charged while stationary. The trap door is fastened and the drum is rotated like any mechanical mixer.



NEW MIXER COMBINES MECHANICAL MIXING AND PNEUMATIC PLACING OF CONCRETE

When ready to discharge the batch, compressed air is admitted to the drum and the concrete conveyed under pressure through pipes to the forms. Flanged steel pipe is used with one or more sections of heavy hose for flexibility. The terminal length of 20 or 50 ft. of hose may be handled by one man on the type of machine shown in the picture.

This two-bag-batch machine has a capacity of 15 to 20 cu. yd. per hour. It is designed for use in the construction of buildings, culverts, abutments, retaining walls and roads. Skids or trucks are furnished as desired. Also the buyer has a choice of 3-in. or 4-in. discharge pipe. Air is furnished through a 2-in. pipe.

The Pneumatic Placing Company will manufacture the new type of mixer in 3 and 4-bag sizes.

Pressed-Steel Construction Suit Dismissed

On June 16 Judge John H. Clarke, in the United States District Court for Ohio, dismissed the suit brought by the Berger Manufacturing Company vs. the Trussed Concrete Steel Company to restrain the latter from infringing a certain patent of the former company. The infringement claimed was in certain pressed-steel products of the Trussed Concrete Steel Company. The court decided that the claim under which the suit was brought was void for want of patentable novelty.

Rolling Mill Resumes Operations

The Hirsch Rolling Mill Company, St. Louis, Mo., after making extensive improvements and alterations in its plant, has again resumed operations. In addition to its usual line the company will soon begin the manufacture of steel bars for concrete construction and tie plates. M. A. Hirsch is president and general manager; C. C. Denniston assistant to the president, and T. J. Cunningham superintendent.

D. E. Garrison Is Dead

D. E. Garrison, president of the Corrugated Bar Company, died early this month at the age of seventy-six. Since the organization of that firm in 1891 he had been its president. He was at one time head of the Vulcan Steel Works of Carondelet, now a part of St. Louis, where the Bessemer and Siemens-Martin processes were employed. Lack of a supply of iron ore of good quality made further operation impossible and the Vulcan company accordingly gave up business. Mr. Garrison then organized the jobbing firm of D. E. Garrison & Company, and for many years sold large quantities of rails to railways in the Southwest. His organization of the Corrugated Bar Company, Buffalo, N. Y., followed in 1891.

A. C. Garrison succeeds his father as president of the company. A. L. Johnson becomes vice-president and general manager and W. H. Kennedy vice-president and treasurer.

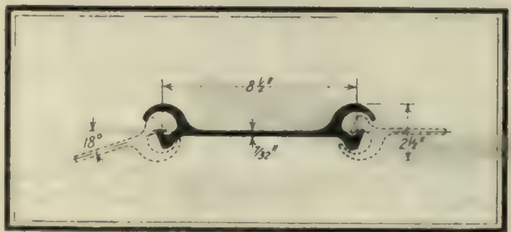
Steel Companies Combine Departments

The bridge and construction business heretofore conducted by the bridge and construction department of the Pennsylvania Steel Company and by the Pennsylvania Steel Company (of Delaware) will hereafter be conducted by the latter firm. Application has been made to change its corporate name to the Bethlehem Steel Bridge Company. The main office will be removed to South Bethlehem, Pa. The officers of the new company are: G. H. Blakeley, president; Thomas Earle, vice-president; B. H. Jones, secretary and treasurer; F. A. Shick, comptroller.

New Sheet Piling Has High Transverse Strength

A new 8½-in. section of standard straight-web Lackawanna steel sheet piling has been designed for use where a section with high transverse strength and minimum weight is required in medium trench and cofferdam work. The section was designed to give a wide range of selection.

The interlocked joint formed between adjacent piles is flexible through an arc of 18 deg. on each side of the center plane of the piling section. The hooks of adjacent sections engage to offer the greatest resistance to longitudinal displacement, while the guards overlap and engage the outer surface of the hooks on the adjacent sections. This prevents lateral and longitudinal displacement. The three lines of contact between the interlocked members of each joint are designed to give a positive, double, firm and close interlock, with a minimum of friction in driving or withdrawing and ample opportunity for displaced material to work into the joint and assist in rendering it watertight. Lackawanna steel sheet piling is made by the Lackawanna Steel Company, Lackawanna, N. Y.



NEW PILING SECTION

Pile Driver Base Turns with Piling—Changed Quickly

A pile-driver base that makes possible the driving of sheet piling at any angle without changing the position of the driver has been brought out by the Ferguson Manufacturing Company, New Orleans, La. It is claimed that with the Ferguson base a single-acting hammer can be used on steel piling without denting the sheeting.

The device can be changed in a few minutes to drive any kind of sheeting, thus avoiding the necessity for changing the driver. It is also said to eliminate the need for cushion blocks and pile plates. Aside from saving time and money the manufacturer states that contractors using the Ferguson base are increasing the day's work by from 10 to 20 per cent.

Air Operates Friction on Cable Drums of Small Dragline

A small dragline excavator for a 1-yd. bucket with air-operated frictions on the hoist and drag-cable drums has recently been put on the market. It also has an extra-large engine, a 70-hp. Minneapolis oil engine operating on kerosene and 42-deg. distillate. The machinery rests on two heavy girders rotating on the lower frame by rack and pinion and revolving on four two-wheeled trucks treading on a 60-lb. 8-ft. rail circle.

SMALL 1-YARD DRAGLINE HAS 70-HP. ENGINE AND BROAD-FACED WHEELS OR CORDUROY GRIPS

The excavator is self-propelled either on broad-faced wheels or on four Corduroy grips. The front axle is built up of 12-in. I-beams, with stub ends for removal in case of wear. The machine weighs 30 tons, has a boom length of 40 ft. and rotates at a speed of 2½ r.p.m. It can be equipped with steam or internal-combustion engines. It can also be operated by electrical power from an outside source or generated in the machine.

This small machine is the first of a complete line of dragline excavators the Pawling & Harnischfeger Company, Milwaukee, is building under the supervision of G. N. Crawford.

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Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

Published by McGraw Publishing Company, Inc.

Volume 74 NEW YORK, SATURDAY, AUGUST 5, 1916 Number 6

Plumbers or Sanitary Engineers

ATTENTION was directed some time ago in these columns to the action of the plumbers of Indiana in calling their state organization a "sanitary engineers'" association. This notion, that sanitary engineering is merely plumbing, is apparently spreading, for a newspaper clipping just at hand records the incorporation of the "Sanitary Engineering Company" at the modest little town of Lake City, Minn. The company, so the announcement says, will do a "general contracting business in lighting, plumbing and heating and all sundry trades." Were the case an isolated one it might be neglected. Coming as one of a number of such instances it shows the need for engineering societies taking up the cudgels in favor of the correct application of the term engineering and of the title engineer. It brings forcibly to mind the article of Mr. Stineman in this journal, April 22, 1916, in which he shows that the term engineer in foreign countries is restricted to professional employment. Locomotive drivers, stationary-engine operators, etc., bear distinctive titles that clearly differentiate their functions from those of men trained to handle problems of a professional order.

Absurdity

THIS journal has had occasion to refer frequently during the last six months to the fight waged against proposals to give New York City a garbage-disposal plant defensible on technical and economic grounds. First the Governor vetoed the proposal for a municipally owned plant. Then citizens of the Bronx and Queens boroughs defeated the plan to locate the plant on Rikers Island, as was recommended by the street-cleaning commissioner. Now the residents of Staten Island are bringing every conceivable force to bear against locating the plant there. Not content with ordinary legal measures, they have carried the fight to the United States Congress. A bill has been introduced to prohibit the transportation of garbage by water to Staten Island, and delegations have appeared before the House committee on rivers and harbors in support of the measure. Were the consequences of this groundless opposition not so serious the matter could be characterized as a bit of public folly and then dismissed. However, the disposal of the wastes of the greatest city of the country is involved. If the inhabitants of every section of Greater New York are to be consulted, the plant will have to be located in the Atlantic Ocean about 10 miles from shore. The street-cleaning commissioner has declared the process to be unobjectionable. There can, then, be only sentimental reasons against the location of the plant. Somewhere the plant must go, for the proceeds are too large for even the City of New York to reject the reduction process in favor of incineration. But even an incineration plant would find opponents to its location. This journal sincerely hopes that Congress will kill the pending bill and that the courts will support the board of estimate and apportionment in placing the plant on Staten Island.

Preparedness for Earthquakes

A CALIFORNIA correspondent sending some views of repaired buildings damaged in the Imperial Valley earthquake last summer urges that the technical press continue its efforts to arouse those in earthquake zones to the need of earthquake preparedness—preparedness, he says, "both mentally and structurally." He lists the shocks of the last half year and adds that the California papers (as usual) said nothing about them. Presumably they fear that notice might discourage immigration and the tourist traffic. Earthquake preparedness is not different in its essentials from military preparedness. It requires a full knowledge of the conditions to be met, and the provision of means for meeting them. As to knowledge of conditions the chief lack, as Dr. Branner, the distinguished geologist, pointed out in this journal Dec. 25, 1915, page 780, is an accurate location of the faults. Unfortunately the people of California and the large corporations (who are particularly able to help) are not co-operating in this work. They are, as it were, geological pacifists. Once the faults are located, special provision can be made for the repair of structures that must cross them and cannot be located otherwise. As to types of structures, such as buildings, not crossing the fault, the precautions are few and simple. Above all, though, the faults need to be located accurately, and in this work the engineers in earthquake zones should lend every assistance.

Our Trade in British Eyes

A CLEAR ANALYSIS of the conditions which will influence our foreign trade after the war is contained in an editorial in a recent issue of *The Engineer*, London. The British journal concludes that neither our present industrial development nor the efforts of American houses to secure foreign trade will arouse apprehension among British manufacturers and exporters as long as we continue two of our characteristic business policies—unwillingness to meet the requirements of foreign markets, and insistence on cash payments or, at least, 30-day settlements. As to the first of these policies, *The Engineer* sees a change. Our manufacturers are beginning to realize that they cannot expect to get and hold foreign trade unless they are willing to produce goods which meet the needs of their prospective customers. Our credit attitude has altered but little, and even if we were to adopt a more liberal financial policy, *The Engineer* holds, we would still be far from the goal which enterprising American merchants hope to reach. That goal can be attained only if we break down the final barrier to foreign markets—our high cost of production. Unless we are able to manufacture more cheaply than other countries and actually to sell more cheaply, even the adaptation of our products and the broadening of our credit system will not give us the opportunities in foreign markets which our strong internal condition would indicate to be possible. Careful students of foreign trade conditions will agree fully with *The Engineer's* analysis. The fundamental basis of a foreign trade, quality being the same, is low price. Low prices will not be possible without a wholesale adjustment of present wage scale—which again brings us to the pleas made in this journal several weeks in succession, that our present industrial situation and its solution require the concentrated attention of the best economic thought in the country.

Controversy Over Check Dams

SINCE the board of engineers which investigated the flood-control problem of Los Angeles County about a year ago made its report there has been considerable controversy in the Southwestern edge of the country over the value of check dams. It appears that in the discussion there has been more or less acrimony, but the Engineering Record had supposed that a careful presentation of any subject that promised to be of value in solving engineering problems would be welcomed by all engineers. And probably in this case there has been little departure from that professional attitude. Nevertheless, the Engineering Record has been informed that there was some "resentment" because it published in May of this year an article describing the investigations made with check dams in the hills above Los Angeles. It seems that those who cherish the resentment gathered the idea that the Engineering Record advocated the dams as being a sole and sufficient remedy for preventing floods. The interpretation of the article and the editorial comment that accompanied it is no less absurd than the resentment which is cherished. Nowhere in Mr. Olmsted's article nor in the comment can be found the least inkling that these dams were considered by themselves to hold out the possibility of a full and complete solution for flood difficulties. In fact, Mr. Olmsted cites that part of the report

of the engineers who advocated appropriations for check dams in which the statement is explicitly made that their function is merely to cut down the flow that would have to be cared for by other means in the valleys below. Moreover, with the material it has published on flood control it is not to be thought that this journal would quickly throw aside all experience and arguments in favor of a little-known expedient. Los Angeles County has done well, in the opinion of this journal, to appropriate moneys to build experimental systems of check dams. What data are now available promise well for their functioning as part of the comprehensive plan of flood prevention. The data should be, and of course will be, supplemented by careful observations during subsequent seasons. The cumulating information may settle the question over which there has been controversy. No apology, then, is necessary for presenting Mr. Olmsted's article. Anyone may differ with the conclusions, but no fair-minded man will dispute the desirability of a clear presentation of data that carry promise of advancing engineering knowledge.

"Saving New York" Campaign

WHAT is probably the most unusual city-planning campaign ever conducted has been under way in New York since the first week of March of this year. As explained editorially in this journal on March 11, page 342, the high-class retail mercantile establishments promised to show preference in their purchases to those manufacturers of women's garments whose factories were outside of a zone bounded by Thirty-third and Fifty-ninth Streets, Third and Seventh Avenues. In other words, commercial pressure was brought to induce those who had invaded this section to move to other parts. The district in question is occupied by the higher-class retail establishments, the clubs, theaters and hotels. As a result of the invasion by manufacturers, who brought with them hordes of people of the working class, it was fast taking on characteristics which would have rendered it unavailable for its present high-class use.

At the start it was freely predicted that the campaign would be unsuccessful. Even clothing manufacturers in sympathy with the effort to preserve the characteristics of the finest commercial section of the city felt that it would fail, for many of the manufacturers depend for their business on retail establishments outside of New York. It is gratifying to note that the fears have proved unfounded. A canvass just completed shows that 95 per cent of the manufacturers in the affected zone will move to other districts when their leases expire.

While the primary result of the campaign will be to preserve the present characteristics of the shopping, club and hotel district there may be a secondary desirable influence—the rehabilitation of the deserted district between City Hall Park and Twenty-third Street. Time was when this was the center of the women's garment manufacturing business. The factories began to desert the section upon the completion of the Interborough subway, and rows upon rows of empty lofts testify to the completeness of the flight. If the movement from the shopping zone is back to the deserted section there will be an additional notable benefit from the campaign of the "Saving New York" committee.

The success of the movement is now assured. The results should be encouraging to other cities which are unable, through legal steps, to remedy similar conditions.

Working of Compensation Laws

ONE of the many significant things to be learned from the review of decisions affecting labor, just published by the Bureau of Labor Statistics, is that in every case decided in 1915 involving their constitutionality workmen's compensation laws have been upheld. Such laws were attacked on various grounds, the abolition of the common-law defenses being the most frequently encountered objection. Nevertheless, the courts of New Hampshire, New York, Michigan, Ohio, Iowa, Texas and California have swept all objections aside and upheld the compensation laws in these states on the general ground, as stated in the Iowa decision, that "while the right to contract is a property right, like all other property rights it is 'subservient to the public welfare,' and may be taken by the state in a well-directed effort to promote the public welfare by the exercise of the police power."

The Ives case, in New York, in which an earlier compensation law was declared unconstitutional, much to the indignation of a distinguished ex-President, has been followed by the Jensen case, in which the Court of Appeals says:

"With the change in industrial conditions, an opinion has gradually developed, which almost universally favors a more just and economical system of providing compensation for accidental injuries to employees as a substitute for wasteful and protracted damage suits, usually unjust in their results either to the employer or the employee, and sometimes to both. Surely it is competent for the state in the promotion of the general welfare to require both employer and employee to yield something toward the establishment of a principle and plan of compensation for their mutual protection and advantage. The act now before us seems to be fundamentally fair to both employer and employee."

Since it is evident that workmen's compensation laws have come to stay, it is all the more important to follow their workings. One of the issues that comes up most frequently in connection with their adjudication involves the question as to whether an injury "arose out of and in the course of employment." How liberally the courts are construing the phrase quoted may be judged from these cases: In New York the accident was construed as in the course of employment in the case of the driver of an ice wagon who was hurt while leaning from the seat to warn some boys off of the step. Death from heart trouble caused by lifting bags of coal, and death induced by the effort on the part of a steamboat cook to save effects from a sinking vessel, were held in Massachusetts to be in the course of employment. Minnesota courts placed in the same category the death of a wagon driver by lightning, and injuries received by a workman who was making a key, "under an implied authority to do certain work in which the key would be of service." The California compensation law was successfully invoked in the case of an employee who was shot by an intruder, and one who was injured by the assault of a fellow-workman.

All the decisions, however, do not follow the lines of those just referred to. In Michigan a claim was disallowed on the ground that injuries from lightning received by a section man who had taken refuge in a barn did not arise out of and in course of employment. Just what is the essential difference between being struck by lightning while riding on a wagon and while standing in a barn is not clear.

Taking the decisions as a whole it seems safest to conclude that almost anything that happens to an employee during working hours will be considered as having occurred in and arising out of the course of his employment.

An Epoch-Making Building-Restriction Law

AS ANNOUNCED in this journal last week, the board of estimate and apportionment of New York City has adopted certain resolutions limiting the height of buildings, proportion of lot area which may be covered, and the type of occupancy of all present and future buildings in Greater New York. The rules are by far the most comprehensive ever adopted, even in Europe, and some of their significant features and the conditions under which they were formulated should therefore be emphasized.

While the vote on the rules was not unanimous, it was so nearly so as to be significant. The single negative vote may be assumed to typify the few scattering cases in which property values or claimed rights of ownership have, in the opinion of the owners, been detrimentally affected. Fifteen-sixteenths of official opinion was favorable and at least a similar proportion of property ownership. This practical unanimity is noteworthy because it measures a final opinion almost in exact measure a direct reverse of the original ideas of those affected. It has always been claimed by their advocates that zoning ordinances will be the greatest possible stabilizer of real-estate values. Large depreciations, by the intrusion of undesirable forms of occupancy, will be made impossible. Late decisions, in particular one by the United States Supreme Court, have probably settled the constitutionality of such measures, so that a district now designated as exclusively residential will not be subject to invasion by a garage, corner grocery, stable, or Chinese laundry; while a mercantile district cannot be spoiled by the erection of a multi-story loft building occupied by near-sweatshops.

The limitations placed upon building heights and upon the maximum area which may be covered, when taken in connection

with other existing laws, place definite limits upon the number of people that may be housed upon a given street block, be it in a residence or a factory zone. The city planner will thus be able to arrange the details of the street system to accommodate the probable traffic. Material economies can be secured in street-pavement widths in districts probably destined to remain permanently residential. With the residence, mercantile and manufacturing zones delimited, with population limits, and the travel which will probably take place between them, determinable, a proper number and arrangement of primary and secondary thoroughfares can be provided for. Pavements can be designed for the kinds of traffic which may be expected for an indefinite future. Rapid-transit lines can be laid down with some authoritative prophecy as to probable earnings. Water mains can be made of sizes to correspond with coming fire hazards. Parks and playgrounds can be located to serve the future population. Modifications of existing systems of rapid transit, water distribution, etc., will, of course, take account of the new conditions. In fact, New York City will pass from a category of a city which has "just growed," like Topsy, to one in which growth will conform to the clothes which have been designed for it. Minor adjustments there may be, but material alterations will probably be unnecessary.

In every district the limitation imposed on building height will make possible an increase in the present average height. In some districts this possible increase in the average is considerable. Those in charge of the work, however, have obviously had much with which to contend; their judgment is evidenced in the early determination of practically the limits finally adopted, while their diplomacy is shown by the ultimate conversion of a large majority of the community to their way of thinking.

The methods adopted by them are of interest because they involved such an immense amount of detailed investigation. Zones as small as a single street block are numerous all over the city, showing that each of the several hundred thousand units of that size must have been studied intensively wherever necessary. This method and result are different from that followed elsewhere, both in this country and abroad, where zones have always been of larger size. This unit was necessary since the commission adopted it as one of its primary tenets that every effort should be exerted to maintain real estate values; the only way to do so was to analyze conditions almost down to the individual plot.

Building heights have been limited in many other American cities and had heretofore been limited in New York City as to the universal maximum. The present action places on buildings a varying limit depending upon location. The width of the fronting street is used as the measuring stick, and ratios of this width have been adopted as the several limits. This scheme is relatively new in connection with zoning work. The percentages of the area of lot which may be occupied have been made primarily dependent upon the use of the structure. Warehouses may cover 100 per cent, while in other zones detached houses may not cover more than 30 per cent. Area zones differ somewhat from height zones, but not nearly as widely as do the zones which limit use. These are the ones which have been studied with the greatest care and concerning which the greatest step in advance has been taken. No such widespread and careful segregation has ever been undertaken before, even in Germany, where the best work has heretofore been done.

Having established the scheme and worked it out in detail, having officially adopted it after exhaustive public discussion, the real test of its possibilities and influence will be evidenced in its administration. The selection of an expert body for this function is rather difficult. The commission which formulated the plan was a non-paid citizen body assisted by experts. The board of estimate and apportionment, which was given power by the legislature to adopt or reject the scheme, is also charged with a multitude of other duties so that it cannot (except through the medium of committees with staff assistants) consider the detail of the application of the new law. The newly created board of appeals of the building department is, however, as its name signifies, a special body intended for exactly such detailed investigation and to it the decision of appeals has rightly been intrusted.

The action on the whole matter may well be considered epoch-making. The example will doubtless be followed by other cities of the country.

Beam Tests and Common Theories

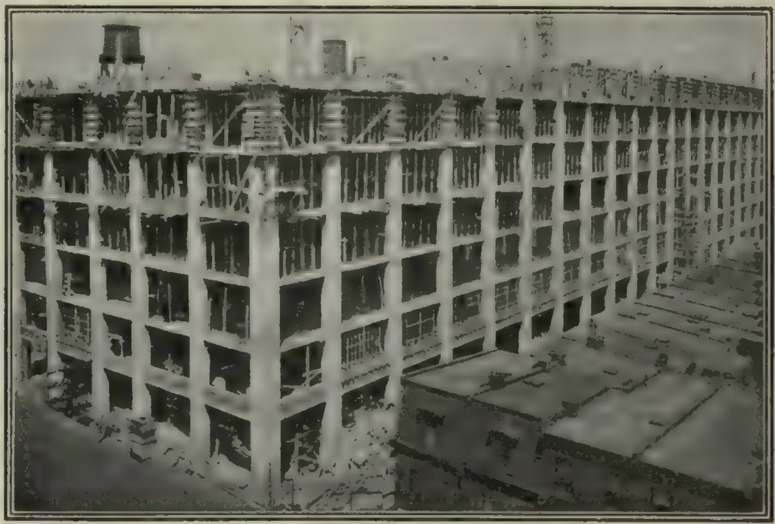
WELL TRAINED and experienced designers may be distinguished from "handbook experts" by the possession or lack of possession of complete and reliable information concerning the limitations in the application to actual design problems of the theories upon which the usual formulas and handbook tables are based. That such limitations to the use of formulas derived by the common theory of flexure exist and that the engineers' approximate methods may be largely in error in special cases are known to all qualified designers. One of the best methods for testing a given design is to observe the unusual conditions of loading and to check the analysis of special problems. The competent engineer will bring to such problems all the practical and theoretical information available, including results of experimental tests which substantiate or disprove ordinary theories.

An example of the kind of working knowledge which structural steel designers should possess is to be found in Bulletin 86 of the Engineering Experiment Station of the University of Illinois—one of the many valuable contributions to engineering science which have been issued under the able guidance of Professor Talbot. In this bulletin, by Professors Moore and Wilson, the important subject of shear and direct stresses in webs of I-beams and of built-up girders is investigated. The principal conclusions are abstracted briefly in this issue on page 179.

The investigation furnishes data on the practical design of beams and girders with light webs in cases where high shearing stresses exist. It is shown that the usual assumption that the shearing unit stresses can be approximately determined by dividing the total shear by the area of the web may, in extreme cases, be in error as much as 20 per cent. Although the measured strains in various parts of the web agree with values computed by formulas which include the effect of lateral strain (Poisson's ratio), and while the maximum shearing stress may be taken at the neutral axis without much error, the tests indicate that maximum tensile or compressive stresses may occur in the web adjacent to the flange instead of in the extreme fibers of the flange. The necessity for investigating these stresses is therefore apparent. Furthermore, it is shown that for beams carrying concentrated loads without stiffeners, the web should be investigated for three possible types of failure. It is remarkable that the two tests of built-up girders showed that the girder with no intermediate stiffeners between the loads had a higher yield point and ultimate strength than the girder with additional stiffeners. The necessity for stiffeners at points where concentrated loads are applied is clearly indicated by the unequal strains measured vertically on opposite sides of the web, marked twisting of the web being indicated in some cases by tension on one side.

It is unfortunate that the authors did not make measurements of the longitudinal strains in the extreme fibers of the beams at the concentrated loads. It has been theoretically demonstrated, in the discussion of H. S. Prichard's paper on "Faults in the Theory of Flexure" in the Transactions of the American Society of Civil Engineers, Volume 75, page 932, that a consideration of shear strain in the normal sections, usually assumed to be plane, indicates errors in extreme fiber stress which vary directly with rate of change of shear. This error, which is on the side of danger and may amount to large percentages in special cases, is therefore maximum at points of concentrated loading, and depends upon the distance over which such loads are applied. It is shown that the error increases for beams with light webs and small ratios of length to depth, so that these tests would have furnished an excellent opportunity to check these theoretical formulas and important errors by measured strains. As the error is zero for constant shear, the only flange strains measured by the authors, which were at the centers of the beams where no shear existed because of symmetrical application of loading, are valueless for this purpose.

It is to be hoped that another series of tests in which the extreme fiber strains both top and bottom will be measured at the points where the loads are applied will be made in order to impress on the profession the magnitude of these errors in fiber stress, the influence of the details of the application of concentrated loads and of the length and dimensions of the beams, and the danger in applying heavy loads to short, deep beams designed only for bending.



FIFTY-ONE TENEMENT BUILDINGS OCCUPIED ON MARCH 1 THE SITE OF THE STEEL PLANT SHOWN NEARING COMPLETION ON JUNE 21

World's Reinforced-Concrete Construction Record Claimed for Frame of Philadelphia Factory

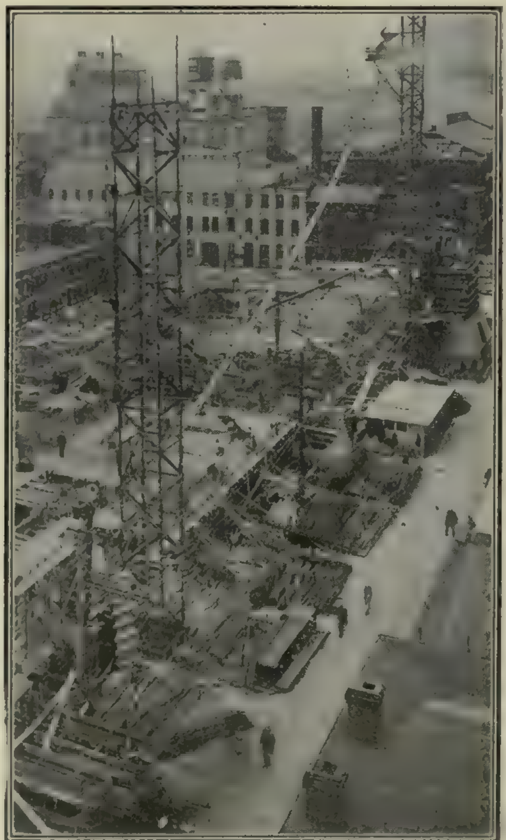
Floor 100 x 400 Feet Formed and Poured in Three Days—Work Handled From Streets in Completing in 25 Days 8-Story Frame of Steel Plant Designed for Speed of Construction

IN FORTY-ONE days elapsed time, or 25 days working time, has been built the reinforced-concrete frame for an 8-story building 100 x 400 ft. containing, exclusive of 5000 cu. yd. in footings, 15,000 cu. yd. of concrete. The building, in which the Baldwin Locomotive Works began on July 17 the manufacture of shells, casings and other steel products, occupies an entire block bounded by Eighteenth, Nineteenth, Noble and Hamilton streets in Philadelphia.

On March 1 last two of the 51 three-story brick tenements which occupied the site were turned over, and by March 15 the contractor had possession of about half of them, scattered promiscuously over the site; but it was not until April 6 that all were vacated and the work of demolition could be pushed rapidly. It was then discovered that more than half of the spread column footings had to be carried to a depth of 18 or 20 ft. instead of 8 ft. as was expected, and it was not until May 19 that this work was finished. Between that date and June 30 was completed the entire building of 8 floors and the ground-floor slab, representing an area of 360,000 sq. ft. Out of this time there were 16 days when, on account of Sundays, rain and one holiday, no men were at work. Thus the actual working time was reduced to 25 days. On the basis of floor area and total elapsed time this building was constructed at more than double the speed attained in building the Hotel Traymore in Atlantic City. This work, described on page 50 of the Engineering Record of July 10, 1915, was considered at the time an unequaled construction performance. Even in these days of rapid industrial building it is likely that the Philadelphia plant will stand as an unapproached record for concrete construction.

The arrangements for supplying materials were unusually well planned, everything being handled outside the limits of the structure from the streets. Most of the material was delivered in 5-ton motor trucks.

All story heights were made 12½ ft., to save remaking column forms, and all panels were approximately 20 x 20 ft. The usual expensive architectural attempts to conceal the lines and purpose of the building were conspicuous by their absence. Each floor carries a low brick wall only ten courses high, the rest of the wall space being entirely occupied by Lupton steel sash. The exterior columns and edges of the floor slabs appear exactly as they were formed, with the double result of eliminating useless trim and producing a structure of proportions that are pleasing because they are correct. The building has no basement, construction above ground being cheaper and faster. The first reinforced-concrete floor is laid directly on compact gravel fill. The Akme system of girderless floor construction was employed, doing away with all necessity for beam forms.



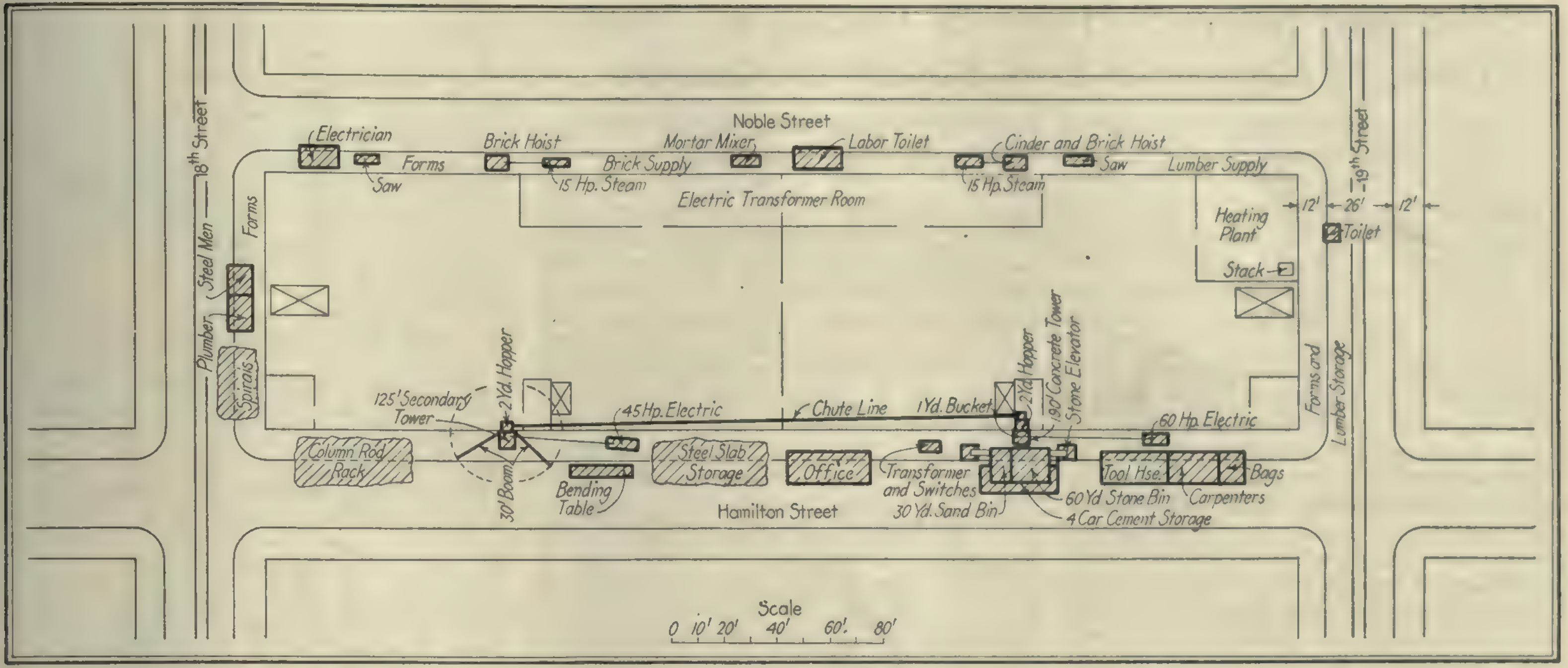
REINFORCING HANDLED BY LEFT TOWER

Complete regularity in the formwork, however, could not be obtained. The heating plant, occupying 2000 sq. ft. at the Nineteenth and Noble street corner, is two stories in height. The second floor is omitted over this area, and a reinforced-concrete coal hopper of 100 tons capacity, filled at third-floor level by an elevator from the street, was built on the Nineteenth Street side of this space. Electric power at 110 and 220 volts will be used entirely to operate the machine tools, and the transformers, taking current at 23,000 volts, occupy 4000 sq. ft. additional space on the first floor, excavated 5 ft. below this level.

MOTOR TRUCKS ENTER BY ELEVATOR

Also there are two shafts, one at each end, for 10-ton elevators and two shafts for 3-ton elevators, all extending full height. Automobile delivery trucks will enter the building at one end, light or with raw material, ascend to any floor, drive down the center aisle, discharge or load and descend to the street at the opposite end of the building. Nearly all the material manufactured will be conveyed in this way on the 10-ton elevators, the 3-ton pair being used for passengers and light inter-floor traffic. The only wood used is in the floors, which are of ⅞-in. maple, square-edged and face-nailed, on 1⅛-in. and 1¾-in. tongue-and-groove subfloors. The floors rest on 2 x 3-in. sleepers embedded in a cinder fill. The fill for the first floor, however, was made of tar and sand. There is a fire wall across the center of the building, and two 50,000-gal. steel tanks will be erected on the roof for water supply.

The column footings rest on compact red gravel, loaded to 3½ tons per square foot. The footings vary up to 14 ft. square, and are from 8 to 20 ft. below street level.



WORK WAS LAID OUT SO THAT, WITH HELP OF MOTOR TRUCKS, MOST OF THE MATERIALS WERE DELIVERED TO PLACE AS NEEDED

The gravel dug from these footings was left ungraded on the lot till the second floor was finished, when it was leveled off and the 2000 yd. left over was hauled away. The extra excavation at the west end of the lot dictated that the floor work be carried through from east to west. Columns and 9-in. slabs were poured in this order, the concrete being mixed at the main plant, shown on the layout drawing, spouted to the secondary tower for the east half of the building, and distributed in buggies. Concrete for the west half of the floors was distributed from the main tower. Booms on both these towers, an elevator in the secondary tower and, to some extent, the two brick hoist towers on the south side of the building were used to raise forms and reinforcing.

Entire Floor Built in Three Days

Before the concrete on the east end of a floor was 6 hours old a carpenter gang would begin erection of the centering for the next floor. Close on their heels the reinforcing would be placed, this work following through the concreting of the floor below to the west end. Before this end of the lower floor had set, the concrete plant would be spouting again to the secondary tower for the east end of the upper floor. The sixth floor was entirely poured in this way and forms were ready for a start on the seventh floor three days after the first sixth-floor forms were begun, making a record of a complete floor, with 1700 cu. yd. of concrete formed and poured in something less than three days.

Two Sizes of Form Lumber

Four complete floors of slab forms and one set of column forms and heads were furnished, no weight being taken by the columns until the floor centering was stripped. Even so, floor centering was removed in 14 days and column forms at 24 hours. The interior column forms were circular, and were cut down for each floor, the columns varying from 40-in. diameter at the bottom to 18 in. under the roof. The size of the exterior columns was varied by reducing the thickness only, so that only the sides of the forms were cut down.

All forms except those for the outside columns were of 1-in. tongue-and-groove lumber, the only other size of form lumber being 4 x 4 in. This greatly simplified the storing and handling of the form lumber, of which 1,000,000 ft. b.m. was used. After the columns were made up with 2 x 6-in. tongue-and-groove, nothing was used but 1 in. or 4 x 4-in., and there was no time lost hunting odd sizes with which to patch or remake.

Two features which greatly increase the speed were high runways and the use of concrete blocks to support the reinforcing. The runways were made with 1-in. cross-plank on 2 x 4-in. stringers. Panels of this construction rested on 24-in. horses, the lower ends of whose legs were tapered. The runways were laid out so that no concrete was carted over finished floor. The concrete was finished clean under the runways before their removal. A long-handled, 30-in.-square float was used to level off all the concrete, and the runways and horses were taken up within 30 minutes after pouring. No holes for elevators or any other purpose were left in the construction to require patching later.

Continuous Material Supply

So perfectly timed was the motor truck delivery of materials that the 4-car cement house under the aggregate bins was stocked at the start of the job and remained untouched until the roof was concreted. The bucket elevators feeding the aggregate bins from the pits in the street have handled as much as 2000 tons of stone and sand in one day. The stone elevator had a capacity of a yard a minute—double that of the sand elevator. The plant made runs of 600 cu. yd. in 24 hours, and worked continuously, all overhauling being done on Sunday.

Rehandling steel bars in the narrow streets was impossible. As 80 per cent of the 1400 tons of reinforcing was bent on the job, gangs of laborers bent each truck load as soon as the steel was taken off and before it was stacked. Only straight bends were required, and the work was done by hand on tables set up in the street.

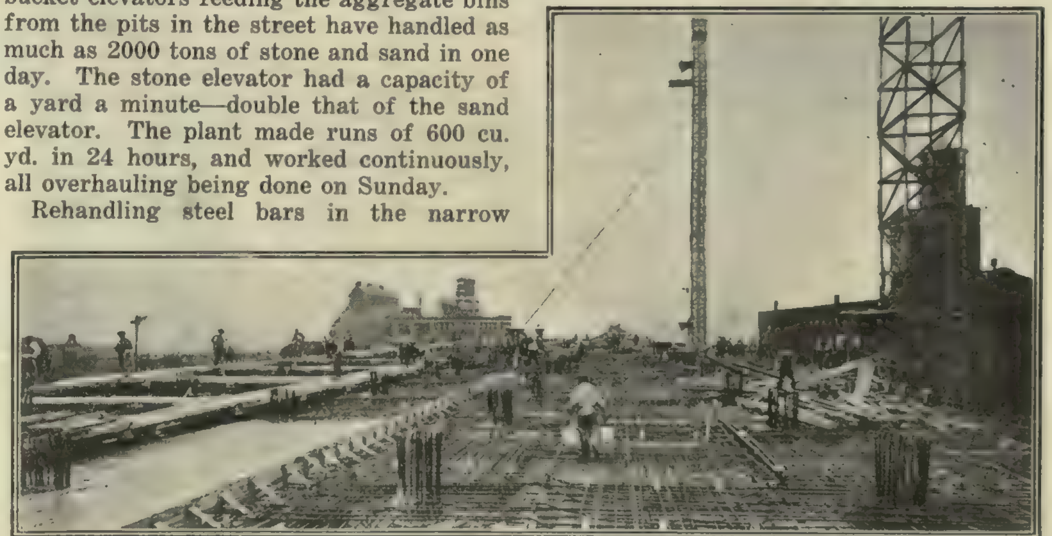
No brick or flooring was delivered until there was a place to use it. Such material was taken to the floor requiring it as soon as it reached the job.

A Thousand Men Kept Busy

To attain this speed, a thousand men of all trades were employed. While concreting, 300 carpenters were worked in three shifts a day. The day crew of laborers worked six shifts of 10 hours each a week, and the night crew five shifts of 12 hours, giving the two crews the same total time on the payroll.

All construction equipment, except the two 15-hp. steam hoists on the brick elevators, was driven electrically.

The plant is being completed for the Baldwin Locomotive Works by the F. W. Mark Construction Company, Inc., represented by V. E. Winell as superintendent in charge. It was designed by the Condron Company, of Chicago, under the direction of Fred Jasperson, consulting engineer for the Baldwin Locomotive Works. Mr. Jasperson also supervised the construction.



HIGH RUNWAYS AT LEFT, ALLOWING QUICK FINISHING, HELPED SPEED OF CONSTRUCTION

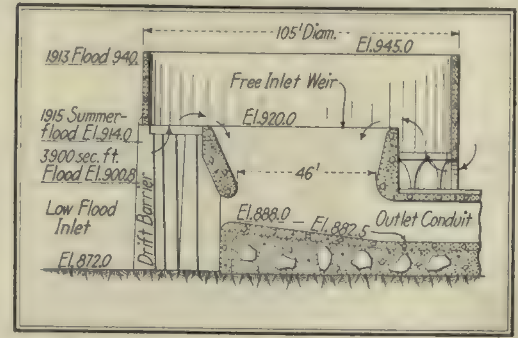
"Cat and Kitten" Holes in Outlet of Dam Control High and Low Flood Discharges

Water-Supply Storage, Protection of Farmland from Summer Floods and Novel Drift Barriers Are Features of the Columbus Flood-Relief Plans

CONTROL of small summer floods, storage of water for Columbus, Ohio, and the restraining of heavy spring freshets constitute the threefold problem worked out in detail for the Dublin dam on the Scioto River in the official plan recently presented to the Franklin County Conservancy District by the chief engineers, Alvord & Burdick. A gatehouse has been provided, consisting of six gates so proportioned that the Columbus water may be stored, released in small amounts as needed, and quickly wasted after the drought season has passed, so as to leave the full capacity of the basin for the storage of flood waters. The gates have a large capacity, in order that the moderate winter floods may readily pass through, and thus not occupy detention-basin capacity which might be needed for a great flood. A large circular weir inlet at a higher elevation augments this discharge for the greatest floods.

In developing the recommended project, described in the Engineering Record of March 25, page 419, a few modifications have been made, with a slight reduction in the total cost. The safe channel capacity through Columbus has been increased from 50,000 to 64,000 sec.-ft., and the ultimate bankful capacity from 75,000 to 90,000 sec.-ft. The sewage of the State Industrial Home for Girls, at Rathbone, is to be pumped over a divide into the Olentangy River, thus keeping it entirely away from the Columbus water supply. The plans for drift barriers include protection by cables at the upper end of the basins, by a concrete grillage in the river channel, just above the Dublin dam, for stages 20 ft. above the top of the gates—at which stage it is believed drift cannot obstruct them—and for very high stages a circular curtain or trap around the free-outlet weir.

The operation of the Dublin basin will require the services of an attendant who will live at the dam, and whose duty it will be to operate the gates in accordance with regulations laid down by the conservancy board of directors. In a great flood, the operation of these gates is not important; that is, the works are so designed that the capacity of the outlet works is not materially affected whether the gates are closed or opened. They are of use only in reference to the Columbus water supply, and to a certain extent in the protection of the farmlands.



DELAWARE BASIN OUTLET IS NOT COMPLICATED BY VALVES FOR STORAGE

Assuming all the works to be completed and starting about the middle of April in the normal season, the operations at the dam will be as follows: By this time, in the normal year, or, in any event, not later than the first of May, vegetation will be well started and all danger from a record flood will have passed. As soon after this time as the river falls to a low stage all gates will be closed and the water will be allowed to rise behind the dam to such amount as is necessary to store the water required for Columbus in the very dryest season. The height to which the water will thus be ponded will vary with the growth of Columbus. The river bed at the dam is at El. 767. By 1920 it will be necessary to pond the water up to El. 800. In 1950 the level will be carried at about El. 839.

The water having risen to the height required for Columbus water storage, one or more of the balanced needle gates will be opened as much as is necessary to hold the pond level, the gates being altered possibly once a day to accommodate the fluctuations of flow coming in.

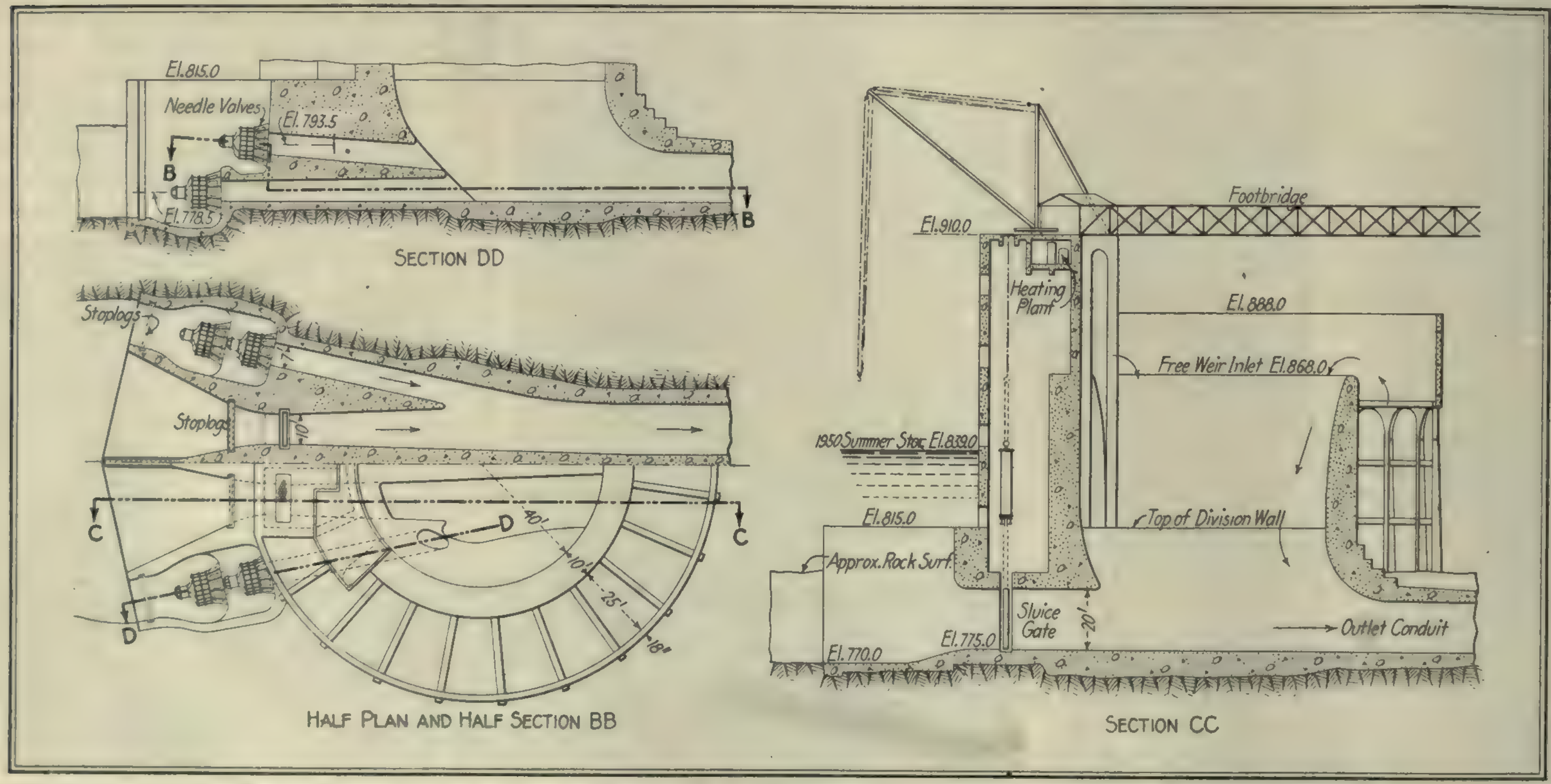
Hard Summer Storms

In the event of a hard summer rainstorm the needle gates will be gradually opened, holding the pond level in accordance with the water coming down, until a flow of about 5000 sec.-ft. is reached, as evidenced by a gage downstream from the dam. This flow measures approximately the amount of water that it is desirable to deliver to the stream in summer to obviate the overflow of farmlands. If the water coming into the basin exceeds 5000 sec.-ft., the surplus will be allowed to rise, and in the event of a great summer flood, such as occurred in 1915, the water will rise up to about the top of the free concrete spillway of the gatehouse. The plan places the lip of this spillway at El. 868. This provides for the probable conditions of 1930 or 1940, depending on the growth of the city of Columbus and the amount of water that must necessarily be stored for it. At a later date the lip of this spillway can be somewhat increased in height.

The valves being set at 5000-sec.-ft. delivery, after the water has ceased coming into the basin, the surface will rapidly fall, and when it has fallen to the level required for the Columbus storage the balanced needle gate will be closed enough to hold the pond at this elevation.

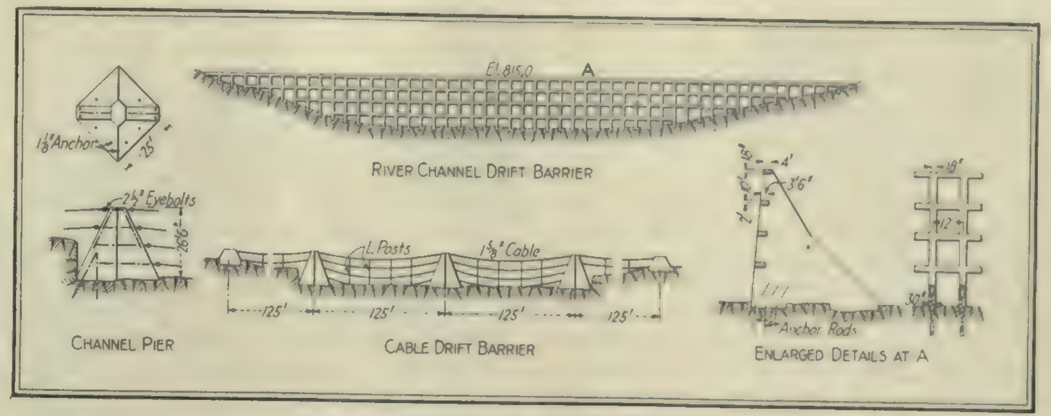
Reservoir Drained in Late Fall

When the growing season has passed, say about Nov. 1 in a normal year, after which the water storage is not required for Columbus, and after which a record flood may be anticipated, the needle gates will be



OUTLET WORKS AT DUBLIN BASIN ARE DESIGNED TO CONTROL LOW AND HIGH FLOODS AND WATER-SUPPLY STORAGE

opened and the water stored will be allowed to drain away. When the water in the basin has fallen to about El. 815, or 20 ft. above the top of the large rising stem gates, these gates may be opened, but this would probably not be done until the water had fallen somewhat lower, say to El. 790, or perhaps less. At this point all the gates would be opened wide, and until the next growing season is well advanced the river would be allowed to pass through the gates freely, except for such obstruction as is furnished by the outlet conduits. The gates are so proportioned as to produce only a minor obstruction to the passage of the water, the flow being principally governed by the outlet conduits for all stages of water when the gates are open; and even if the gates are closed the conduits govern the delivery for stages of water above the lip of the concrete free spillway.



RIVER CHANNEL DRIFT BARRIER PROTECTS LOW FLOOD OUTLETS; CABLE BARRIERS STOP DRIFT AT HEADWATERS

In Case of Record Floods

In the event of a record flood, like that of 1913, the water will rise up to about El. 882, or 18 ft. below the emergency wasteway, or 28 ft. below the top of the earth dam. With this stage of water in the basin, the conduits will be delivering about 27,400 sec.-ft.

In the operation of the official plan, only the lower part of the basin will be frequently flooded. The Columbus water storage will require the flooding of the land below El. 839 in the summer season, in the year 1950, and lesser elevations for the nearer future, as has been previously indicated. Above this elevation only a very small part of the acreage will be subject to flood in the crop season. So far as summer floods are concerned, based on past experience, a summer flood of El. 870 would be expected about once in sixteen years. Water at this stage covers about one-third of the total Dublin land acreage.

Delaware Basin Operation Simpler

As no water is impounded for Columbus, and therefore no gates are necessarily installed, the operation of the Delaware detention basin is entirely automatic. In an excessive flood the outlet works at the dam will be entirely submerged. The outlet conduits are in duplicate to provide for repairs at the low-water season. Each conduit is supplied through two openings.

The lower or small opening is for the purpose of regulating the minor floods; particularly to regulate the summer floods for the benefit of the bottom lands. The top of this opening is level with the top of the outlet conduit to facilitate the passage of small drift. The two lower water openings will discharge 5000 sec.-ft. under a head level with the top of the free weir inlet, which marks the elevation to which the summer flood of 1915 would rise if repeated. This is the greatest summer flood of which there is accurate record. In the case of a great flood such as might occur in the barren season of the year, the capacity of the outlet will greatly increase as the water rises above the lip of the free weir inlet. Thus, at El. 924 the delivery is entirely governed by the conduit cross-section, the discharge of the two conduits being about 9500 sec.-ft.

The 1913 flood would rise approximately to El. 940, or 10 ft. below the emergency wasteway, or 20 ft. below the top of the earth dam. The provisional flood, 45 per cent greater than the flood of 1913, would rise to the level of the emergency spillway at El. 950.

In providing for the control of summer floods, with the inlets arranged as described, a small part of the basin capacity is sacrificed that would otherwise be available for storage of the very excessive floods. This loss of capacity is small, however, it being estimated that the difference in water level within the basin, with and without the summer flood-control opening, would be less than 1 ft. under a repetition of the 1913 flood.

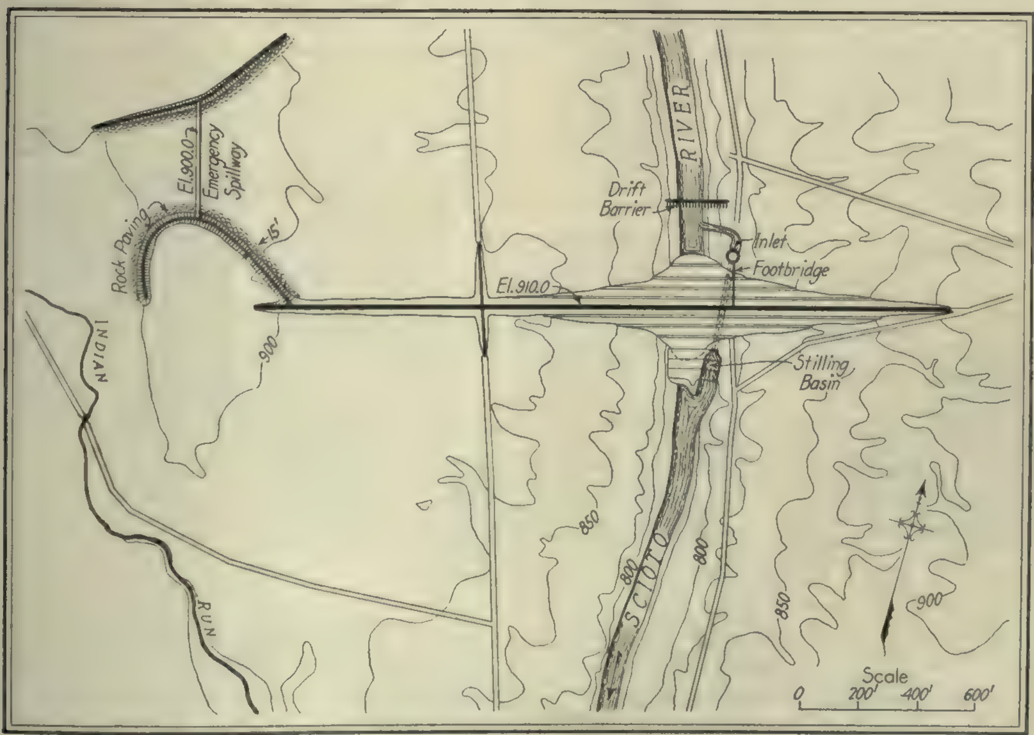
Develop Drift Barrier Designs

The cable drift barriers to be constructed at the upper end of the Dublin basin are to arrest floating drift originating on the lands beyond the ownership of the district. The cables are to be of tar-coated woven wire secured to structural-steel spacers, and anchored to concrete piers.

The channel barrier just above the Dublin dam across the river channel is an immense reinforced-concrete grillage anchored to rock and supported by buttresses. It must withstand a pressure equivalent to water on the upstream side at the top and on the downstream side 20 ft. below the top. The free spillway is protected by a circular wall supported on piers and braced by struts connecting to the lip of the spillway.

Two cable barriers, and an intake barrier with the piers closely spaced to protect the low-water inlets, are provided for the Delaware basin.

The stilling basins are designed to permit dissipation of the energy of the discharged water by means of the standing-wave principle.



DRIFT BARRIER, HIGH AND LOW LEVEL FLOOD OUTLETS AND STANDING-WAVE STILLING BASINS ARE FEATURES OF DUBLIN DETAINING DAM

Why Wood Is Used Instead of Concrete for Seattle Wharves

In answer to criticism on the use of timber and pile construction in the Seattle wharves, J. R. West, chief engineer of the Port of Seattle Commission, in a recent report states that "wharves and freight sheds such as have been built by the port will have a life of probably from 20 to 25 years, which is also about the economically useful life of such a structure. Conditions of water transportation are constantly changing, and this will render terminal structures obsolete after a certain number of years, this period being on the average about 25 years. It has not been demonstrated that concrete made of Portland cement is permanent in salt water. If it does not prove to be permanent, then the added cost is not in any way justified, and if it does prove permanent then the physical life of a wharf would exceed its useful life, which is not economical. Another argument in favor of the cheaper creosoted pile and timber construction which is particularly true of Seattle is that a given amount of money can be made to produce more terminal facilities to invite new business than could be provided if the more expensive type of construction had been adopted."

Color in Crayon Drawings Fixed with This Solution

No Need to Resort to Water-Color Washes, Which Are Difficult to Apply, for Graphic Charts

By THOMAS A. HAYDEN
Surveyor General's Office, Phoenix, Ariz.

THE USE of color in graphics, such as the representation of quantity by differently colored masses; the differentiation by this means between materials of construction, soils, rocks and geologic formations; the coloring of geological, county, state and other maps, and other processes which will occur to the reader are often attempted by water color washes, and an otherwise well-executed drawing or report is too often marred by the unskillful way in which this is applied. It is a matter which requires considerable technical skill to apply a thin wash so as to produce absolutely uniform results, without overlaps, variations in depth of shade and, in short, a regrettably splotchy and untidy appearance. Furthermore, it will often be observed that one part of a drawing will exhibit a marked dissimilarity from another part, intended to be identical, but executed at a different time, with a different wash. Another difficulty sometimes encountered in working with this medium is the liability of the drawing to suffer distortion from an accidental strain in drying, or from wetting one part and not another.

Crayon Better Than Water Color

The writer believes that decidedly better results will be achieved by the average person with ordinary graphite and colored pencils, crayon, pastel, charcoal, chalk, or similar materials, according to the nature and purpose of the work. It has not, however, generally been considered practical to employ these agents, on account of the lack of permanency of the work, which has a marked tendency to blur when handled and subjected to friction; nor is the writer aware of any really efficient and generally known fixative which will correct this fault. It is not unreasonable to assume that if such a fixative, with which permanent results could be achieved with small effort and at low cost, were available, these materials would be brought into much more general use among engineers, architects and others, and that they would be a welcome substitute for the unsatisfactory washes hitherto used.

Formula for Fixative

The writer offers a formula recently acquired from Burt Harwood, a distinguished American artist, which he believes to be entirely new to the profession, and which will be found inexpensive, easy to prepare and satisfactory from every point of view. The main ingredients are casein and borax. Casein, a proteid substance forming the principal part of curd, is a highly resilient compound, a property which has caused it to be used in the manufacture of the cheaper grades of pool balls, and which is responsible for the permanency of the fixation of a drawing treated with it. Commercially it may be purchased in coarse granulated form from dealers in chemicals or from the larger dealers in artists' supplies.

The fixative is prepared as follows: Mix ⅝ oz. of casein and ⅓ oz. of borax with a few tablespoonfuls of water, and allow to stand for a few hours, preferably over night. The mixture should be resolved into a paste, which may then be thinned with water until it makes about a quart of solution. To this add ½ pint of alcohol as a preservative. After a few days a certain amount of undissolved casein will have settled to the bottom, and the turbid liquid may be drawn off and kept indefinitely.

The strength of the solution may be varied to suit different purposes. It is applied with an ordinary atomizer, such as may be purchased at any drug store. The treatment does not in any way affect the paper or drawing. There is no yellowish or other tinge imparted to the paper, the colors retain their original values, and there is no chemical action on the paper itself or the bleaching agents contained therein.

A drawing so treated may be made "waterproof" by spraying with a weak solution of aluminum acetate (about 3 or 4 per cent), the mineral salt combining with the casein to form an insoluble compound. After this treatment it may be exposed to the weather with impunity. Aluminum acetate may be procured commercially either in the form of a powder, easily soluble in water, or in an 8 per cent solution.

Improved Arrangement Doubles Production of Concrete-Casting Plant

Hopper Redesigned to Give Free Flow of Sand and Gravel—Locomotive Crane and Stiffleg Derrick Reduce Cost of Handling

BY PRACTISING a little ingenuity in using old equipment and by utilizing the facilities at hand to effect an efficient arrangement the production of a concrete-products plant is being increased and considerable labor saved. A hopper was redesigned to save the labor of three men. A traveling crane and a derrick were added to the equipment and several changes made in the system of operation. An old steam-power concrete mixer is being used in addition to one driven by an electric motor; cranes are doing work formerly done by hand, and every minute of the day is being utilized to the best advantage possible. As a result, production is being doubled, though the operating cost is about the same. The plant is that of the C. F. Massey Company, Newark, N. J., and the chief products are concrete pipe and piles.

Before the present hopper was built three men, at 20 cents an hour, were detailed to keep the sand and stone in the old hopper moving down the chute to the concrete mixer. The derrick *B* unloaded sand and stone. The traveling crane moved finished products, poured concrete at the pipe-casting platform at the east end and attended to odd jobs. There was no cement-storage room except the one between the tracks and the river. The one mixer supplied concrete

ARRANGEMENT OF SHED AFFORDS CEMENT-STORAGE SPACE—NOTE HOPPERS ON TOP

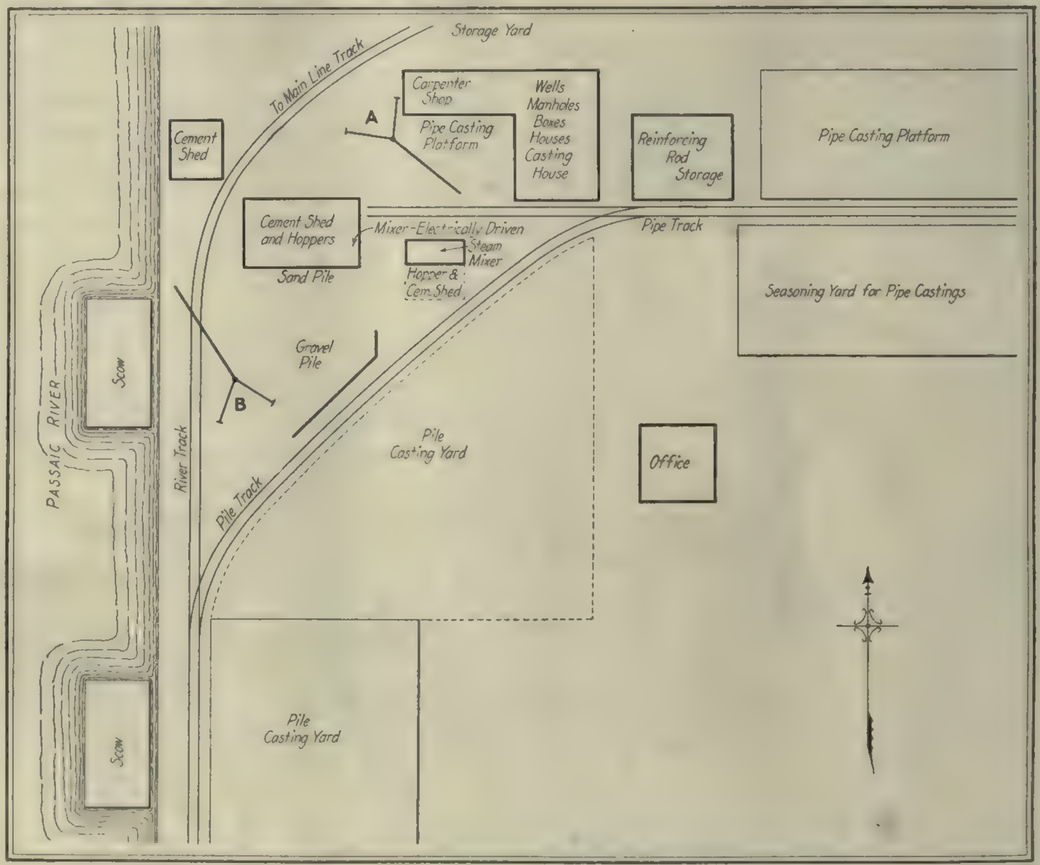


DIAGRAM SHOWS LAYOUT OF CONCRETE-CASTING PLANT

Locomotive crane on pipe track carries concrete from mixer to pipe-casting platform and handles forms in morning. Crane on river and pile tracks brings concrete from mixer to pile-casting yard, loads pile on scows or cars and carries finished products to storage yard. Derrick A has 60-ft. boom, reaches both mixers and loads material on river track direct from pipe-casting yard. Derrick B has 70-ft. boom, reaches both mixers to swing concrete to proposed pile-casting yard and unloads material from scows into hoppers and sand and gravel pits.

PILE-CASTING YARD NEAR SCOWS AND TRACKS PERMITS QUICK LOADING

to the pipe and pile-casting departments. The mixture for piles differs from that for pipe, and a supply for pipe casting was frequently needed at a time when the drum was full of pile mixture and could not be emptied immediately. This resulted in loss of time.

TRAVELING CRANE OPERATES ONLY ON PIPE TRACK HANDLING FORMS AND CARRYING CONCRETE

One of the first radical changes was the reconstruction of the shed housing the mixer. The building was originally about 20 x 25 ft. in plan; the hoppers were so constructed that a ledge nearly 3 ft. wide at the outlet prevented sand and stone falling to the mixer. The illustration shows the new hopper. The steep slopes of the sides and the absence of the level ledge at the bottom cause the sand and stone to flow freely without assistance. This design, as stated, eliminated the labor of three men. The new house, a plan of which is shown, also provides cement-storage space. The mixing platform, on which cement is stored, is 6 ft. above the ground floor. A measuring box on this platform directly under the chutes dumps stone, cement and sand into the mixing drum.

The old 24-ft. capacity Koehring mixer was replaced with one of the same make having a 30-ft. capacity. It is driven by a 15-hp., 200-volt Westinghouse motor. Mixer and motor are protected from the weather.

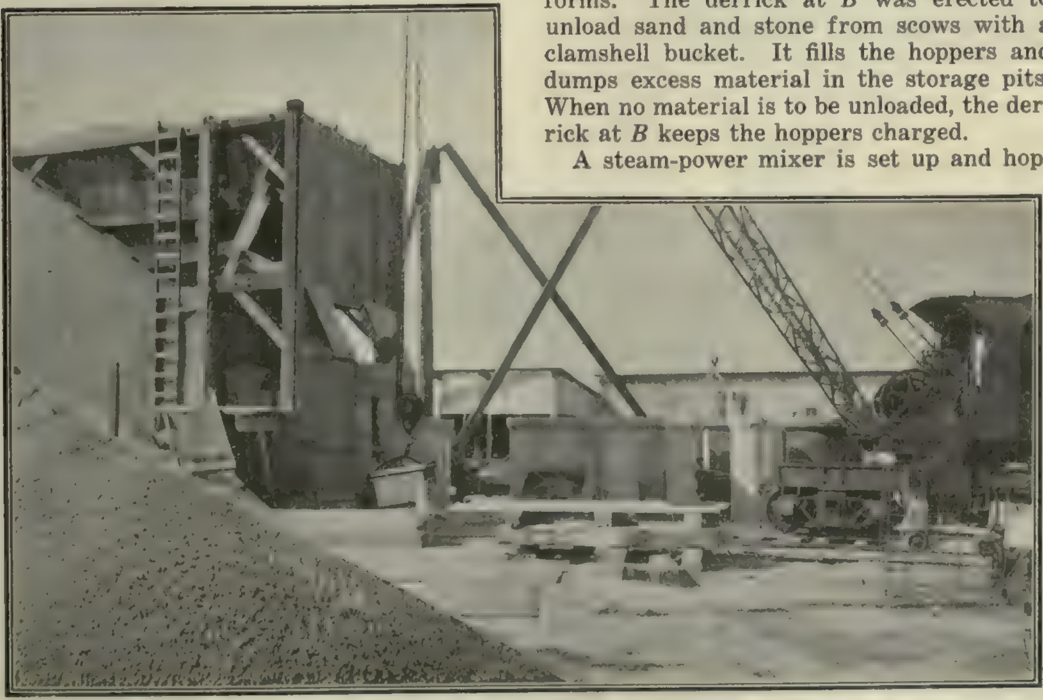
Crane Operates on Pipe Track

A Browning crane was added to carry concrete to the pile-casting yard and to load the finished products. The Brownhoist crane is now operated only on the pipe track. It handles the pipe forms and carries concrete to the pipe-casting platform.

The derrick at *A* brings concrete to its pipe-casting yard and is also used to handle forms. The derrick at *B* was erected to unload sand and stone from scows with a clamshell bucket. It fills the hoppers and dumps excess material in the storage pits. When no material is to be unloaded, the derrick at *B* keeps the hoppers charged.

A steam-power mixer is set up and hoppers and shed similar to the one now in use are being built at the point shown. This will supply concrete for battery wells and houses until the pile forms are ready to receive concrete. The electrically driven mixer will handle pile mixture until 10 a. m., at which time the pipe forms are ready to be filled. Thus after 10 a. m. each mixer runs only one kind of concrete. Formerly the one machine alternately delivered loads of pipe and pile mixture.

The yard in front of the office is being filled in and will be used for casting piles. This will bring the pile-casting yard nearer the mixer.



NEW HOPPERS ARE SO BUILT THAT SAND AND GRAVEL FLOW TO MIXER BY GRAVITY

What Has Been Accomplished

The changes are too recent for accurate data on the actual saving to be secured. Using cranes and derricks to do work formerly done by hand has added to the efficiency. Rebuilding the hopper has saved the cost of shoveling material and afforded a near-at-hand storage for cement. The daily production of 1200 ft. of pile, 600 ft. of pipe (12 in. to 84 in.) and four concrete telephone houses, together with battery wells, tubs and manholes, is nearly double that of four months ago. The operating cost remains about the same.

Hydrated-Lime Mortar Increases Strength of Brick Piers

TESTS of 8 x 8-in. brick piers 7 ft. long made by J. S. Macgregor in the testing laboratory of Columbia University show that the addition of hydrated lime to cement mortar increases the ultimate strength as compared with 1 : 3 cement mortar up to additions of 50 per cent of hydrated lime to the cement by volume. The accompanying table gives the results for face-brick piers, each figure representing the average for three piers tested. The relative costs which have been given in Bulletin J of the Hydrated Lime Bureau of the National Lime Manufacturers' Association, Pittsburgh, are based upon Pittsburgh costs as follows: Portland cement, $1.80 per barrel in paper; hydrated lime, $10.50 per ton in paper, and sand, 80 cents per ton. It is seen that mortar 5 with 50-per cent hydrated lime gives a strength 980 lb. greater at 3 months than plain cement mortar. It is stated that this increase in strength, accompanied by decrease in cost, is due to the effects of the more plastic mortar, the decrease in loss of moisture absorbed by the brick and the consequent better hydration of the Portland cement.

RESULTS OF TESTS OF BRICK PIERS WITH VARIOUS CEMENT MORTARS

Mortar No.	Proportions by Volume: Cement	Hydrated Lime	Sand	Ultimate Strength at Age of: 7 days	28 days	3 mos.	Cost of mortar for 1000 bricks
1..	1	0	3	2630	2840	2840	$2.18
2..	0.9	0.1	[illegible]	3080	3170	4435	2.08
3..	0.85	0.15	3	2890	3230	4300	2.03
4..	0.75	0.25	3	3120	3470	4170	1.99
5..	0.50	0.50	3	2760	3100	3820	1.71
6..	0.25	0.75	3	1945	2370	2720	1.48
7..	0	1	3	1535	1870	1950	1.24

Prices given are based on ½ yd. mortar to 1000 bricks.

Lumber Cut of United States in 1915

The total lumber cut of the United States in 1915 was 37,000,000,000 ft. b.m., as stated in the Engineering Record of June 17, page 810. The note in the issue of July 22, page 102, was in error.

Building Districts Defined for New York City

Height and Use Limitations Fixed by New Law—Maps of Borough of Manhattan Indicate Restrictions in Detail

AFTER about two years of extensive investigation, including many public hearings and thousands of personal conferences during the past few months, the Commission on Building Districts and Restrictions appointed by the Board of Estimate and Apportionment of New York City in June, 1914, has succeeded in accomplishing the task of districting the city. On July 25 the board passed the modified resolution for this purpose submitted by the commission, which at once became law, owing to the fact that, growing out of the work of the Heights of Buildings Commission appointed in February, 1913, a law modifying the New York City charter to permit the Board of Estimate and Apportionment to divide the city into districts for the purpose of regulating the heights of buildings, the area of courts and open spaces and the location of trades and industries and of buildings designed for specified uses, was passed by the New York legislature and became law in April, 1914.

LIMITS TO HEIGHT, AREA AND USE OF BUILDINGS IN BOROUGH OF MANHATTAN

Pursuant thereto the present commission was appointed, and took up the work of the previous commission, using its data, investigations and report, and working with the aid of the expert staff of the Committee on the City Plan of the Board of Estimate. The commission made a detailed study of the present distribution of population in the city and of the transit facilities. Maps were prepared and a tentative report submitted on March 10, 1916, followed by public hearings as required. This report formulated the principles upon which the plans and proposed districting resolution were based (see the Engineering Record of Feb. 26, page 284). The report and maps were extensively distributed and discussed, and in the hearings the general opinion expressed was overwhelmingly in favor of the plan outlined, while many testified to the necessity for its adoption.

Changes in Proposed Plan

The restrictions to height, areas of courts and open spaces and to use for residence and business, excluding factory purposes, as finally adopted for the borough of Manhattan, are indicated on the maps herewith. Most of the changes from the first tentative plans are in the nature of greater restrictions, although strips of waterfront area in the limited-height districts have been transferred from the one-and-one-half to the two times width of street limitation. Broadway from the Battery to Reade Street, also Park Street and the Wall Street district, have been changed by excluding factories, and the section from Second to Sixth Avenue south to Twenty-third Street has been similarly restricted. Residence districts have been introduced in business sections near certain parks and open squares, and in the west Central Park district.

The new law does not require any change in plans or construction of a building or in its designated use if a permit had been issued before the law was passed, and if at least the whole ground story shall be completed within one year and the complete erection effected within five years from the date of passage of the law. If an existing building be destroyed, it shall not be rebuilt unless it conforms to the provisions of this law, although if only 50 per cent of the building is damaged it may be rebuilt even if it violates the present regulations.

The details of the districting plans have been worked out under the guidance of Edward M. Bassett, chairman of the commission, with Robert H. Whitten as secretary and George B. Ford as consultant. The final maps for all boroughs of the city are now being prepared in conformity with the revised limitations.

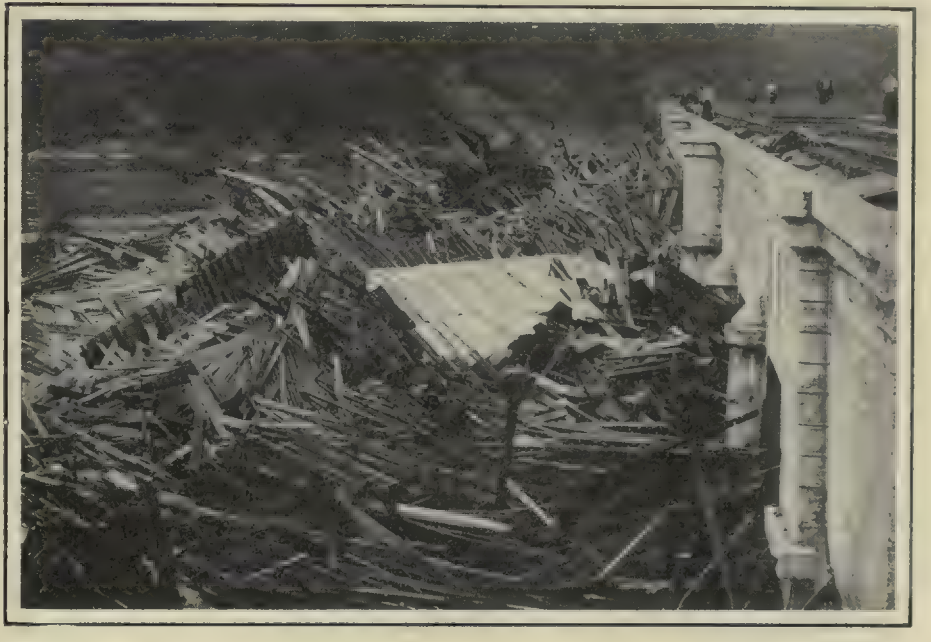
Leveling Snow on Roads

In order to prevent winter traffic from keeping to one set of ruts during a winter of heavy snowfalls, it is the practice of the Wayne County (Michigan) Highway Commission at intervals during the winter to get out their road forces and drag the roads, thus obliterating the ruts and encouraging traffic to use all parts of the highway.

Bridge at Asheville Holds Despite High Water and Débris

THE SOUTHERN RAILWAY bridge at Asheville, N. C., successfully withstood the high waters of the recent flood despite the lumber and other débris that piled against it, as shown in the picture to the left. The right-center photo gives more details of the nature of the material brought against that structure by the flood, and shows how compactly it was swept together. The wreckage shown in the circular picture is a part of what remained of the Smith bridge over the French Broad River at Asheville. Houses, boilers, telegraph poles and lumber of all kinds were piled together at the point shown in the bottom picture. The plant of the Asheville Power & Light Company, just above the point at which the picture was taken, was almost submerged.

The loss at Asheville is estimated roughly at $10,000,000. Damage to manufacturing and power plants threw hundreds out of employment and left the city and vicinity without lights or power for several days. Railroad traffic was temporarily suspended.



Railroads' Side of Valuation, as Handled on Jersey Central, No Small Task

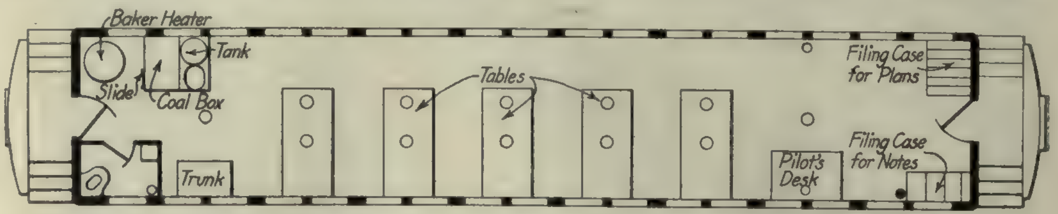
Program Includes Careful Preparation of Data in Advance and Checking of Computations with Government—Office-Car Idea Well Developed

By C. W. STARK
Associate Editor, Engineering Record

THE COST to the government of valuing the interstate carriers of the United States is estimated at $20,000,000. The expense to the railroads is estimated at $50,000,000. A large part of this latter sum is in the compulsory furnishing of complete maps and other data, obtainable in many cases only by complete resurveys. No inconsiderable part of it is due to the preparations deemed necessary by the railroads to equip themselves, through their pilot engineers, to show the government their entire physical plant and point out on the spot any omissions or errors of the government field men. Probably few if any railroad valuation men have given this matter of thorough preparation more attention than has Charles Hansel, who is in charge of the valuation departments of the Philadelphia & Reading Railway and the Central Railroad of New Jersey, and is serving a number of other railroads in a consulting capacity; and who has the advantage of the experience derived from fifteen years' practice, having been a member of the advisory board of the Michigan appraisal in 1901, and from his evaluation of the railroads of New Jersey several years ago. With equal thoroughness his forces are working with the government's field parties and checking the government's computations as fast as they are made.

PRIMARY LIST AN IMPORTANT FEATURE

An important feature of the equipment of the valuation departments with which Mr. Hansel is connected is the primary list. This is defined in the instructions as being "for the purpose of furnishing the pilot, and through him the government, with a list of such property of the carrier as is available from the records; also to give information as to the extent of the plans and other data as a guide for the field forces." Nine forms, including the index, are used. They are printed on thin paper so that they can readily be blueprinted. The headings of most of these are shown. Two others relate to miscellaneous signals and to interlockers respectively, while a third is the government's D. V. Form 135 for industrial tracks, which has been substituted for one on the same subject, somewhat different, previously prepared by Mr. Hansel. The forms are all 9 x 12 in. As many as are needed for each valuation section are filled out and bound together.



BOTH GOVERNMENT AND RAILROAD COMPUTERS ARE ACCOMMODATED IN THE OFFICE CAR

In order to insure the correct and uniform use of the forms a 17-page mimeographed booklet of instructions, with a 4-page appendix of abbreviations and a sample of each form, has been prepared. Each column of each form is taken up specifically. For example, under column 6 of the form for bridges, trestles and culverts it is stipulated that the type and material of the substructure be recorded first, and be separated by a dash from the corresponding information regarding the superstructure. When either is not known the fact is indicated with an asterisk. Thus the note * — T PL G shows that the material of the substructure is not known, while the superstructure is a through plate girder. A list of twenty abbreviations for use in this column takes care of all ordinary features of construction.

In column 12 the letters C, P and N are used, standing for "complete," "partial" and "none." Thus PC shows that some of the substructural and all of the superstructural quantities are on record. The same symbols are used in columns 14 and 16, and in the corresponding columns of the building sheets. Other abbreviations and groups of letters make it possible to give in a simple code most of the desired information in all of the forms except the track diagram.

Examination of the track diagram will readily disclose its use. Each horizontal file between heavy lines is given over to one main track, as many files being used simultaneously as there are main tracks. For rails the weight, length, brand, kind and year rolled are recorded; for fastenings, symbols representing standard types; for ties, the number per mile and the average dimensions; and for ballast, the kind and quantity per mile—all in the first rectangular space. Wherever there is a change in any of these items material enough to affect price, this is recorded in the next space and the mileage put in the circle on the dividing line. It is then assumed that other items continue as before.

Each pilot engineer receives a set of these instructions, together with a blueprint copy of the primary lists for the valuation sections on which he is working. The government party is also given a copy.

"VADE MECUM"

Another feature of the pilot engineer's armament is a folder of four blueprint maps of the railroad system, designated as a "Vade Mecum." These maps are colored in various ways for quick reference—one showing the valuation districts, another the separate corporations, another the dates of construction and the fourth the mileages.

FIELD FORM No3-F V.D.-221

CENTRAL RAILROAD CO OF NEW JERSEY SYSTEM
RECORD OF I.C.C. D.V. ROADWAY AND TRACK PARTY · NOTES AND COMPUTATIONS CHECKED BY RAILROAD COMPUTERS

CORPORATION .... VALUATION SECTION NO. ....
BRANCH .... COLLECTION SECTION NO. ....

	I.C.C. Acct No.	Check with R/w Map	Check with Primary List & Supporting Data	Check Computations	Check with Pilot's Notes	Compare with Other Accounts		Check with D.V. 135	Check with Construction Plans				Question to take up with Pilot	Initials of Computer making Check
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Chaining Notes			X	X	X	X		X	X					
Memo to Bridge & Bld'g Party				X	X			X	X					
Memo to Signal Party	27			X	X			X	X					
Abandoned Property		X		X		X		X	X					
Memo to Telegraph Party	26	X	X	X		X		X	X					
Culverts, Retaining Walls etc.	3A	X				X		X						
Clearing & Grubbing	3B	X	X			X		X	X					
Culverts & Retaining Walls	6A	X				X		X						
Ties - Main Line	8A	X	X		X	X		X	X					
Ties - Sidings	8B		X		X			X	X					
Rail - Main Line	9A	X	X		X	X		X	X					
Rail - Sidings	9B	X	X		X				X					
Frogs	10A	X	X		X			X	X					
Switches	10B	X	X		X	X		X	X					

ALL GOVERNMENT COMPUTATIONS ARE CHECKED AND COMPARED WITH OTHER DATA

FIELD FORM No4F V.D. 225.

CENTRAL RAILROAD CO. OF NEW JERSEY SYSTEM
WEEKLY PROGRESS REPORT OF I.C.C. ROADWAY AND TRACK PARTY NO. ....
AND C.R.R.CO. OF N.J. FIELD COMPUTERS

WEEK ENDING .... 191... VALUATION DEPARTMENT, N.Y. CORRECT .... Pilot Engineer

Valuation Section Numbers	Corporation or Branch	Miles ■ Route		Field Work: Chaining	Cross Sectioning	Inventory	Inspection		I.C.C. Office Work: Cross Sections	Volume Diagram	Inventory	Inspection Notes		C.R.R. Office Work: Cross Sections	Volume Diagram	Inventory	Inspection Notes	
			Current Week															
			Total to Date															
			Current Week															
			Total to Date															
			Current Week															
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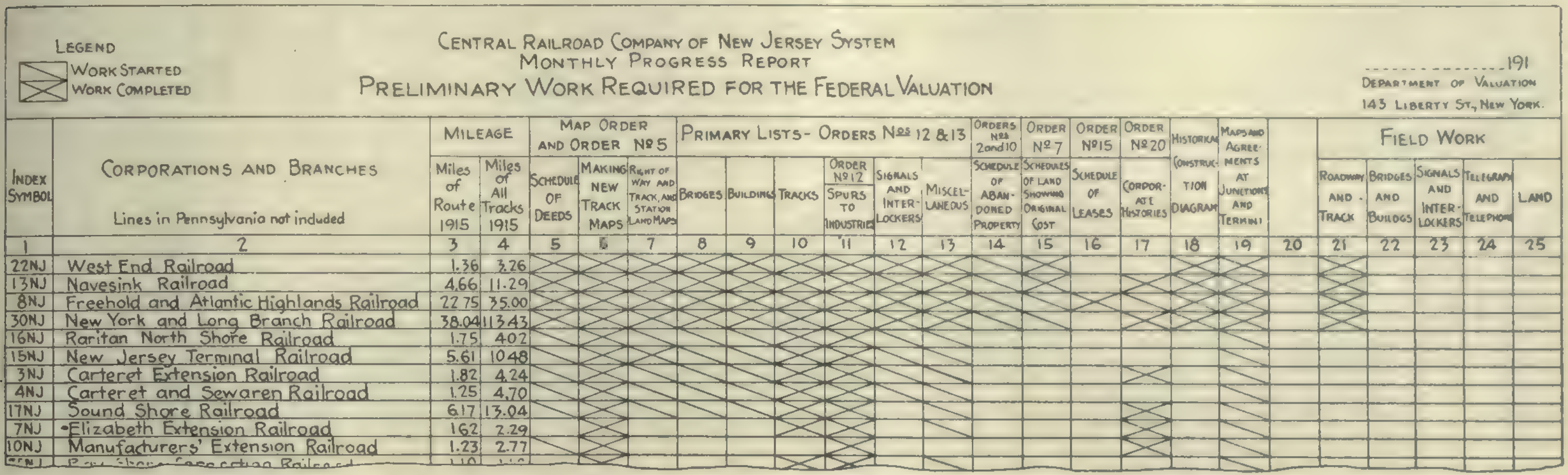
			Current Week															
			Total to Date															
			Current Week															
			Total to Date															
SUMMARY TO DATE:	Note: Field Work completed on following Valuation Sections. Nos.																	
Val. Sect. Nos.			Current Week															
			Total to Date															

I.C.C. Ass't Field Eng'r ....

C.R.R. Computers ....

Remarks:-

THIS FORM GIVES AN ACCURATE RECORD OF ALL ROADWAY WORK DONE EACH WEEK



BY THIS SIMPLE CHART THE VALUATION ENGINEER EACH MONTH GIVES THE PRESIDENT OF THE ROAD A BIRD'S-EYE VIEW OF THE WORK

In addition to the preparation of the primary lists and other data for the pilot engineers, a large amount of work has to be done in the preparation of maps, examination of land titles, studying of land values and carrying out of various government orders for information.

OFFICE CAR WELL DEVELOPED

Believing that, in order to avoid later disputes, the railroads should as far as possible verify all of the government's field computations, as well as the notes from which they are made, Mr. Hansel has two computers, as well as a pilot engineer, out with each government roadway party. To accommodate them he has developed the office car to perhaps as high a degree of usefulness as has been done on any other road. A plan is shown of the car of the Central of New Jersey. Besides the pilot engineer's desk there are four or five drafting tables. Each table is fitted with a hook to be attached to a corresponding eye in the side of the car, so as to hold it in place while the car is in motion. There are eyes on both sides of the car, so that the tables can be placed more favorably to the light. Two lights over each table fit either arrangement equally well. The railroad men use the desk and the two adjacent tables, while the government computers have the remaining tables. The assistant field engineer retains his office in the end of the living car, the two cars being coupled together.

In an office car of the Pennsylvania visited by the writer there was one long table down the center of the car, with the men working on one side of it and on a short table running from it to the wall in a flat T-shaped arrangement.

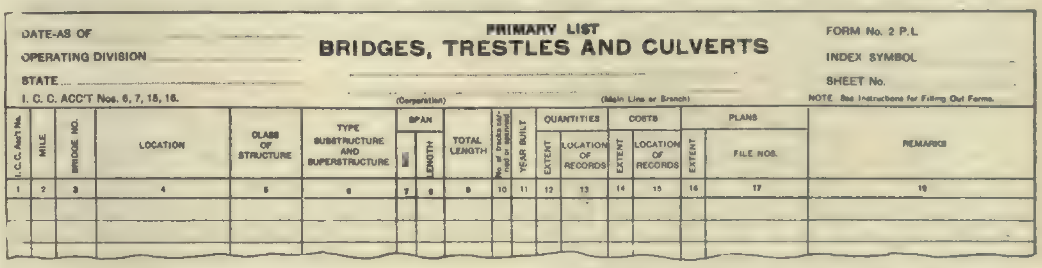
GOVERNMENT COMPUTATIONS CAREFULLY CHECKED

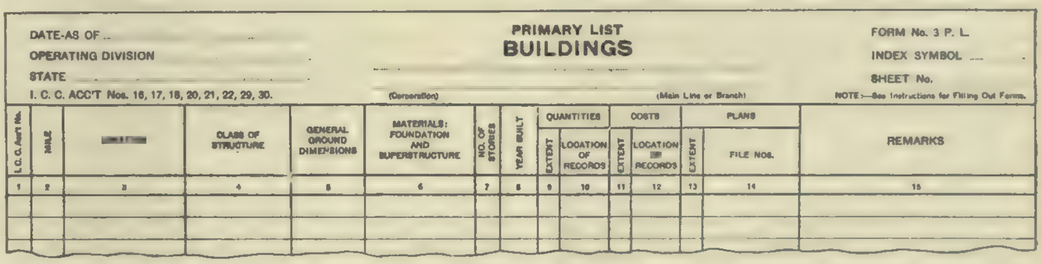
An idea of the many angles from which the government's notes and computations are scrutinized in the effort to make them perfect is obtained from the checking form, part of which is here reproduced. The form is self-explanatory; as the items are checked the proper space is filled in by the two diagonals.

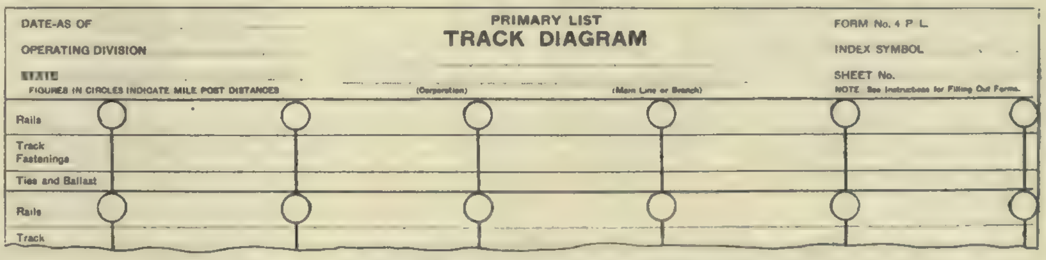
In connection with the computations it may be mentioned that the Central of New Jersey has arranged with the Division of Valuation to have the volume profiles plotted on tracing cloth. The railroad makes a negative of this and furnishes the government with a white print, while the government also retains the tracing.

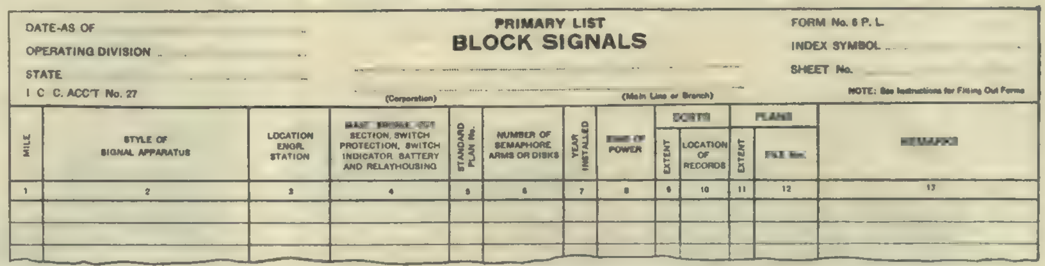
The weekly progress of all the work, including that done by the government field parties, is recorded on the form shown. Because the government's office work (meaning that done in the office car) must necessarily follow the field work, and be in turn followed by the railroad office work, the whole process may take several weeks, and at any given time there may be work going on on several valuation sections. Consequently the form is made out to record the progress of seven sections simultaneously and bring the whole week's advance on one sheet.

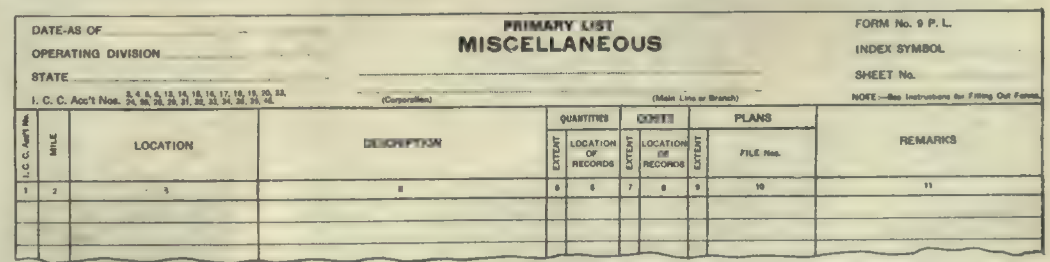
One other form that may be mentioned is that of the monthly report made by Mr. Hansel to the president of the road. This, as the part reproduction shows, embraces everything done by the valuation department, which includes, as the headings show,











THESE FORMS, WITH THREE OTHERS AND A SUMMARY SHEET, COVER THE PRIMARY LIST

the assembling of data of various sorts, as well as the field work with the government parties. As the simple legend indicates, percentages are dispensed with in this report. One diagonal is drawn when the particular kind of work on that valuation section was started, and the other indicates its completion. Each month the new diagonals are drawn in red paint on the blueprint transmitted, and before the next month they are put on the tracing in ink. Thus a succession of the blueprints affords a month by month comparison of the progress of the whole work.

The work above described is under the direction of Charles Hansel, consulting engineer, of New York City. Carl Tombo is principal assistant valuation engineer of the Central Railroad of New Jersey and the Philadelphia & Reading Railway, with headquarters at Philadelphia, while E. Y. Allen is assistant valuation engineer at New York. W. W. James is pilot engineer for the Central Railroad of New Jersey.

Heavy Scherzer Rolling-Lift Bridge Carries Railway and Highway Traffic

One of the heaviest, if not the heaviest, rolling liftspan in the world has recently been completed in England as part of the Keadly Bridge, described recently in *Engineering*. This bridge, located on one of the important main lines of the Great Central Railway, contains a 150-ft. clear span of the Scherzer type, weighing 2900 tons. It provides for both railway and highway traffic. The great convenience to the public afforded by adding the provision for vehicles which the previous swingbridge span did not possess is evident when it is stated that the nearest highway crossing was 15 miles distant. Difficult navigation, due to swift current and the location at a bend in the river, was an important factor in the selection of the rolling-lift type of bridge, the new bridge providing a clear opening without a central pier. Furthermore, the new span could be built in a vertical position, leaving the channel free for navigation during construction. Higher clearance when closed could also be provided, making it unnecessary to raise the span except for ships with masts, which form but a small proportion of the river traffic. The bridge was designed under the supervision of J. B. Ball, engineer of the Great Central Railway, and the contractors were Sir William Arrol & Company of Glasgow.

Wrecked Bridge Span 260 Feet Long Replaced in 13 Days by Girders on Pile Piers

Government Dredge and Contractor Help Railroad Forces Restore Traffic Over Span Destroyed Through Shifting of Load of Car Steel

BUT THIRTEEN days were required to replace with deck girder spans the 260-ft. truss in the Tennessee River bridge of the Cincinanti, New Orleans & Texas Pacific Railway Company, which was wrecked on the night of March 17 last. According to information made public by officials of the railroad, the steel span fell into the river at 9.50 p.m., carrying with it eleven cars from the middle of a 54-car train. A car stake, found broken near the bridge, after the accident, had permitted the shifting of one of a number of steel center-sills loaded on a flat car, which crippled the west or downstream truss of the span by striking some of its members. Although the span and the cars from the center of the train dropped 75 ft. to the river bed, landing in 10 to 15 ft. of water, there was no loss of life, as the train was proceeding at 8 miles per hour, and the rear section, with the caboose, stopped in a few car lengths. The accident was noted on page 466 of the Engineering Record for April 1, 1916.

THROUGH TRAFFIC DETOURED

Arrangements were immediately made for taking care of through-passenger and all freight traffic over the Southern Railway, between Chattanooga and Harriman Junction, via Knoxville. Local passengers, a train load of whom may be seen in one of the photographs walking down the river bank, were transferred across the river by a ferry service which was at once organized. During the thirteen days the bridge was out of service a total of 84 passenger trains and more than 5000 loaded and empty freight cars were diverted, at an average cost of between \$5,000 and \$6,000 per day.

An island just upstream from the bridge ordinarily diverted drift, of which considerable quantities pass down the river during its frequent rises, under the very span which collapsed. Moreover, the river bed at this point is apparently of solid rock, overlaid by from 2 to 6 ft. of compact gravel. For these reasons the gap could not be closed by a pile trestle, and it was decided to span the opening by putting in three pile piers and utilizing deck plate girder spans. The two center spans were 75 ft. long, and the end spans 43½ and 45½ ft. respectively.

WRECKAGE CLEARED RAPIDLY

The War Department, through Major Burgess and Captain Bain, Corps of Engineers, U. S. Army, assigned the government snag boat Nolichucky to the work of clearing the wreckage, and George Vang, president of the Vang Construction Company, engaged in building the new Market Street Bridge at Chattanooga, offered the services of his plant and organization for driving piles and removing wreckage. One of the photographs shows a driver barge, a derrick boat, and the snag boat at work in the gap. Spur tracks were built on the north shore to the bank of the river, one for the wrecking crane, which dragged ashore and loaded the steel and cars taken from the river, and others for the camp cars required by the working force. The necessary bridge timbers and piling had been ordered to the site shortly after news of the wreck was received, and the work of driving and capping the pile piers and erecting braced timber bents on them proceeded rapidly as soon as sufficient wreckage had been cleared from the river.

The short girder spans at each end were carried out and placed by bridge derrick cars. The girders for the central 75-ft. spans were transferred from flat cars to barges at the railway company's bridge over South Chickamauga Creek, just south of the Tennessee River bridge. The barges were floated to the site and the spans raised and placed by derrick cars. The last girder was placed and the track connected in time for the "Royal Palm" to pass over the bridge at 8.40 p.m. on March 30, 12 days, 22 hours and 50 minutes after the accident occurred.

NEW DOUBLE-TRACK BRIDGE TO BE BUILT

The present bridge, which is 1808 ft. long, and consists of one drawspan and seven fixed spans, is single track. Increasing traffic had already justified the building

WRECKAGE HAULED OUT BY CRANE ON QUICKLY BUILT SPUR

ROADMASTER CONNERTON DIRECTS PLACING OF LAST SPANS

LESS THAN THREE DAYS AFTER THE ACCIDENT CLEARING OF THE WRECKAGE HAD PROGRESSED SO AS TO PERMIT START ON PILE DRIVING

of a double-track bridge, plans for which were on file with the government before the accident. These plans have now been approved by the President and the War Department. The new bridge, which will handle the heaviest engines, will be constructed on the site of the present one.

The work of reconstruction was carried out under the direction of Curtis Dougherty, chief engineer, and G. H. Gilbert, engineer of bridges and buildings, of the Queen & Crescent Route.

Registering Hydrometer for Great Depths

Third Device of Argentine Engineer Can Be Used Also as Recording Tide Gage and for Sounding

TWO hydrographic instruments, one to take profiles of under-water surfaces and one to map the route traversed by a boat, developed by Agustin Mercau, an engineer of the Argentine Republic, were described in the Engineering Record of July 22, page 109, and July 29, page 147, and a third instrument, the registering hydrometer, was referred to. This article deals with the latter device.

THE REGISTERING HYDROMETER

Mr. Mercau's registering hydrometer was constructed to serve as a recording tide gage or as a hydrometer, when it is desired to make observations along turbulent coasts where it is not possible or economical to construct a fixed installation or to make use of such an instrument as the Profilograph, described in the first of the articles referred to. The indications of depth are registered by means of the changes of pressure of the air contained in the rubber pocket *W*—similar to that used in the Richards type of registering hydrometer—and placed in communication, by means of a flexible tube, with the pressure gage contained in the case *A*.

The rubber pocket is inclosed, as shown in Fig. 1, in a hermetically sealed case. This is placed in the water and attached to a container which is open at the top and filled with water. The latter is connected with the pressure gage *A*; also by a flexible tube.

The gage, by means of a play of levers, moves the bar *E* (Fig. 2), which is provided at its free end with a curved guide similar to that on the Profilograph. By this means the angular movements are transferred in another right line of length equal to the sines of the angles described by it. The guide conducts a small aluminum car (Fig. 2) which is provided with a pen that registers its movements on a roll of paper. By means of the pen (*K*) a line of reference is obtained.

Between the uprights *O* and *O′* (Fig. 2) is placed an automatic numerator that permits the noting of whatever tops or points of reference may be necessary. So that the apparatus can be used either as a recording tide gage or as a Profilograph, the recipient *W″* (Fig. 1) and the rubber pocket are inclosed in a small metal case that is placed at the bottom of the water.

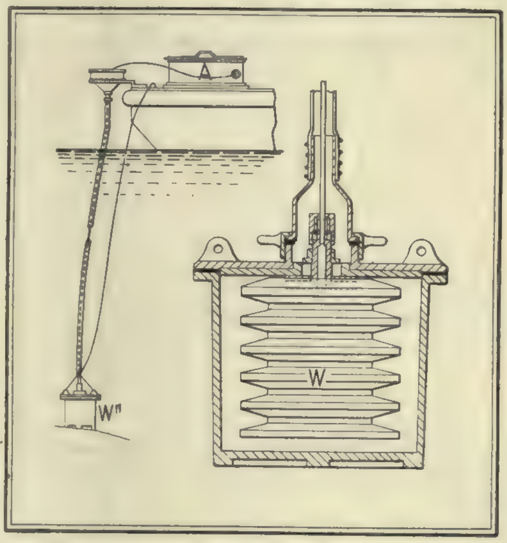


FIG. 1—BELLOWS IN CASE AT BOTTOM

The case is attached to the boat by means of a steel cable designed to support the force of traction to which it is subjected when the boat moves, and to take the strain off the flexible tube. The length of the cable is regulated by means of a small hand winch.

When the apparatus is used as a recording tide gage or as a hydrometer, the boat that carries it is anchored on the site selected, and should be level and steady. Also, although with slight modification of details, it can be placed in a fixed position above piles and similar supports.

In this condition the apparatus can be made to work indefinitely, it is claimed, without its being influenced by the different causes of error that affect the observations taken with the usual apparatus.

Bids for Concrete Roads Drop 40 Per Cent in Three Years

When the building of concrete roads was started in Maryland in 1912 the work was new to most of the competing contractors. After three years of experience, instead of bidding from \$1.30 to \$1.50 per square yard, as they did then, some bid as low as 90 cents. The cost of maintaining the roads has been so small as to be almost negligible, according to the State Roads Commission.

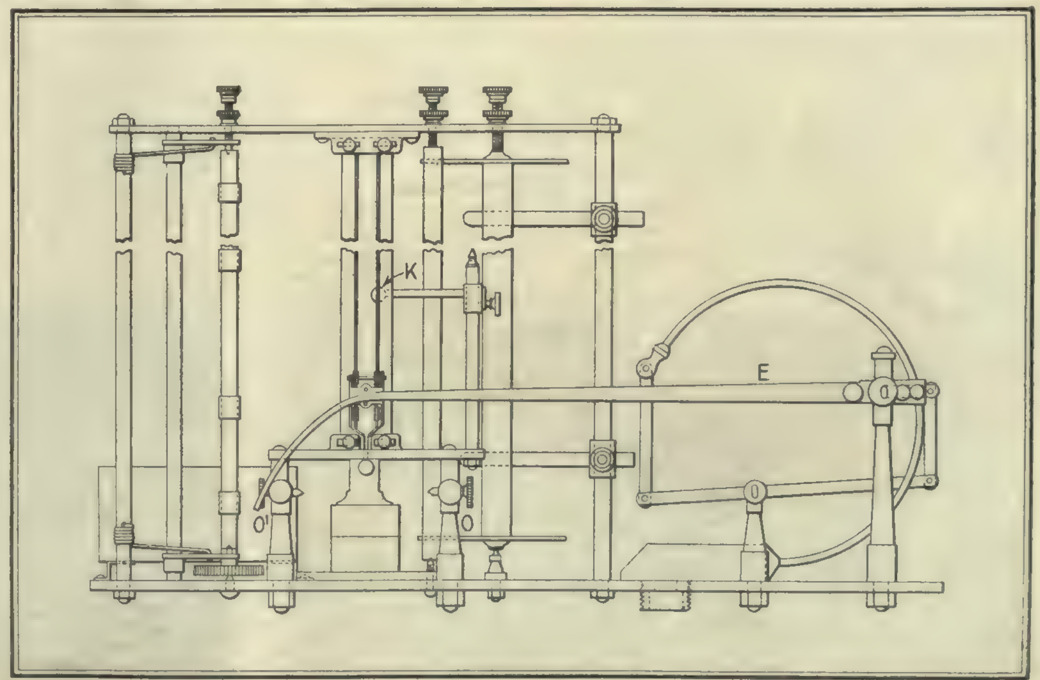


FIG. 2—REGISTERING HYDROMETER CONSTRUCTED FOR OBSERVATIONS AT ISOLATED POINTS

A Semi-Floating Highway Bridge

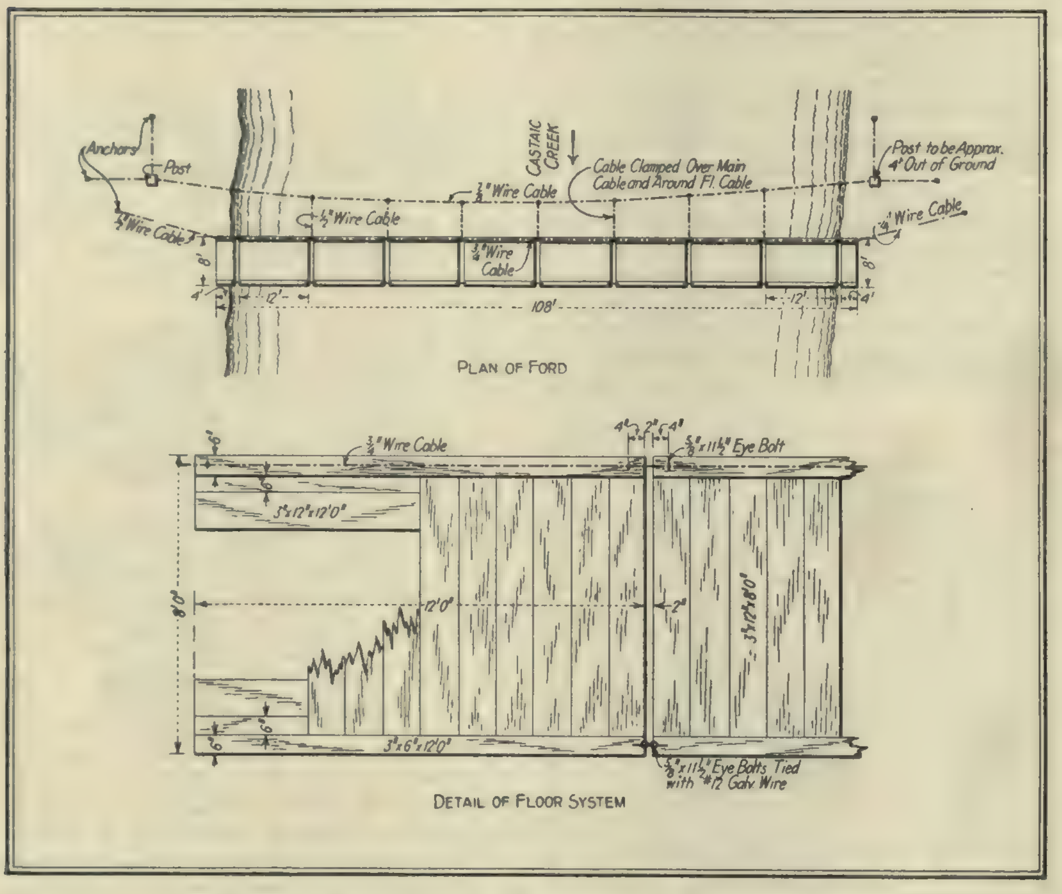
Deep Ford, Provided with Floating-Plank Roadway, Enables Autos to Cross Under Their Own Power

DURING the construction of a bridge across Castaic Creek, in Los Angeles County, California, highway traffic has had to ford the stream at a point where the depth is usually sufficient to submerge the carbureter of the average car. Teams have, therefore, been maintained at the crossing by the county to tow automobiles across. This procedure, however, usually caused considerable trouble in getting the engine started again after crossing, and it was recently determined to try a better method.

Plank Road Built in Sections and Held by Cables

The stream has a sandy bottom, and the depth is fairly uniform, so it was decided to build a plank road in sections, and hold it in place by cables in such a way that a good surface would be continuous across the ford. By this plan the effective depth of water would be decreased, not only by the thickness of the plank and stringers, but also by the amount which the tires would otherwise sink into the soft, sandy bottom. As a matter of fact, the heavy plank units are so buoyant that light cars pass over them at fairly high speeds with practically dry tires, and, even at slow speeds, heavy cars can safely cross under their own power.

After being built up on shore and floated to place, the sections were held together by a ¾-in. cable, threaded through eyebolts in each section. This cable was attached at 12-ft. intervals, by means of ½-in. cables, to a ⅞-in. cable stretched across 25 ft. above the plank sections, and drawn sufficiently taut to hold it 4 ft. above high water.



THIS SEMI-FLOATING BRIDGE WAS BUILT FOR TEMPORARY USE

On the downstream sides the sections were wired together by strands of No. 12 galvanized wire. At each end of the ford, 4-ft. sections were left, with free ends resting on shore.

Construction Details

In building up the sections, two 3 x 12-in. by 12-ft. stringers were spaced 5 ft. center to center, to which twelve 3 x 12-in. by 8-ft. planks were securely spiked with four 50d. wire nails to each plank. The end planks were also bolted to the stringers with ⅜-in. carriage bolts. A 3 x 6-in. by 12-ft. wheel-guard timber was securely spiked with 50d. nails along each edge of section. At the four corners of a section a ⅝ x 11½-in. eyebolt, with two cast-iron washers, was securely bolted through the guard rail and end plank, the eye of the bolt being placed at right angles to the center line of the section on the upstream side, and parallel on the downstream side. Eight sections 12 ft. in length, and two sections 4 ft. in length, were made up in this manner, the total length of the crossing being about 104 ft.

One end of the bridge was securely anchored with a ¾-in. cable clamped to the eyebolt on the last 12-ft. section, and made fast to a deadman on the shore. The opposite end was lightly secured with a ½-in. cable to a deadman, the intention being that in case of high water carrying drift against the bridge this end would be released, allowing the bridge to swing around to the opposite bank.

The bridge was completed in two days, at a cost of $17.50 for labor and $126 for material, freight, and cartage. The work was done under the supervision of the California Highway Commission, of which A. B. Fletcher is chief engineer. E. E. East, who was resident engineer in charge of the work, reported directly to W. W. Patch, division engineer.

Street-Car Companies Want Less Crown in Pavements

Intensive Study in Chicago Gives Relation Between Vehicular and Surface Traffic and Physical Condition of Streets

EXHAUSTION of the track capacity for the surface lines in Chicago has led to a study by the Board of Supervising Engineers, Chicago Traction, of every available avenue of increasing that capacity. Pavements, on account of the effect the type has on the vehicular traffic, are of the greatest importance. From a recent report the following notes are taken:

In the wholesale and factory districts granite paving preponderates, while in the retail and office-building districts smooth paving is used—either asphalt or wood block. Some of the representatives of the teaming interests have protested against smooth paving, claiming the right to use these through streets for trucking as well as for cars, but others have stated that detours are frequently made to streets west of the river to avoid the loop congestion.

In icy weather, or after sprinkling, heavy teaming on these smooth pavements

THE OLD WAY—WATER OFTEN OVER THE CARBURETER

THE NEW WAY—A PRACTICALLY DRY-SHOD PASSAGE

becomes extremely difficult and constitutes a grave source of congestion in the terminal district.

While at times the practice of sanding these streets has been carried out to some extent (assisted occasionally by private contributions from commercial houses), little appears to have been done as yet toward a systematic sanding of smooth pavements throughout the loop to relieve traffic obstruction. As a result car movement continues to be seriously impeded at times by vehicles in the track, which condition has not yet been corrected by enforcement of ordinances.

CROWNING

This use of car tracks results to some extent from the excessive crowning of the pavements. In some cases the slope from track to curb is so great that in winter time loaded vehicles and teams have been observed to slide to the curb.

To relieve this condition an effort has been made in the recent repaving of Van Buren Street to flatten the crown. Here the gutter is dropped only 4 or 5 in.; on other streets it is dropped from 6 to 9 in., resulting in an average grade of from 3 to 8 per cent. On Dearborn Street north of Randolph Street a drop of about 15 in. from track to gutter was observed, and 10 in. or over occurs in the vicinity of The Fair and other buildings.

It is stated by city authorities that flat paving should be encouraged as far as possible, but that it is more expensive for the reason that it requires considerable extra drainage.

SURFACING

In the case of granite-block paving the danger of skidding, of course, is much less. But unless the paving has been laid in an unusually substantial manner, continuous use by heavy teaming will result in such poor surfacing as to encourage the use of the car tracks even on as wide a street as South State Street. Teaming interests appear to prefer granite block first and brick second, and are usually opposed to all forms of smooth pavement. However, the preponderance of passenger automobile traffic offers concrete evidence of the desirability of a different class of pavement within the retail district than that best adapted for trucking purposes.

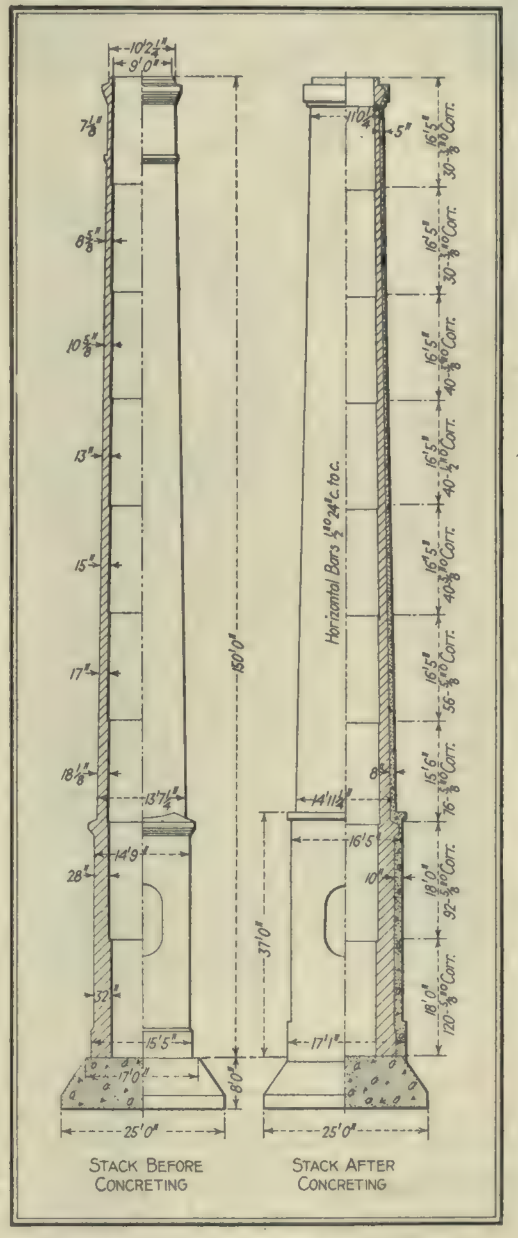
LARGE CRACKS ENDANGER BRICK CHIMNEY

Brick Chimney Strengthened by Reinforced Concrete

Shell Built Around Dangerously Cracked Factory Smokestack Without Interrupting Operation of Furnaces

By ERNEST McCULLOUGH
Consulting Engineer, Chicago

REPAIRS to a dangerously cracked brick factory chimney 150 ft. high successfully transformed it, to all external appearances, into a concrete chimney. A reinforced-concrete shell was built around the old brickwork, using the latter as interior forms and galvanized steel as exterior forms, without interrupting the operation of the plant. The total cost of the work



DETAILS BEFORE AND AFTER CONCRETING

was about one-half the original cost of the brick chimney.

About 14 years ago a vertically perforated brick chimney was built in Prospect Hill, Mo., for the St. Louis Portland Cement Works, owned by the Union Sand & Material Co., of St. Louis. Three years after it was erected cracks appeared without any apparent reason, which gradually increased in size until last year they excited alarm. Their appearance at that time is shown in one of the photographs. The insurance company threatened to cancel policies on every structure near the chimney unless it was repaired.

Plans were prepared in the office of the

CONCRETE APPLIED WHILE CHIMNEY IS USED

company and the employees at the plant did all of the work. A concrete casing 10 in. thick was placed around the base for a height of 37 ft. The brick was used as an inside form and the outer forms were of wood. Above the square base a circular metal form of No. 8 galvanized steel was used. It had a height of 42 in., tapered, and this height was poured each day the weather permitted. All work was done while the chimney was in use during the past winter, starting in November, 1915. On the tapered shaft the concrete is 8 in. thick at the bottom and 6 in. thick at the top.

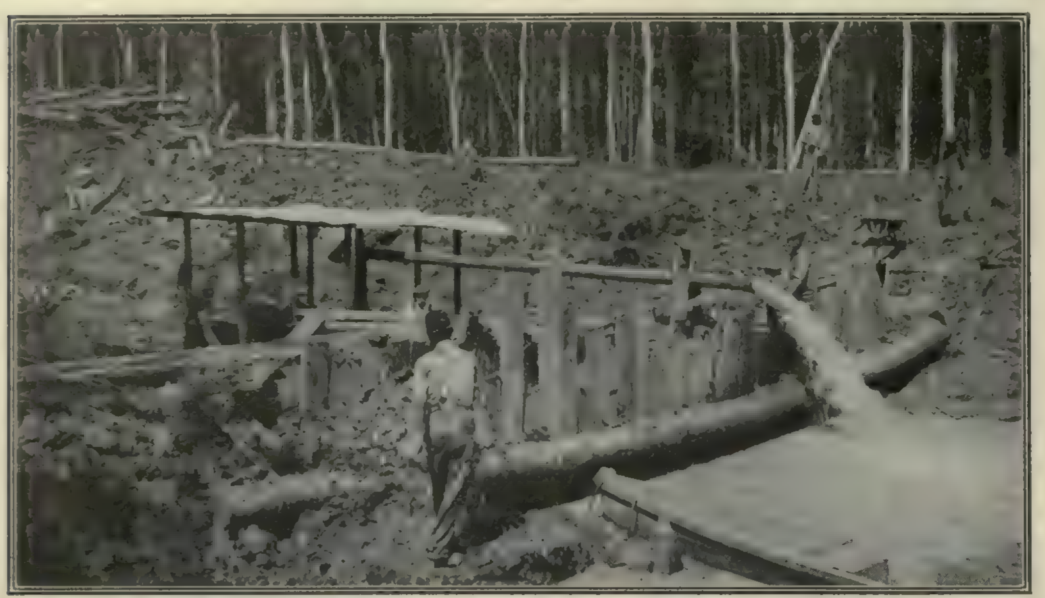
The reinforcement is indicated on the accompanying drawing, showing details of the chimney before and after concreting. The horizontal bands consist of ½-in. bars spaced 24 in. apart.

Timber scaffolding of the type shown in one of the photographs was used, the concrete being a 1:2:3 mix. The total cost of all the concrete work was $2,465, the original cost of the brick chimney from the ground line to the top being $4,800.

D. N. Armstrong is general manager and George Ross is superintendent at the plant. Many chimneys have been repaired with iron bands, but this is probably the first for which reinforced concrete has been used. A great many chimneys now causing owners and insurance companies considerable anxiety might be similarly treated.

Pig-Iron Production in 1915 29 Per Cent Greater Than in 1914

The production of pig iron, including ferroalloys, was 29,916,213 gross tons in 1915, compared with 23,332,244 gross tons in 1914, an increase of 28 per cent, according to figures published by the American Iron and Steel Institute. The pig iron, exclusive of ferroalloys, sold or used in 1915, according to reports of producers to the United States Geological Survey, was 30,384,486 gross tons, valued at $401,409,604, a gain of 36 per cent in quantity and 34 per cent in value. The average price per ton at furnaces in 1915 was $13.21, compared with $13.42 in 1914. At the close of the year, however, prices had advanced 35 to 40 per cent.



DYNAMITE BOXES ARE BURIED IN DAM FOR SUBSEQUENT DEMOLITION
Cables over ends of logs hold sheeting and canvas over face makes berm watertight.

Canalization of Half-Million Acre Drainage District Discloses Canal-Width Limits

Dredging Method for Excavating Canals of 123-Foot Base Involves Two Pilot Cuts and Rehandling of 900 Yards Per 100-Foot Station

TO PROVIDE drainage for the portion of the Little River Drainage District of Missouri lying south of its headwater diversion works (see the Engineering Record of July 14, 1914, page 67; Aug. 22, 1914, page 204; Dec. 5, 1914, page 612; May 27, 1916, page 701, and June 24, 1916, page 826) involves the construction of 624 miles of drainage ditches, varying in width from 4 ft. to 123 ft. at the base and from 8 ft. to 11 ft. in depth, and necessitates the excavation of 33,400,000 cu. yd. of earth. This article describes the construction methods employed in clearing and digging the canal, defines the economic limits of floating equipment and gives experience with pilot cuts.

Constant Supervision Unnecessary

In the construction of these drainage canals the constant supervision required on the headwater diversion works is unnecessary and semi-monthly inspections are made. At these times the canals are cross-sectioned at intervals of 100 ft., covering the reaches excavated subsequent to the previous inspection. Such clearing as has been completed in the same period is also inspected, and should any defects be found in either the excavation or clearing, the contractor is directed by a written order to correct them.

In the main the requirements insisted upon are that the canals shall be excavated to grade, have side slopes 1:1, berms full width, bank-line stumps be removed and that berms and ditch faces of spoil banks be kept free from logs, timber débris, etc. The material excavated from the drainage ditches is spoiled both ways, except where conditions are met which require other disposition, and where openings of at least 20 ft. in width are required in the spoil banks, such as at all natural watercourses, well defined depressions and at 500-ft. intervals alternately where there are no watercourses nor depressions. Where natural watercourses are intersected the downstream side is dammed by spoiling the excavated material into the course.

The main canal extends the entire length of the district and is 98 miles long. For the last 30 miles of its length it has a base width of 123 ft., which is practically the limit for economic construction with floating dredge equipment now built.

The method of clearing for the drainage canal is somewhat different from that on the main diversion works. All the timber on the areas occupied by the canal, berms and spoil banks is removed, making the cleared width sufficient so that any brush or timber débris shall be entirely covered by the spoil banks. On the remainder of the right-of-way the trees are felled parallel to the ditch line. An effort is made to clear the right-of-way for a whole year's work during the dry season. Where conditions prevail which make it impossible for logs to be snaked from the cleared area by the use of cattle or oxen they are cut into 12-ft. lengths and handled by the dredge. On the large canals skidders are in use.

In addition to numerous other points, work is in progress on the largest canal at three points where the base width is 123 ft. A typical plant near Tallapoosa was visited. It consists of one Marion steam dipper dredge having a 50-ft. boom and a 2½-yd. dipper for doing pilot cut work on both sides of the immense channel. The excavated material from each cut is placed on one side beyond the berm lines, forming a comparatively small bank, which excludes the drainage from the lowlands. The channel carries off the excess water from the main area to be excavated. A Marion steam dipper dredge with a 90-ft. boom and 4½-yd. dipper is used to make the main excavation. It digs the first cut of about 40 ft. in width, working from the center of the prism toward the berm. The second cut is similarly made on the opposite side of the channel. These separate cuts are made about 1 mile long, so that sufficient time is given for drainage and so that the spoil banks may become stable. The width of the channel is such that in the operations on this contract the material is not first placed back far enough to give the required berm.

Further cuts are then made, one each side, to trim the remainder of the prism to the 1:1 slope and then to remove the material from the berms, it being necessary to rehandle about 900 cu. yd. per station, which could not be deposited beyond the limit of the boom. This operation of digging back the roll from the 15-ft. berm and the embankment is undertaken after the final trimming of the canal slope has been made.

Merits of Pilot Cuts

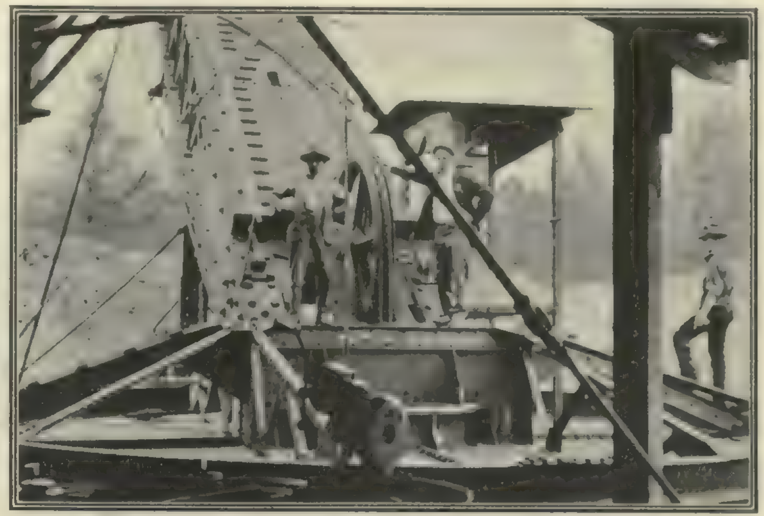
Both advantages and disadvantages of making pilot cuts on such large canals have been found by the engineers. The principal advantage is in increasing the efficient length of the boom, since the pilot cut material spoiled acts as a banquette, forcing soft material from the subsequent cut away from the prism. As to the disadvantages, it is found that where stumps must be removed by excavation it is impossible to dispose of all of them unless they are chained over the bank, thus reducing the efficiency of the large dredge. It is also impossible to keep the main excavation entirely away from the pilot cut. The roll from the dipper will enter the cut, necessitating removal. When this is done the roll over the berm is excessive and a clean berm, typical of smaller canals, is made more difficult to secure.

The cost of labor and fuel to operate the larger dredge is about $2,800 per month, and the average excavation is about 80,000 yd. Work proceeds for 20 hours night and

FINISHED SLOPES AND BANKS PRESENT REGULAR LINES

PILOT CUTS MAKE SITE READY FOR LARGE MACHINE

DREDGE TRIMMING SLOPES ON THIRD AND FOURTH CUTS



LOOKING OVER BULLWHEEL TO TRUSSED WOOD BEAM

day with crews consisting of 1 runner, 1 man in the crow's nest, 1 fireman, 1 deckhand, and during the day 2 extra laborers, a foreman and launchman.

Light is furnished by electricity from a Fairbanks 3½-kw. generator and 8-hp. engine. Fans to keep the mosquitoes from the operator add to efficiency. A week's run is 120 hours, and the week previous to our visit the dredge was down for 5 hours only to clean out one of the two 110-hp. boilers.

The launchman brings in the coal barges and supplies, which are loaded from a railroad siding at Tallapoosa built to the site where the plant was erected. This was ½ mile from canal 44 and 2½ miles from main canal 1. The coal barge holds 40 tons and required the excavation of the entering channels to a depth of 13 ft. for a 20-ft. width. For the dredge a 6-ft. depth was cut for a width of 40 ft. The crew is housed and fed in a quarter boat having an office, dining room and kitchen on the first floor and sleeping rooms above.

This equipment, belonging to Kochtitzky & Warner, who have 3,000,000 yd. in contract 19, is typical. R. H. & G. A. McWilliams and the Canal Construction Company have 10,000,000 cu. yd. in contracts 20, 25 and 26, the T. Foohey Dredging Company has in contract 3 1,600,000 cu. yd. and the Hoosier Land & Investment Company has contracts 11 and 17, with 6,100,000 cu. yd. R. H. & G. A. McWilliams have three 3½-yd. Marion and one 1-yd. Fairbanks dredges. The Canal Construction Company has one 3, one 3½ and one 4½-yd. specially built dredges.

The work is being executed under the direction of the Board of Supervisors, for which William A. O'Brien is chief engineer and Isham Randolph consulting engineer.

DIGGING THE BANKS FROM THE BERMS
About 900 yd. per station on the largest canals must be rehandled.

Utah Road Engineers Adopt Short-Span Standard

Data Available Determine Type to Use for Certain Spans—Broad Washes Crossed with Stone Fords

ON ACCOUNT of the rough topography of Utah, the streams and washes are narrow, usually less than 100 ft. As there are a very great number of these washes, the engineers of the State Road Commission have drawn standards to meet all spans up to 100 ft. Moreover, as most of the spans that are to be required fall considerably below 100 ft., they are all trusses of the pony type. In standardizing the details of the various types, improvements have been incorporated to increase the strength and lighten the weights of the bridges, thereby rendering the designs more economical. The following notes on the subject are taken from the latest biennial report of E. R. Morgan, state road engineer.

The standard steel-truss bridge is designed with Warren trusses having midpanel hangers. The trusses are braced laterally at the hanger points and the floorbeams are set on top of the lower chord. The floor consists of a reinforced-concrete slab having a crown of 1 in., and is laid flat on the tops of I-beam stringers. The slab has an average thickness of 7 in.

The standard wood-truss bridge is designed with Howe trusses, having round steel rods as vertical members, and having cast-iron washers and bearing shoes. A steel plate is laid on top of the lower chord timbers to take up the entire lower-chord stress. As in the steel-bridge design, the floorbeams are laid on top of the lower-chord plates, which position tends to throw the floor level more nearly toward the center of the truss, providing excellent opportunity for bracing the trusses. The trusses are braced laterally at panel points by means of angle irons extending from the upper chord down to the extremities of the floorbeams produced. These new features constitute the principal elements of the design. A bridge superstructure constructed in accordance with this design costs a little more than half as much as a corresponding steel-truss or concrete-girder superstructure, and is capable of carrying just as great a load.

One difference in favor of steel or concrete structures lies in the fact that their floors are of concrete, which material is preferable to the timber flooring of the wooden structures, and probably the chief point of superiority of the steel or concrete bridge is its permanence. The concrete bridge, well designed and well constructed, should last forever; and the steel bridge will also last indefinitely, provided it is carefully protected from the rusting action of the atmosphere. The wood bridge, however, requires less attention than does a steel bridge to prolong its life in certain localities, such as in alkali regions.

The concrete-slab-and-girder bridges were also standardized. From the data sheets made for the various types of bridges the curves giving the total cost of the superstructure were all platted together on one sheet, which shows by their comparative cost which type of bridge should be constructed for a given span. The curves show that for ordinary conditions of cost and labor, cost of materials, and proximity to shipping points, the following types of bridges are preferable for the spans mentioned: Concrete-slab superstructure, 5 to 20-ft. spans; concrete-girder superstructure, 25 to 40-ft. spans, and steel-truss superstructure, 45-ft. spans and greater. These types are for permanent structures having concrete floors. The wood-truss bridge, from 20 to 80 ft. in span, is cheaper than either of the types mentioned, but does not possess a permanent floor.

Trenton Makes Alum

Trenton, N. J., has installed a plant to manufacture alum for purifying the city's water. This scheme is said to save the municipality about $12,000 a year. The plant turns out 6 tons a week, which is about equal to the yearly consumption of 300 tons.

Special Mechanical Devices Needed at Small Wharves

Pier at Santa Cruz, California, Has Davits for Raising 5-Ton Fishing Boats Quickly—Operated by Water Motor

BY J. W. SWAREN
Hayward, California

ENGINEERING problems of the smaller wharves along the Pacific Coast, in the matter of handling cargo and equipment, are far more complex than in the larger wharves. A small wharf will be in use only at intermittent intervals, and a supply of labor for handling the commerce expeditiously is difficult to maintain. Features of the mechanical equipment installed on a new wharf at Santa Cruz, Cal., a great fishing center, as well as pleasure resort, include davits for raising 5-ton fishing boats quickly and a water motor for driving the capstan.

The wharf is built with the decking 20 ft. above mean sea level, a rather unusual height, to minimize the slap of the waves against the bottom. The fishing boats are hauled up on the wharf. Many of these boats are of 4 or 5 tons displacement, with an additional weight of cargo often reaching 2 tons. It is essential that these boats be raised to a place of safety on the wharf in the shortest time possible, as the fishermen stay on the fishing banks till the last moment and then come into the port racing with the approaching storm.

Swinging Davits to Raise Fishing Boats

A series of heavy swinging davits has been installed for this work. The king post of the davit is a 10 x 12-in. Oregon-pine timber, 12 ft. long, capped at either end with a cast-iron base carrying a 2½-in. gudgeon cast integral. The lower gudgeon rotates in a cast-iron plate fastened to the floor of the wharf, while the upper gudgecn rotates in a similar plate attached to a filler block set in an inverted trough formed of 2 x 12-in. planking bolted together. One-inch strain rods connected by eyebolts to the filler block and deck floor take the principal lifting strain. The main arm of the davit is an 8 x 10-in. Oregon-pine timber, 10 ft. long, and is supported by a knee joint with upper diagonal members of 10 x 12-in. spruce.

CAPSTAN FOR OPERATING HOIST IS DRIVEN BY WATER MOTOR

For the upper boats the spacing between the davits is 35 ft., while for the smaller boats the spacing is respectively 25 and 30 ft.

Water Motor for Capstans

A power-driven capstan winds the hoisting ropes. The capstan head is driven at 17 r.p.m. through a train of gears actuated by a Pelton-Doble 18-in. water motor of special design and having a rating of 8 hp.

The question of suitable driving power for this equipment was carefully analyzed, the merits of gasoline, steam, electric and water power being considered. In view of the exposed position of the wharf it was felt that the electric motor would be unsatisfactory, owing to the corrosion of connections, while steam and gasoline were deemed inadvisable, requiring skilled attendants at all times. Santa Cruz has a gravity water supply under a pressure of 90 lb. per square inch.

SWINGING DAVITS ARE OF TIMBER

Under actual operating conditions a boat rated at 5 tons, with a cargo of 2 tons, has been hoisted to the deck of the pier with a four-strand tackle in 2 min. 40 sec. The cost for water required was 8 cents.

Stairways at two points on the wharf provide a safe entrance to the fishing and pleasure craft. These stairways are hinged at the upper end, while the lower end is supported in a stirrup, which in turn is connected to a hoisting mechanism so that the stairway can be raised and lowered to accommodate tide conditions.

The hoisting cylinder, which is set in the tower, was salvaged from the hydraulic presses of a powder mill that formerly operated near Santa Cruz, but which went the way of all powder mills. It is a 10-in. cylinder with a 6-ft. stroke, having a drawbar pull of 4000 lb. Safety connections are provided on the water-supply pipe to prevent over-running at either end.

Warehouse Equipment

A warehouse at the extreme end of the pier is served by a broad-gage track running the entire length of the wharf.

As virtually all vessels of the present day are fitted with hoisting apparatus of some type, it was not thought necessary to install derrick equipment, but it was deemed advisable to provide for the convenient loading of trucks. A hydraulic elevator has been installed in the center of the warehouse for this purpose. It has a 6 x 6-ft. platform.

RAISING A 3-TON BOAT TO THE WHARF

This elevator is operated by a hydraulic cylinder similar to that used in the stairway hoist. It has a capacity of 2 tons, and has proved a great labor saver. By the use of the elevator, a teamster can load nearly all merchandise without assistance.

The installation of the first power-driven capstan has been so successful that two additional ones are now being installed, and it is probable that at a near future date still another elevator of a construction similar to the one now in use will be required.

Water Supplied by 6-Inch Main

The water supply is brought upon the wharf through a 6-in. wrought-iron main. For the greater part of the way this is laid on the deck of the wharf, but at the outer end, where it would interfere with the fishing operations, it is carried underneath the deck on a creosoted-wood cradle.

The pipe was covered with burlap and then dipped in pitch for protection against the salt spray. The burlap was put on in strips, lapped one-half, thus providing two thicknesses of burlap. The wrapping was done at the factory, leaving only the sleeve couplings to be burlapped when the pipe was laid.

Near the middle of the wharf a 3-stage centrifugal pump, direct-connected to a 75-hp. 220-volt electric motor, has been installed. This equipment is for fire protection, but it discharges direct into the main water line and can be used in an emergency to operate the capstans and elevators. Its supply is taken from the bay

These mechanical devices were designed and have been constructed and installed under the direction of R. S. Tait, superintendent of the municipal waterworks department.

$16,213,387 for Roads from Motor Fees

Registration and license fees for 2,445,664 motor vehicles in use during 1915 in the United States amounted to $18,245,719. Of that amount $16,213,387 was spent on county and state roads. There were 734,325 more motor vehicles used in 1915 than in the preceding year. In 1906, 48,000 motors were registered. Because of different state methods of registering these figures, given by the good-roads office, do not necessarily represent the total number of cars.

LOADING GRAVEL AT A LOCAL PIT

Four Construction and Thirteen Maintenance Gangs Care for McLennan County's Roads

Each Unit Allotted a Given Mileage—Highways of Recently Constructed $1,075,000 System, and Dirt Roads as Well, Carefully Attended To

BY WILLIAM C. DAVIDSON
Assistant Engineer, McLennan County, Texas

McLENNAN COUNTY, TEXAS, has 175 miles of hard-surfaced roads, recently completed. It also has its proportion of dirt roads. To care for them it maintains a patrol system consisting of thirteen small maintenance gangs located at convenient points and four convict construction gangs.

The system has a total length of 175 miles of hard-surfaced roads, consisting of 5 miles of concrete road, 60 miles of oiled macadam and 110 miles of gravel. There are about 400 bridges and culverts, constructed of reinforced concrete, structural steel and corrugated and vitrified pipe.

Thirteen two-team outfits and four eight-team outfits comprise the maintenance force. These are distributed over the county under the direct supervision of the Commissioners' Court. The two-team outfits are located at Waco and one each at West, Leroy, Axtell, Mart, Riesel, Rosenthal, Lorena, Moody, McGregor, Crawford and China Springs.

One of the gangs at Waco is a special crew used in the repair of macadam roads, doing such work as the other gangs are not qualified to do. The organization is practically the same for all gangs.

The convict construction gangs are located in the four Commissioners' Precincts. The work of each gang is confined to the locality in which it is stationed. In an emergency, however, two or more gangs may be combined.

CONVICT CAMPS

Each convict camp is in charge of a foreman. Under him there are three guards and a cook, all of whom are on a monthly salary paid by the county. These men, together with the convicts necessary to carry on the work, constitute the camp.

The convicts employed in the camps are what is known as "county convicts," and serve, on the average, terms of about 30 days. They are made up mostly of Mexicans and negroes, who are worked together in the same camp. All the white convicts are likewise worked together. Owing to the fact that the time of the convicts is so short, it is difficult to build up an efficient organization in the matter of "trusties" and laborers particularly adapted to certain kinds of work. The convicts are allowed $1 per day, which applies on their fines.

Each camp is furnished with an eight-team outfit and all necessary road machinery, such as plows, road grader, drag scrapers, fresnoes and such small tools as picks, axes, shovels, etc. Tools necessary for the construction of concrete, steel and wooden bridges are also furnished. The tent equipment of each camp consists of a cook tent, a sleeping tent for the convicts, a stable tent for the mules and one or more tents for the accommodation of the foreman, guards and cook.

The convict outfits are used chiefly on construction work, and are moved from place to place over the precinct as the county engineer directs. Insofar as possible the work performed by these gangs is of a permanent nature—the building of concrete culverts, structural-steel bridges, short stretches of concrete and gravel road. In addition they grade old roads that were poorly located in the first place, straighten stream channels and perform other duties incident to a general campaign of road building.

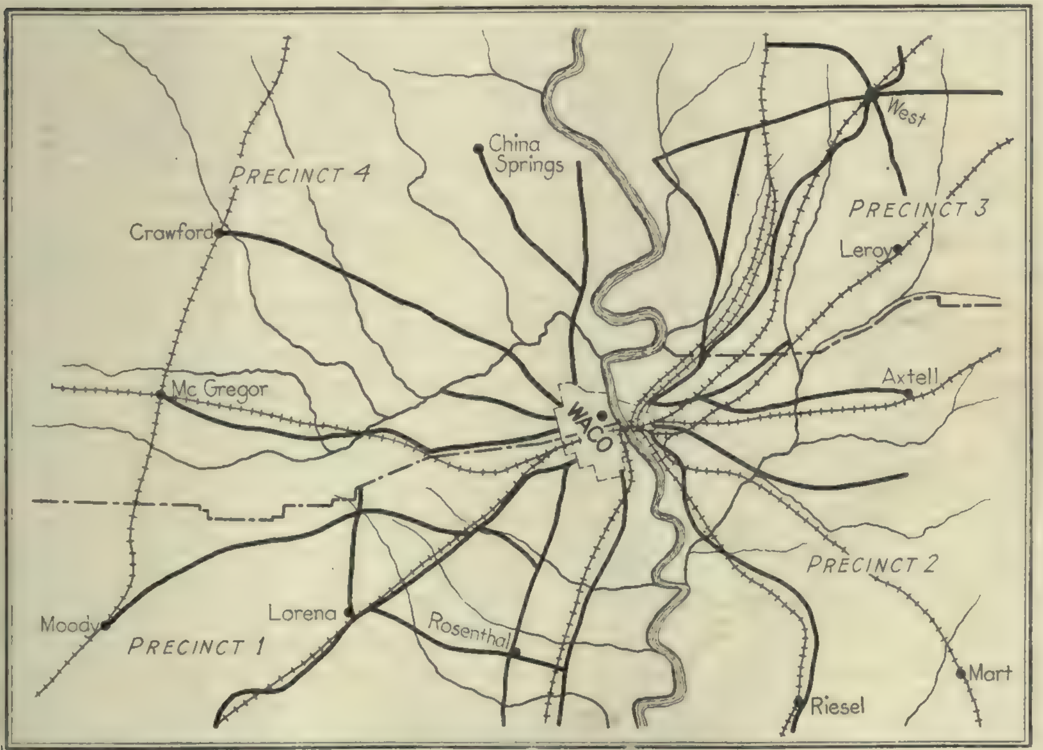
MAINTENANCE GANG MOWING WEEDS

All such improvements are under the direction of the county engineer or his assistant, who makes frequent inspection trips to the camps and over the work. Instructions are given to the foremen as to future work, and where necessary grades and stakes are furnished.

At the end of each week the foremen of the convict camps are required to submit to the county engineer a report made out on blanks provided for the purpose. This report shows the character of work done each day, the actual time worked, the location of such work and the number of teams and men in each camp. By referring to the reports, the superintendent is able to keep in touch with every phase of the field work and to plan ahead.

Every month the foremen must furnish the county engineer with an inventory of all equipment, material and feed on hand. Such a report acts as a check on wastage of material and breakage of equipment. Every few months data are compiled from the weekly and monthly reports showing the unit cost of feeding teams and men.

The duties of the thirteen small main-



MAIN TRUNK HIGHWAYS—BLACK DOTS INDICATE LOCATION OF MAINTENANCE OUTFITS

tenance gangs are strictly of a repair and maintenance nature. Each outfit has a certain territory to cover, keeping in repair all bridges and culverts, cutting weeds from the right-of-way at least twice during the year, watching the road as to its drainage, hauling gravel and making repairs. Each of the outfits consists of two teams and two men.

Work Not Restricted to New Roads

The work of these men is not restricted to the 175 miles of improved roads, but covers the repair and maintenance of earth roads as well. The foreman is held responsible for the condition of the roads within his district. He is required to keep a telephone in his residence, so that he can be at all times in touch with the county engineer, the Commissioners' Court or any citizen who may discover urgent need of repair to a road or culvert. Each outfit is supplied with all necessary road machinery and tools. The equipment consists of a small road grader, a mower, road drag, drag scraper, fresno, plow, wagons with gravel beds and various small tools.

Duties of Maintenance Outfits

The duties of these outfits are to drag all main roads after each rain, regrade earth roads in the spring and fall and perform such other duties as the engineer may direct. At the end of each week the foreman of each gang is required to make a report to the county engineer. This report shows the location and character of the work done every day during the week. At the end of each month the foreman must submit to the county engineer an inventory of equipment.

Generally speaking, instructions are issued daily to the foremen of the maintenance gangs. This is done either by telephone or in person by the county engineer or his assistant.

Most of the outfits are placed in towns centrally located within the district. Each outfit is provided with camp equipment, so that in cases of emergency the gang may camp at the site until the work is completed.

The daily cost of operating one of these maintenance outfits is as follows:

Foreman, per month	$57.50
Helper, per month	40.00
Extra help, per month	10.00
Salaries, per month	$107.50
Salaries, per day	$3.58
Feed for 4 mules, at 30 cents per day	1.20
Total cost per day	$4.78

The macadam roads are maintained by a special gang which is made up of men experienced in such construction. Two teams and the necessary equipment are allotted the outfit. The work is usually done by two men, but the number may be increased as the importance of the work demands.

The gang is stationed at Waco, where all of the seven macadam roads virtually begin. From this point they extend from 5 to 20 miles out. The duties of the gang are to repair all defects and to patch the road with asphalt when such repair is necessary. When the gang is not thus engaged it is hauling shoulder gravel for the protection of the macadam, mowing weeds and doing other work incidental to road maintenance.

Instructions are given to the foreman each day by the county engineer. Material for the repair of the roads is stored at convenient places throughout the district.

WEEKLY FORCE REPORT

CONVICT CAMP, PRECINCT No.______, FOR WEEK ENDING SATURDAY,__________191__

Day of Week	Day of Month	No. Men in Camp		Convicts Working	Teams		No. Hours Actual Work	Location and Character of Work
		Paid Employed	Convicts		In Camp	Working		
SUN.								
MON.								
TUE.								
WED.								
THU.								
FRI.								
SAT.								

GENERAL REPORT

Camp Located__________ __________Foreman

EACH FOREMAN MUST FILL OUT AND MAIL THIS REPORT WEEKLY

The foreman makes weekly and monthly reports to the county engineer's office. These reports are similar to those submitted by other maintenance outfits.

Supplies for the different gangs are purchased in large quantities. The county auditor is ex officio purchasing agent. Orders for the needs of each gang are

INVENTORY REPORT

FOR MONTH OF__________191__

______Outfit No.____ Working in Commissioners Precinct No.____

No.	ITEM	No.	ITEM	No.	ITEM
	Tools and Implements		Lumber.		Feed.
	Teams				Bu. Corn
	Tents		3 in. x 12 in. x 20 ft.		Sacks Oats
	Tent-Flies		3 in. x 12 in. x 18 ft.		Bales Alfalfa
	Sets Harness		3 in. x 12 in. x 14 ft.		Bales Johnson Grass
	Road Drags		3 in. x 12 in. x 12 ft.		
	Fresnos		2 in. x 12 in. x 18 ft.		
	Road Graders		2 in. x 12 in. x 16 ft.		Miscellaneous.
	Plows		2 in. x 12 in. x 14 ft.		Spools Barb Wire
	Slips		2 in. x 12 in. x 12 ft.		
	Wagons		3 in. x 8 in. x 16 ft.		Lbs. 8d Nails
	Adz'		3 in. x 8 in. x 14 ft.		Lbs. 10d Nails
	Axes		3 in. x 8 in. x 12 ft.		Lbs. 12d Nails
	Hand Axes		2 in. x 6 in. x		Lbs. 16d Nails
	Bits		2 in. x 6 in. x		Lbs. 20d Nails
	Braces		2 in. x 4 in. x		Lbs. 30d Nails
	Crow Bars		2 in. x 4 in. x		Lbs. 40d Nails
	Drill Bars		4 in. x 6 in. x		Lbs. 60d Nails
	Claw Hammers		4 in. x 6 in. x		Lbs. Staples
	Sledge Hammers		4 in. x 4 in. x		
	Nail Pullers		4 in. x 4 in. x		in. Bolts in. long
	Picks		10 in. x 10 in. x		in. Bolts in. long
	Pairs Pliers		Cedar Posts ft. long		
	Post Hole Diggers		Cedar Posts ft. long		
	Hand Saws		Cedar Posts ft. long		
	Cross Cut Saws		Fence Posts		
	Short Handle Shovels				
	Long Handle Shovels				
	Wire Stretchers				
	Spirit Levels				
	Squares				
	Files				

__________Foreman.

A MONTHLY INVENTORY CHECKS THE COUNTY'S MATERIALS AND EQUIPMENT

CONVICT CREW GRADING ROAD, M'LENNAN COUNTY, TEXAS

sent to the county engineer by the foreman, and after they are carefully checked in his office requisitions are drawn for them. At the end of each month all bills, with the requisitions attached, are submitted to the county engineer for approval. They are then sent to the county auditor for final check, after which they are submitted to the Commissioners' Court for indorsement.

The maintenance system was established about two years ago by Rollen J. Windrow, county engineer and road superintendent. During the two years that it has been in operation it has proved highly successful. Associated with Mr. Windrow as assistant engineer is Manton Hannah, formerly county engineer of Lamar County, Texas. Mr. Hannah has personal supervision of the field operations of the maintenance outfits.

Test Webs of I-Beams and Built-Up Girders

Experiments by H. F. Moore and W. M. Wilson Check Elastic Theory—When Exact Computations Are Necessary

TESTS of six 12-in. I-beams and two 24-in. built-up girders are reported by H. F. Moore and W. M. Wilson in Bulletin 86 of the Engineering Experiment Station, University of Illinois, and an exhaustive analysis and theoretical study of the results are presented. The experiments were made for the purpose of studying the strains in the webs of I-beams and girders, hence the webs were planed thin to insure that web failure would be the primary failure. Complete sets of strain-gage measurements were made, and the effect of using both flats and angles as stiffeners at points of concentrated loading were measured.

The results and conclusions given by the authors show that the ordinary elastic theory, including the effect of lateral strain (using Poisson's ratio), agrees closely with the measured strains at the various parts of the webs, where not affected by local concentrations. The maximum shearing strain may be either at the neutral axis or at the junction of flange and web. These are generally nearly equal, and the maximum at the neutral axis may be used in design. The common approximate method of computing the shearing stress in the web by dividing the total transverse shear by the web area is sufficiently exact, according to the authors, except when such value is more than 80 per cent of the allowable shearing stress in the material, in which case the exact formula should be used. Ultimate shearing stress in webs should be taken as the yield point of the material in shear.

In some cases the diagonal tensile and compressive stresses in the web at the junction with the flange greatly exceeded the direct maximum tensile and compressive stresses, computed ratios of about 1.5 being obtained. This was partly due to the high ratio of shearing stress to longitudinal stress in these special girders with thin webs. The value of diagonal stresses in cases of high shear should be computed, and should not in any case exceed the safe working stress of the material in tension. The following formula is derived:

$$S_d = (1-\gamma)\, S/2 + (1+\gamma)\sqrt{S_s^2 + (S/2)^2}$$

in which S_d is the diagonal unit stress corresponding to the maximum strain, S is the direct fiber unit stress, S_s is the shearing unit stress, and γ is Poisson's ratio.

The results, according to the authors, show that webs without stiffeners are capable of developing the lowest of the following critical values: (1) The yield point of the material of the web in shear, or (2) the compressive strength of the web as computed by Euler's column formula for a 45-deg. strip as a fixed-ended column subjected to a compressive stress equal to the transverse shearing stress at the neutral axis, or (3) a diagonal strain equal to the strain at the yield point of the material in tension.

Stiffeners at supports and under concentrated loads, well fitted to the flange, are very necessary, according to the authors, and the local compressive stress in the web when no stiffeners are used may be computed with fair accuracy by Hudson's formula. They believe the tests show that the ability of thin webs without stiffeners to resist buckling has been underestimated. The measured deflections were found to agree with computed deflections based on the ordinary elastic theory, when the deflection due to shear was included.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

What the Engineer May Expect in Latin America

SIR: In reply to your questions regarding opportunities for American engineers in Latin America, I would say that I consider them good; but I desire to qualify the statement. Primarily, as American interests increase here, more American engineers will be employed and the rate of pay will, or certainly should, be higher than in the United States. When the engineers leave their own country they will find conditions very different and will have to live largely to themselves and exercise great self-control in order to save any money. If they seek amusement or entertainment it will be found so expensive that their savings may very likely be negligible. After they return to the United States they will find that practically everybody has forgotten them, that the mode of life and doing work is very different, and that the fact that they have occupied positions of importance in Latin America will mean very little to employers in the United States. In other words, they will have to accept a routine subordinate position at home after having been in a responsible position abroad, and probably at a rate of pay much less than they received abroad; all of which tends to make them dissatisfied.

Their only real future, after a few years' experience, lies in being able to save enough money to get into business, say contracting, for themselves, or to enter the employ of a very limited number of firms who finance or build foreign projects, and who are located principally in New York or Boston, or to remain permanently in Latin America in the hope of securing a good salaried position there, and to keep the position until a better one comes; in other words, to cut themselves off entirely from home and to emigrate to the newer countries, with the lack of comforts and pleasures to which they have been accustomed.

There is comfort and pleasure in living in some parts of Latin America, but the North American does not always find them, and he can never become one of the people in the sense that a European can become one of us after a few years in our country.

There is always the possibility that the American engineer coming here can secure control of valuable properties and build them up, provided he has relatives and close friends at home who will not forget him in a year and will help him to finance the projects; but few engineers are fitted for this class of work—fitted technically, perhaps, but not temperamentally. It is not the class of work to which they have been accustomed.

As regards the possibility of associating themselves with financial interests at home after a long and valuable experience abroad, the chance is limited, because it is human nature to seek men personally known, or enjoying a great reputation, to make reports. No great reputation filters into Wall Street and Broadway nor into Milk or Market Street from the new parts of Latin America, and obviously the engineer cannot maintain his personal acquaintances and connections at home while working in foreign countries. The result is that men are ofttimes engaged to make reports who have never been here, and employ experienced men as subordinates. Again the man staying away from home for a long time sees little of his fellows and may be behind the

times, but generally his knowledge of fundamental facts and conditions is sounder because of his broader experience, both as regards responsibilities and familiarity with differences in conditions, people and point of view.

Out of many who go abroad some may succeed greatly, but the vast majority probably will not, because the value of their experience is not appreciated at home. The fundamental reason for the latter statement is that we have not been a creditor nation and have not been greatly interested in foreign projects.

It would seem that I am a bit pessimistic, but I see great opportunities for some of our engineers, provided they are in touch with investors, or provided they are very competent and will emigrate permanently.

V. L. HAVENS,.
M. Am. Soc. C. E.; American Commercial Attaché, U. S. Department of Commerce.
Santiago, Chile.

Licensing Law for Engineers and Architects Needs Revision

SIR: The status of the engineer and the architect, as established by legislation in Illinois and in some other states, is a subject of much discussion, correspondence and argument, all of which are engendering ill-feeling and misunderstanding between the two professions.

The situation as it stands to-day is a most unfortunate one; and more than this, it is rather a ridiculous condition. The architect makes a statement that by virtue of law he alone is authorized and labeled competent to design structures. The engineer says the same thing, and each claims that the other is infringing or trespassing on his rights. This denial and contradiction has led to considerable ill-feeling between at least some of the members of both professions, and there has been concerted action taken, based not on professional ethics or for professional protection, but solely in a spirit of retaliation. This is unbecoming of the men who are responsible for it.

Lawyers, doctors and dentists are licensed in some way or other; that is, they are permitted by the proper legislation, which is supposed to safeguard the public, to practise their profession just as architects and engineers are. Nobody ever heard of a doctor or lawyer securing business by virtue of his ability to display on the walls of his office a piece of paper 8 x 8 in. bearing the privilege to do certain things. The documents which entitle me to call myself a structural engineer and an architect have never, to my knowledge, secured for me any business, nor do I expect that they ever will. If these laws did what they were intended to do, the engineer's and architect's licenses would mean something, and would be of value to their possessors.

The fundamental purpose of these laws is to safeguard the community by licensing only competent engineers and architects. This result is not obtained in the slightest degree, and there is not a practising engineer or architect in this state who will claim that the operation of these laws prevents the practising of incompetent architects and engineers.

If, then, these laws have failed signally in the accomplishment of the purpose for which they were enacted, why should they not be repealed and proper legislation substituted therefor? A registration law or laws permitting only upon careful and rigid examination the practise of architecture and engineering would be far more effective than the present statutes. Such a law would prevent a man from calling himself an engineer simply because he can run a level, or prevent him from calling himself an architect simply because he is a draftsman or because he has in the past had some cards printed bearing the word engineer or architect thereon. A registration law seems, in the opinion of a great many architects and engineers with whom I have discussed this question, the only feasible, logical solution of the problem, and deserves the consideration of all interested.

It seems high time that members of the two allied professions of architecture and engineering should stop the ridiculous and unseemly squabbling of which many have been guilty, to co-operate with those of the professions who are earnestly striving to place restrictive legislation on a proper basis, and in so doing place the professions and their members in a position of a dignified responsibility which they deserve.

I have been granted both a structural engineer's and an architect's license. I am mentioning this for the simple reason that I wish to make it apparent that I have no personal gain in the continuance of either license law. FRANK D. CHASE,
Licensed Architect; Licensed Engineer.
Chicago.

Justice to the Contractor

SIR: I have been reading with a great deal of interest the discussions now going on as to the powers given the engineer by specifications for certain work. This is a subject that is very difficult to handle and one in which more "horse sense" should be used than anything else.

All specifications should be clear and definite on every item, and should be drawn in such a way that there would be little or no chance for misunderstandings. In handling work there must, necessarily, be someone at the head who will take all responsibility and say "Yes" or "No" and state definitely whether a thing is right or wrong. In many instances the decisions of the engineer are rather hard on the contractor, whereas in many other instances they are equally so on the state, county or party he is representing.

If specifications were such that all disputes had to be submitted to a board of arbitration, then there would be nothing, in my judgment, ever done, for there are many contractors who would contend over the smallest details, and if there were a great deal of work going on and many contractors involved this board would have to be in session continually. The arbitration board, in a way, would constitute a court, and where there was a great deal of work going on and many disputes there would, necessarily, be many more delays on that account than if one person had full authority, under specifications well drawn, to say "Yes" or "No" and whether a thing was right or wrong.

I do not mean to say that the specifications should be such that the contractor could make no appeal from the engineer's decision, but I do believe that full responsibility should be centered in one man, and he should be the judge as to whether the work is being properly done. It all comes down to a question of judgment and the qualifications of the man who is the judge. It is a question that is very difficult to solve, as it is purely a personal one, and it has as many different sides as the persons concerned. If the contractors would only do the right thing at the right time and in the right place this matter could be easily handled and left to a board of arbitration or anyone else; but there are many instances where the contractors do not do the right thing at the right time and in the right place, and vice versa in regard to the engineer.

After thinking quite thoroughly in regard to this matter, the only way I can see that all parties concerned would be protected is by the means of well-drawn specifications—specifications that are clear in every detail; and if any unforeseen complications should arise, then the difference in cost should be mutually agreed upon between all interested before the work is started.

H. G. SHIRLEY,
Chief Engineer, Maryland State Roads Commission.
Baltimore.

Engineers' "Right-of-Entry" Act

SIR: In regard to the right-of-entry act mentioned in your current number recently enacted by the legislature of Maryland, it might be interesting to know that the State of West Virginia has protected the surveyors for many years. I believe as the law now stands on her statute books it is a model. The law reads:

"Any company incorporated for the work of internal improvements may, by its officers, servants or agents, enter upon lands for the purpose of examining the same, and surveying and laying out such as may seem fit to any officer or agent authorized by it, provided no injury be done to the owner or possessor of the land. But no company shall, under authority of this section, throw open fences or inclosures on any land, or construct its work through the same or in any way injure the property of the owner or possessor, without his consent, or until the same may have been legally appropriated to the use of the company, as is provided by the laws of the State of West Virginia, relating to the condemnation and appropriation of private property for the use of companies incorporated for internal improvements. But no person under this act shall invade the dwelling house of any person, or any space within 60 ft. thereof, without the consent of the owner, unless it be absolutely necessary for the construction of such road, by reason of its passing through a narrow gorge, defile or narrow space; provided that this act shall not apply to any city or incorporated town." (This exemption relates to the 60-ft. limit.—W. D. S.).

W. D. SELL,
Charleston, W. Va. Civil Engineer.

Locations for Mining Experiment and Safety Stations Selected

Locations for two of the three mining experiment stations and the three mine-safety stations provided for by Congress have been announced by the Secretary of the Interior. The first experiment station is to be located at Fairbanks, Alaska, the second at Tucson, Ariz., and the third, not yet definitely announced, in the Pacific Northwest. The safety stations will be at Butte, Mont., Reno, Nev., and Raton, N. M. The sum of $25,000 is appropriated for each of the mining experiment stations and $101,-500 for the three safety stations.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Pneumatic Placing Saves Space in Concreting Retaining Wall

By D. S. STUDDIFORD
P. J. Joyce & Company, Inc., Pittsburgh, Pa.

PNEUMATIC placing was used to advantage in building retaining walls and abutments containing some 30,000 yd. of concrete on the grade-separation work of the Baltimore & Ohio Railroad in Pittsburgh, described on page 797 of the Engineering Record for June 17, 1916. Ordinary methods might have been employed for concreting the piers and abutments, but the retaining walls were located so close to main-line tracks over which traffic was maintained that lack of space precluded the satisfactory use of such methods.

An electrically driven air compressor was set up on vacant ground just off the right-of-way about midway of the length of the walls. From this plant, which had a capacity of 2200 cu. ft. of free air per minute, a 6-in. pipe line 2000 ft. long conveyed air to the mixing plant. The mixer, a ½-yd. Type B machine made by the Pneumatic Placing Company, Inc., was located under a gravel bin of 40 yd. capacity and a sand bin of half this size. Adjoining the bins was the cement house, holding four car loads. The bins were fed by a 20-ton crane. Cement was unloaded into the house direct from railroad cars, and conveyed to the mixer on a track running lengthwise of the house. Two measuring tanks were used, one filling as the other discharged. A perforated pipe circling the top of the mixer insured an even distribution of water and produced a uniform mix for each batch.

Instead of being shot directly into the form, the concrete was conveyed through an 8-in. pipe to a hopper placed on top of the traveler which supported the Blaw wall forms. This was found to be more satisfactory from the standpoint of separating the stone from the grout than to have the pipe discharged into the form direct. Wooden chutes leading to various parts of the form distributed the concrete from the hopper, the flow being controlled by gates. The form sections were 65 ft. in length and 20 ft. high. As the hopper was fastened to the top of the traveler, it moved with the traveler when the form was moved. The only work necessary to resume concreting was to insert extra lengths of pipe in the delivery line.

The quantity of concrete placed varied with the distance of the form from the mixing plant. It was found that at a distance of 400 ft. about 35 cu. yd. per hour could be placed, while at 900 ft. the quantity fell to between 25 and 30 yd.

Only the actual space for setting up the forms was required by the side of the main-line track, and it was possible to locate both the air plant and the concrete plant where vacant space was available. One setup of the mixing plant, which was constructed so as to be easily taken down and moved, sufficed to concrete 900 ft. each way, or a total stretch of 1800 ft. P. J. Joyce & Company, Inc., are contractors for the work.

Truck Hauls 30-Ton Industrial Trains on Road Jobs

INDUSTRIAL trains of 12 and 13 cars are being hauled by a Four-Wheel Drive automobile truck, which straddles the narrow-gage track, to transport material for a concrete road being built near Sioux City, Iowa. Ten round trips are made daily, and the contractors, Hanlon & Oakes, estimate that 50 teams have been replaced by the railroad.

Two trains of 1½-yd. cars are used to transport the crushed rock, sand and cement. One is loaded while the other is making the 3½-mile trip to the end of the first section of pavement. The truck pulls these trains with apparent ease in high gear at speeds of 10 to 15 miles per hour, making 2½ to 3 miles on a gallon of gasoline. Although no load is carried on the body of the truck, it is stated that ample traction is secured. It is asserted that on one occasion both trains, fully loaded, were coupled together and pulled by the truck around a sharp curve on a 5-per cent grade —the most difficult stretch on the railroad.

To facilitate charging the mixture, the cars are pushed up an incline at the end of the line. The truck is cut loose from the train for this purpose and run alongside the incline behind the cars, pushing them with a pole. The highway, known as the Prairie Creek Road, is 16 ft. wide, and is being built at the rate of 500 to 600 ft. per day.

Field-Office Accounting: The Payroll

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company, Scranton, Pa.

PRACTICALLY all settlements due the contractor are made on a monthly basis, but modern legislation in most states demands that the employee be paid weekly or bi-weekly. To avoid confusion in figuring monthly cost, it is expedient to make out payrolls on a quarter-monthly or semi-monthly basis. For months containing 30 days, where weekly payments are required, let the first quarter-month cover eight days, the second seven, the third eight, and the fourth seven. For months containing 31 days, let the first three quarters be of eight days each.

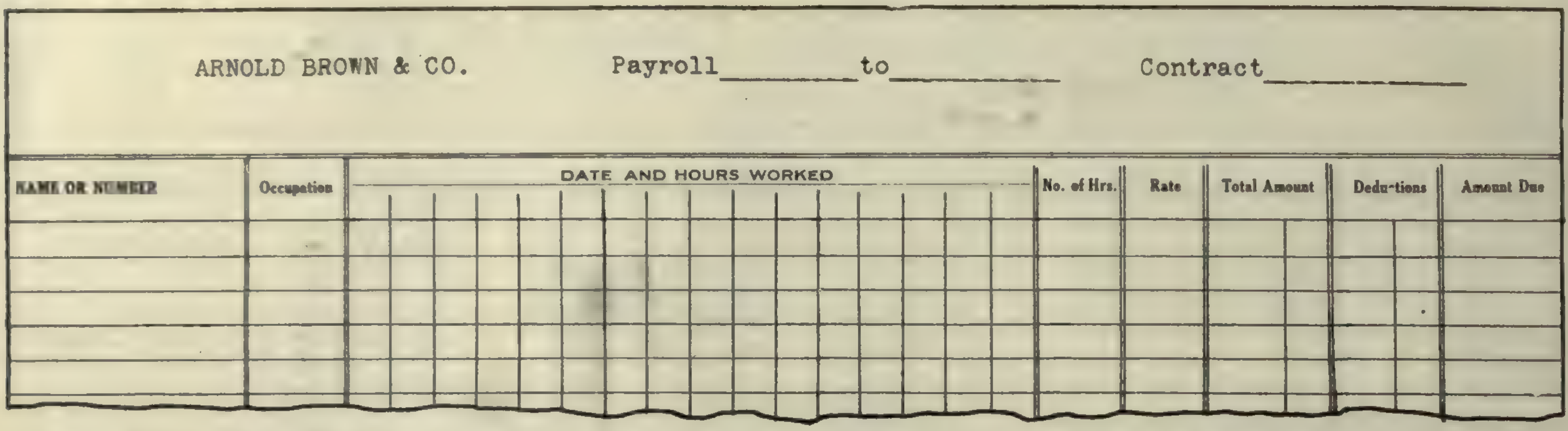
An elastic payroll form which meets most conditions is shown on page 182. Additional columns for specific deductions will no doubt be found advisable in some cases.

Sixteen columns being provided for daily time, this form is readily adaptable to a weekly or semi-monthly payroll. It should be printed on paper not too heavy for pencil and carbon work, padded, or perforated at the left-hand margin and bound in paper covers. The carbon copy of the payroll should be held at the field office for future reference, the original being forwarded to the general office. It will be noted that this form combines the time book with the payroll, forming a complete permanent record of each employee's account. The time can be entered from day to day, from the daily reports, and the extensions carried out at the end of the payroll period. At the end

	Total	Deductions	Net
1st week	$460.00	$60.00	$400.00
2nd "	500.00	30.00	470.00
3rd "	450.50	40.50	410.00
4th "	250.00	30.00	220.00
	$1,660.50	$160.50	$1,500.00

Distribution		
Excavation	$245.00	
Sheeting	300.00	
Foundation Concrete......	750.00	
Wing Walls..............	100.00	
Reinforced Concrete......	120.00	
Repairs	45.50	
Local Office..............	100.00	
To R. Sanders, Agt.... (cash advances)		$160.50
" General Office....... (per paymaster)		1.500.00
	$1,660.50	$1,660.50

MOTOR TRUCK STRADDLES INDUSTRIAL TRACK TO PULL 30-TON TRAINS OF MATERIAL CARS ON ROAD JOB NEAR SIOUX CITY, IOWA


ARNOLD BROWN & CO. Payroll________to__________ Contract___________

NAME OR NUMBER	Occupation	DATE AND HOURS WORKED	No. of Hrs.	Rate	Total Amount	Dedu-tions	Amount Due

ELASTIC PAYROLL FORM THAT CAN BE USED FOR EITHER THE QUARTER-MONTHLY OR THE SEMI-MONTHLY BASIS OF PAYMENT

of the final payroll sheet for the month, or on another sheet if desired, summarize the payroll shown on the previous page.

The payroll sheets should measure 17 in. from left to right and 11 in. from top to bottom. When folded across from left to right they will then fit comfortably into the same size drawer as that ordinarily used for filing correspondence. Write on the back, just below the fold, the name of the contract, the month and the year.

The payroll can then be filed readily, with others, in alphabetical and chronological order at the general office. The duplicate can be filed in similar manner at the field office, or slipped on to a "Shannon," whichever proves most convenient.

Building-Foundation Specialists Use Sectional Forms

THE success attained by a firm in Chicago employed as subcontractor exclusively in constructing concrete foundations for buildings is attributed by it to rapid delivery of materials by motor trucks, greatly simplified forms requiring a minimum amount of lumber and careful study of non-freezing compounds, permitting it to lay concrete in cold weather and to guarantee the quality equal to that laid in summer.

Sectional wood forms are used for practically all basement walls 9 ft. or less in depth. The forms vary from 3½ to 4½ ft. in width and 4 to 9 ft. in length. For greater depths than 9 ft. it has been found more practical to use special forms of loose lumber.

When using the built-up sectional forms the concrete footings are put in first. The forms for the outside of the wall are then set up; but before erecting a form section strips of 28-gage hoop steel, about 1 in. wide and of sufficient length to nail to the outside of the frame of the outer form, extend across the wall at the bottom and permit nailing to the inside of the frame of the inner form. When the inner forms are set up, by placing wood wall gages between the side forms at the bottom, drawing the steel hoops taut and nailing them on the inside of the frame of the inner form, the lower part of the form is held securely on the footing. At intermediate distances between the bottom and top of the forms wood wall gages are inserted and the forms wired together, the wires extending around the lateral bracings of the forms. At the intersection of forms the sections are tied together by diagonal wiring. Adjacent forms are nailed together through the side frames, the nails used for this purpose being of sufficient length so that when driven to the heads the points protrude on the opposite side a considerable distance. This method of nailing affords great holding strength and permits driving back the nails when it is desired to remove the forms without injury to the frames. At the top the forms are held by U-bar hoop steel nailed to the outer sides of the forms on either side.

When these forms are properly set up with sufficient wall gages, wired, nailed at the intersections and secured with the steel hoop bands at top and bottom, the entire construction is very rigid and only a small amount of bracing on the sides is required to steady the forms against shock.

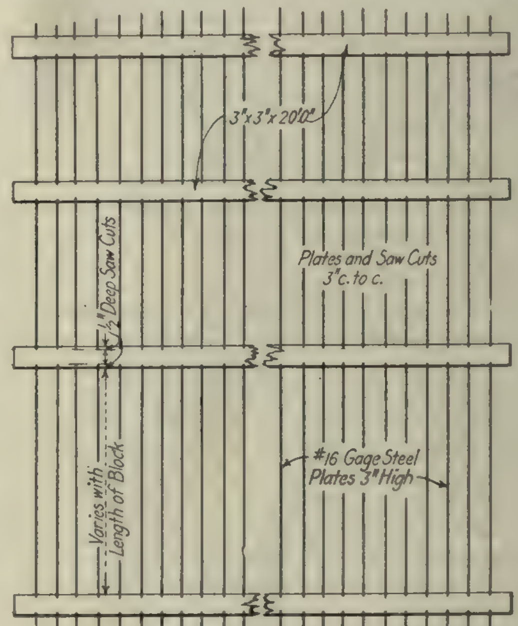
The work of erecting forms and placing concrete begins practically at the same time, and on many foundations of moderate size a skilled crew is able to erect all forms for the basement in a few hours.

Ten portable Standard mixers are used by this firm, F. Johnson & Company. They are moved along as the work progresses, so that most of the concrete is spouted directly to the forms.


SECTIONAL BASEMENT FORMS STRAPPED TOP AND BOTTOM REQUIRE LITTLE BRACING

Concrete Blocks, to Support Reinforcing, Simply Made

CONCRETE BLOCKS of three lengths, to support reinforcing steel, were economically made by the thousand, with the use of forms illustrated herewith, in building the plant of the Baldwin Locomotive Works described on page 160 of this issue. In 20-ft. lumber, dressed down to 3 x 3-in size, saw cuts ½ in. deep were made at 3-in. intervals on opposite sides. A casting platform, on which these pieces were spaced at the proper intervals, was built in a back yard across the street from the plant. Metal plates 3 in. high, and of



FORMS FOR CASTING SMALL BLOCKS BY THE THOUSAND

No. 16 gage, were fitted in the saw cuts, between adjoining pieces. As the 3-in. square concrete blocks were required in 6, 7, and 11-in. lengths, these plates were cut 7, 8, and 12 in. long.

A thousand blocks were cast on every alternate working day. The total number of each length of block required was determined and a proportionate number of each length made at each casting. This was readily done by spacing a certain number of the wood pieces with 7-in. plates, a certain number with 8-in., and the rest with 12-in. plates. Concrete was shoveled into these forms, and the whole struck off level as it was filled. When the concrete was set, the plates and blocks were loosened and removed by raising the wood pieces. The forms were scraped and oiled after each use. About 30,000 blocks in all were made in this way.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Electric Spark Said to Have Caused Tunnel Disaster

Nine Men Still Buried in Cleveland Tunnel—Spark from Electrical Wires Given Unofficially as Cause of Accident

The taking of testimony in the investigation of the West Side tunnel disaster at Cleveland has been concluded by Mayor Harry L. Davis and W. S. Fitzgerald, director of law, who have decided that no one is directly to blame. Indifference all along the line, ranging from a feud between the waterworks' and city chemists' offices to the carelessness of an assistant superintendent in taking a full gang into the shaft before he had been ordered to do so, and the sending of men into the heading without waiting to see the results of analyses of air samples, are unofficially given as causes of the accident.

Nine men who went into the tunnel at 8 p. m. July 24 are still trapped. Ten men died trying to rescue them. Federal mine inspectors have refused to permit clean-up gangs to enter the tunnel because of the presence of methane in quantities up to 5 per cent. Gas was probably present in much greater quantities at the time of the accident.

Gustav C. Van Dusen, superintendent of construction, says that the electrical equipment was the cause of the disaster. The tunnel was lighted by electricity, and an erector, used to place the concrete blocks which line the shaft, is run by a small motor. A spark from this motor or the breaking of an electric light bulb was the real cause, according to Mr. Van Dusen.

Details of Tunnel

The tunnel is 10 ft. in diameter and extends 16,000 ft. out into Lake Erie from crib 4, which is 7500 ft. from shore. When tunnel construction was first undertaken crib 5 was built 16,000 ft. out from shore and work started at both cribs. The tunnel has been built 13,300 ft. out from crib 4 and 1200 ft. in from crib 5, leaving only 1500 ft. to be completed. It was at the heading of the toward-shore section being built from the outer crib 5 that the disaster occurred.

The gang of nine men, all of whom are dead and still in the tunnel, went to work at 8 p. m. July 24. At 9.22 p. m. came the explosion, preceded, according to a surviving air lock tender, by a flash. The air lock is about 1000 ft. from the heading and the air pressure about 22 lb. Federal mine inspectors have concluded that a gas well, instead of a pocket of gas, was struck. That theory was adopted because the gas has come out strong for seven days, and sand and gravel, instead of blue clay, were thrown up.

Tunnel workers who have gone into the tunnel since the explosion say the force of the blast was so strong that not a whole tie remains. Rails have been twisted out of shape, it is reported, and pieces of electrical wiring were driven 3 or 4 in. into timbers. It is feared that the entire end of the tunnel where the bodies of the men are held has been completely wrecked.

According to Thomas S. Farrell, director of public utilities, the tunnel will be cleaned out, the damage repaired and a new heading put in. The tunnel end being built from shore will then be projected into this outer end.

THIS WEEK
Prices of Materials—Contracting News Section

Munitions Explosion Causes Loss of $20,000,000

Six Cars of Dynamite Blown Up on Black Tom Island, Jersey City, N. J.—87 Cars of Shells Fired — Warehouses Destroyed

As the result of a fire on the deck of a barge loaded with explosives a series of terrific explosions at Black Tom Island early last Sunday morning caused immense damage in the vicinity of Jersey City, N. J. The fire spread rapidly and in a remarkably short time a string of cars loaded with dynamite was clothed in flames. When they exploded an immense hole was created into which the water rushed to form a lake. Latest reports give the number killed as six and four others missing.

The National Storage Company, whose plant is on Black Tom Island, suffered the greatest damage. Of twenty-four warehouses, five were blown up and eight more were burned, entailing an estimated loss of $12,000,000. The Lehigh Valley Railroad lost about 85 cars and suffered damage to its tracks, tugs and grain elevator amounting to nearly $1,000,000. On Bedloe's Ellis and Governor's islands the building loss was estimated at $150,000, while in New York City and several Jersey towns the explosions are thought to have broken more than $1,000,000 worth of window glass. According to the information given out by the Public Service Commission, no damage was done to any of the under-river tunnels by the Jersey explosions.

Hearing August 15 on Proposed San Francisco-Oakland Bridge

A public hearing will be held Aug. 15 at San Francisco and Aug. 17 at Oakland on the proposed bridge to connect those cities. The Associated Bridge Engineers, Cleveland, has prepared preliminary plans and estimates for the 5-mile structure. The length across the bay will be about 3 miles. Reference to the project was made in this journal July 1.

The estimated cost of $22,000,000 is based on the assumption that 250-ft. steel trusses will be placed on concrete cylinder piers resting on piles. Two spans of 600-ft. lateral and 100-ft. vertical clearances are included in the preliminary plans, as well as two liftspans of 210 ft. vertical clearance. The preliminary plans provide for four railroad tracks—two for overland and two for interurban traffic. Three roadways are also provided, one exclusively for automobiles and two on outside brackets for slow-moving traffic.

The board of engineers to review the plans and estimates is composed of the following U. S. Army engineers: Lieut.-Col. Thomas H. Rees, San Francisco; Lieut.-Col. Charles L. Potter, Portland, and Major George B. Pillsbury, Los Angeles. The Associated Bridge Engineers for the San Francisco-Oakland bridge is composed of Wilbur J. Watson & Company, Cleveland; William Russell Davis, Albany, and Harlan D. Miller, Albany and Oakland.

Remove Last Legal Obstacle to Cleveland Union Station

The last legal obstacle to the reconstruction of the Cleveland Union Station, used by the New York Central and Pennsylvania systems, was removed July 27 by Congressional legislation authorizing the purchase of the site of the U. S. Marine Hospital.

Indianapolis Water Company Appraisal Completed

Commission's Engineer Reduces Reproduction Cost of Water Rights to Value of Service —Does Not Allow Going Value

A valuation of the Indianapolis Water Company has just been completed by H. O. Garman, chief engineer of the Public Service Commission of Indiana. The figures are subject to revision by the commission itself. As they stand they give the company a reproduction cost new of $8,252,435 and a present value of $7,625,114. No allowance is made for going value or franchise rights. For water rights a lump allowance of $750,000 is made, this figure including the old canal, dams and other structures having an estimated "present value" of $971,456. An allowance of 12 per cent is intended to cover engineering, superintendence, interest and taxes during construction and like factors.

Comparative Values Discussed

The appraisal makes no attempt to go into the question of going value. As to the reduction in the figure for water rights as compared with the reproduction cost of the physical plant, this is justified on the ground that the reproduction-cost method cannot reasonably be applied where the service is not needed and worth its cost to the consumer, that the canal is used only in part for the purpose for which it was constructed and therefore lacks adaptability and is uneconomical and that the allowance of $750,000 is approximately "the capitalized apparent saving in the operating of a hydraulic pumping plant and a steam pumping plant at West Washington Street."

A value of $40,000 less than nothing is found for the water rights in Fall Creek in the vicinity of Schofield Mills, where a new pumping plant has been installed during the last few years. The appraisers contend that, including the fixed charges, it will cost at least $2,400 more per annum to operate the hydraulic plant than it would to operate a steam plant of the same capacity.

Ohio Engineer Battalion Ready for Mexican Service

The Ohio Engineer Battalion of three pioneer companies and one additional company, all from Cleveland, is now mobilized at Camp Willis, Columbus, Ohio. The four companies have been mustered and physically examined for federal service. About three-fourths of the original strength of 672 officers and men are now in camp.

Major Fred M. Fanning of Cleveland is in command of the battalion. Applications for enlistment from a few more engineers and from men with training in engineering or trades useful in engineering work will be received.

Probably the two companies of Michigan engineers which are a part of the same army division will be joined with the four companies of Ohio engineers to form a full regiment under Lieut.-Col. John R. McQuigg.

Washington Raising Engineer Company

Paul P. Whitham, consulting engineer, of Seattle, Wash., has been commissioned by the federal army authorities to form an engineer corps in that city. A similar body is being organized at Spokane.

Must Connect Sewer and Water Pipes Prior to Paving

The supreme court of Indiana has upheld the authority of city officials to require property owners to put in sewer and water connections to the lot line prior to the paving of the street or to have the connection made by men employed by the city and collect the cost from the lot owner. The decision affects utility companies and property owners in every city in Indiana.

The city of Angola, in July, 1912, passed an ordinance requiring the owners of property fronting on Maumee Street to make sewer and water connections to the lot line with lead pipes. Where the connections had previously been made with iron pipes they were to be supplanted with lead pipes. The ordinance was in contemplation of paving Maumee Street. The owners of some of the lots refused to comply with the ordinance. The city made the connections and sought to collect the cost from the property owners.

The owners filed suit for an injunction to prevent the collection of the cost of the improvement. They claimed that the ordinance was void, as the city had not complied with the formalities necessary to make an assessment for a street or sewer improvement.

The supreme court held that the statute under which the ordinance is authorized and the improvement made contemplates a police control of the city over such matters as the sewer and water connections and that it was not necessary to serve notice. The court in passing on the question said:

"The statute provides that the assessment, when fixed on property, shall be collectible as other assessments for street and sewer assessments, but this has reference to the manner in which the assessment shall be collected and not to the procedure by which it shall be created.

"It was the evident purpose of the legislature to confer the power on cities to enforce the making of these connections in summary way under the police power. The legislature determined in advance that each lot affected would be specially benefited to the amount of the cost of such connections. It empowered the city to make the improvement and consider the cost thereof a lien against the property benefited, on default of the owner's making such connection."

Engineers Continue Recruiting Campaign

The Twenty-second Corps of Engineers, National Guard of New York, is appealing to engineers to join the engineer regiments of the National Guard. A pamphlet describes the duties of members of the engineer corps and further emphasizes as essential to the greatest success of such organizations the necessity of field service rather than the perusal of text books. Letters from J. Waldo Smith, chairman of the Military Engineering Committee of New York; R. S. Buck, chairman of the executive committee of the engineers' training battalion, and William Barclay Parsons, chairman of the Joint Committee of the Engineering Societies, enumerate the advantages of joining the depot battalion.

Lake Spaulding Dam Is Being Raised to Height of 260 Feet

The Pacific Gas & Electric Company, San Francisco, July 25 awarded a contract to Twohy Brothers for raising the Lake Spaulding dam 25 ft. That will bring the total height to 260 ft. and increase the capacity from 43,500 to about 65,000 acre-feet. The work is to be finished by Dec. 1. This increase in height is in accord with the original program, which called for a raise of 35 ft. and another increase of 45 ft. to make the ultimate total height 305 ft.

Flood-Control Bill Held Over by Senate Until December

The flood-control bill passed by the House of Representatives May 17 has been laid over by the Democratic caucus until the December session. The bill provides for the expenditure by the Mississippi River Commission of $10,000,000 annually for improvement of the Mississippi until the total of $45,000,000 is reached. Provision is also made for the expenditure of $5,600,000 at the rate of $1,000,000 annually for the improvement of and control of floods on the Sacramento River.

769 Pass Latest Examination for Valuation Positions

Of 1448 who took the examination last November for senior positions in the lower grade for the government valuation work, 769 passed. The detailed results are as follows:

Title of position	Eligibles	Ineligibles	Total
Senior civil engineer	254	184	438
Senior architect	82	23	105
Senior electrical engineer	20	69	89
Senior land appraiser	220	178	398
Senior mechanical engineer	13	47	60
Senior signal engineer	13	5	18
Senior structural engineer	93	58	151
Senior telegraph engineer	6	38	44
Senior telephone engineer	68	77	145
Totals	769	679	1448

San Fernando Water Bonds Invalidated by Error in Boundary Description

Los Angeles will be compelled to call two special elections, one in the Hollywood and Colegrove district and another in the Mission land district, to revote bonds for water-distributing systems. An error in the description of boundaries in the recent proceedings is the cause of the action. It has been announced by City Attorney Stephens and Special Counsel Mathews of the Los Angeles water department that because of this error the $1,020,000 bonds voted for the Hollywood waterworks system and the $300,000 bonds for the Mission land system are invalid.

President Signs Harbors Bill

President Wilson July 27 signed the rivers and harbors bill appropriating approximately $42,000,000 for several new projects and the continuance of old ones.

Engineering Society Activities

The Engineers' Club of St. Louis will hold the annual steamboat excursion Aug. 11 on the steamer "Alton." The society is taking an active part in military engineering preparedness and recruiting a battalion of engineers.

The Associated Technical Men, Chicago, recently elected the following officers: President, H. J. McDargh; secretary, C. C. Hotchkiss; treasurer, J. G. Mensch.

The Engineers' Club of New York, at a special meeting of the board of management this month, resolved that the dues of members who answered the call of Mexico shall be remitted for such period as they may be absent on duty. The names of those members will also be placed on a roll of honor and posted on the club's bulletin board.

The City Engineers of Washington held a meeting July 17 in Seattle, at which Hans Mumm, city engineer of Everett, presided. A resolution was adopted providing for a committee of three to arrange for future meetings and prepare a plan for the organization of all city engineers in the state. The plan will be thoroughly discussed at the meeting of the League of Washington Municipalities to be held in Everett Oct. 17.

What Engineers and Contractors Are Doing

H. O. KELLEY, whose promotion from assistant to division engineer of the Evansville & Indianapolis Railroad was noted in the June 3 issue, has been made engineer maintenance of way. The change is in title only and does not affect Mr. Kelley's duties. He will continue to make his headquarters at Terre Haute, Ind

B. B. SHAW, formerly assistant engineer for the Chicago, Rock Island & Pacific Railway, has been promoted to the position of engineer of the Arkansas division. His headquarters are at Little Rock.

W. R. ARMSTRONG has resigned as chief engineer and general manager of the Salt Lake & Utah Railroad to become engineer maintenance of way for the Union Pacific Railroad, with office at Omaha. After nearly fourteen years' experience in the engineering and operating departments of different railroads, Mr. Armstrong went to the Oregon Short Line in 1905. He was employed on special engineering work during his first year with that road and later had charge of construction of the Yellowstone Park branch and of the line from Huntington to Homestead, Ore. His promotion to the superintendency of the Montana division followed in 1908. He was made chief engineer and general manager in 1913.

F. TAPLEY, formerly assistant engineer for the Canadian Pacific Railway, has taken a similar position with the Canadian Government Railways (Intercolonial) at Moncton, N. B.

CHARLES F. HINCHMAN, assistant engineer maintenance of way at Mount Carmel, Ill., since January, 1914, has been made engineer maintenance of way of the newly created Indianapolis terminal of the Cleveland, Cincinnati, Chicago & St. Louis Railway. He was born at Detroit in 1882 and was graduated from the University of Michigan in 1904. His first experience in railroad engineering was with the Big Four in 1908 as assistant on the engineering corps. For two years, from 1909 to 1911, Mr. Hinchman was employed on interlocking and bridge work, after which he was again made assistant on the engineering corps. His appointment as assistant engineer followed in 1914.

FRANK SCOTTEN, construction superintendent for the Montana Power Company, Holter, Mont., is now engaged on the construction of a 66,000-hp. hydroelectric plant near that city. The length of the dam and intake is about 1300 ft. and the maximum height 130 ft. The station, which is designed to use 6000 cu. ft. per second, will be in operation about September, 1917.

F. D. BATCHELLOR, district engineer maintenance of way of the Cincinnati, Hamilton & Dayton and the Baltimore & Ohio Southwestern railroads at Cincinnati, has had his jurisdiction extended to include the Northwest district of the Baltimore & Ohio. Early in 1913 he was promoted from division engineer to assistant to the general superintendent at Cincinnati. Later in that year he was made assistant superintendent of the Toledo division, and from there was transferred to Cincinnati as district engineer.

E. G. LANE, formerly engineer of the Northwest district of the Baltimore & Ohio Railroad, has been appointed engineer maintenance of way of the Western lines of the Baltimore & Ohio and the Cincinnati, Hamilton & Dayton.

E. J. CORRELL has been promoted from division engineer of the Baltimore & Ohio Southwestern to district engineer maintenance of way of the Southwest district.

PROF. A. N. TALBOT of the University of Illinois and Prof. George F. Swain of Harvard University and Massachusetts Institute of Technology have been chosen as two of the arbitrators of the dispute that has arisen over plans for the rehabilitation of the Galveston causeway. The three steam railroads interested asked Professor Talbot to serve on the committee. Professor Swain was the choice of the interurban railway and the county, who oppose the plans advocated by the three steam roads. Professors Talbot and Swain are to agree upon a third member of the arbitration board.

E. E. HERTH has been promoted from assistant division engineer for the Baltimore & Ohio Southwestern Railroad at Seymour, Ind., to division engineer at Flora, Ill.

F. A. NOETZLI has resigned as instructor in civil engineering at Lehigh University to become associated with Charles C. Hopkins, consulting engineer, Rochester, N. Y. He is employed as resident engineer on the construction of a reinforced-concrete filtration plant at Perry, N. Y. After graduation from the Swiss National Polytechnic Institute at Zurich in 1911 Mr. Noetzli made a topographic map of a part of the Swiss National Park. He was later connected with the surveying department of the Loetschberg railroad, following which he spent a year as designing engineer and inspector on reinforced-concrete construction in Rome. He was a professor at his alma mater for the year preceding his coming to the United States. His first position in this country was with the Carnegie Steel Company at Baltimore. He went from there to Lehigh University.

WILLS, LUDWIG & COMPANY, a new building-contracting firm, have opened offices in the Middle City Building, Philadelphia. A. E. Wills has for the last 10 years been connected with the firm of Henry L. Brown of that city. E. E. Ludwig, structural engineer, was until recently employed by the city of Philadelphia.

GEORGE W. NORRIS, director of wharves, docks and ferries of the city of Philadelphia, has been named by President Wilson as one of the members of the Farm Loan Board of the new federal farm-loan system created by the rural credits act of July 17. After graduation from the University of Pennsylvania Mr. Norris spent six years in newspaper work. He began the practice of law in 1886 and later, in 1894, entered the bond-investment business. He was made director of wharves, docks and ferries in 1911 and in that position became quite well known to engineers interested in harbor development.

W. R. MCCANN, after serving for a year as private secretary to Commissioner Walter A. Shaw, has been appointed by the State Public Utilities Commission of Illinois as its valuation engineer. Prior to joining the Illinois commission Mr. McCann spent several years on the Panama Canal in charge of electrical design and construction.

DION MARTINEZ, who has been employed by the city of Philadelphia since 1912, has been made principal assistant engineer of subway construction in the department of city transit. Mr. Martinez assisted in the preparation of the report presented by the Philadelphia transit commission in 1912, and when the department of city transit was organized in 1913 he was placed in charge of the acquisition of field data. Later he prepared specifications for and had charge of the construction of the subway and elevated lines and the sewers necessary to drain the subway loop. Before entering the Philadelphia transit department Mr. Martinez was engaged by various United States government commissions in Spanish-American countries and carried on a private consulting engineering practice in Cuba.

CHARLES F. PUFF has been promoted from surveyor and regulator in the Bureau of Surveys of Philadelphia to assistant engineer in that bureau. He first took up engineering work in 1900, and after a year's field work studied mathematics and engineering at Temple University. From 1903 to 1905 he was employed by the Philadelphia Bureau of Filtration, and the American Pipe & Construction Company claimed him as resident engineer for the following three years. He joined the Bureau of Surveys in 1908, but resigned in 1912 to become city-planning engineer for Newark, N. J. After a short experience there he returned to the Philadelphia Bureau of Surveys, where he has since been employed.

ROBERT M. PATTERSON, special agent in the general manager's department of the Pennsylvania Railroad, was recently placed on that road's "Roll of Honor." Mr. Patterson was educated at the University of Pennsylvania and after graduation in 1870 joined the engineer corps of the Northern Pacific Railroad. He went to the Pennsylvania three years later as assistant supervisor and assistant trainmaster. After five years' service he resigned to practise engineering in Virginia. The year 1882 found him once more engaged in railroad work, as division superintendent for the Buffalo, New York & Philadelphia Railroad. He returned to the Pennsylvania in 1885 as special agent in the office of the general superintendent of transportation. He was successively superintendent of the Kensington and New York divisions, general superintendent of the Pittsburgh terminals and superintendent of freight transportation. His appointment as special agent in the general manager's department came in May of this year, preceding his retirement by only a few months.

COL. JOHN MILLIS, Corps of Engineers, U. S. A., has been transferred from Newport, R. I., to become engineer of the Southeastern division, with office at Savannah, Ga. Colonel Millis has had charge of the Newport district since 1912, and while stationed there served as senior member of the special board that made surveys for a barge canal from Toledo to Chicago.

COL. WILLIAM E. CRAIGHILL, Corps of Engineers, U. S. A., stationed at Boston, has been temporarily appointed to succeed Col. John Millis at Newport, R. I.

STUART K. KNOX, who for the last eight years has been principal assistant engineer for Nicholas S. Hill, Jr., consulting engineer, of New York City, has been made a member of the firm of Nicholas S. Hill, Jr., and S. F. Ferguson. Mr. Knox was graduated from the University of Michigan in 1903, after which he joined the U. S. engineer's office at Muskegon, Mich. In the spring of 1904 he went to Texas, where he was employed on surveys during that summer. He came to New York City in the fall to enter the employ of the Thompson-Starrett Company as timekeeper. After eleven months in that capacity he was promoted to superintendent of construction, and his appointments as engineer and estimator, and superintendent in full charge followed shortly. Mr. Knox entered the employ of the Foundation Company late in 1907, but resigned after a few months to become associated with Mr. Hill.

W. C. A. PALMER, who has been engaged in engineering work in the Philippines for the last eight years, is now in the United States on extended leave of absence. He has just completed an extensive tour of Spain and the Orient. Mr. Palmer has for the past year been the district engineer of the Province of Occidental Negros, one of the richest islands of the Philippines. He will leave the United States about the first of the year.

HOWARD W. MORGAN has resigned as senior engineer for the Milwaukee (Wis.) Sewerage Commission to become associated with the Dorr Company, engineers, New York City. Mr. Morgan is a graduate of the Michigan College of Mines and was for several years engaged in mining and metallurgical work. He joined the Milwaukee Sewerage Commission early in 1914. He will now specialize on sewage-sedimentation problems.

L. L. BROCKMAN, who has been in the employ of the Louisville & Nashville Railroad, the U. S. Government and the Robert Bruce Construction Company, Indianapolis, was last heard of in Cleveland. His relatives, who have had no communication from him since last March, have requested the Engineering Record to publish this note, hoping that any of Mr. Brockman's friends who know his whereabouts will assist his family in locating him. Letters addressed to this journal will be forwarded to the proper persons.

JOHN V. W. REYNDERS, who recently resigned as vice-president of the Pennsylvania Steel Company in charge of the Steelton plant, has opened consulting engineering offices in the Equitable Building, New York City. His experience in steel construction covers a period of 30 years. He is largely responsible for the prominent place the Steelton plant now holds, and it was through his efforts that those properties remained operative when they were acquired by the Pennsylvania and other railroad interests. Mr. Reynders was graduated from Rensselaer Polytechnic Institute in 1886, and in the fall of that year entered the employ of the Pittsburgh Bridge Company. After nearly two years with that firm he had a brief experience with Snead & Company, which was followed by his appointment in 1888 as designer and computer for the Pennsylvania Bridge Company. The following year he was made shop inspector under George S. Morison for the Union Bridge Company at Buffalo, N. Y., and Athens, Pa. Early in 1890 he was appointed to a position with the Pittsburgh Testing Laboratories, but resigned after about eight months' service to become engineer in the bridge and construction department of the Pennsylvania Steel Company. He was promoted to the superintendency of that department in 1892 and a few years later was placed in complete charge of the Steelton plant.

Obituary Notes

FRANK H BRITTON, president of the St. Louis Southwestern Railroad, died last week at his home in St. Louis. He was 66 years old and had been president of the Cotton Belt for seventeen years.

ERNEST G. BARROW, city engineer of Hamilton, Ontario, for thirteen years, died at Toronto July 22. He was employed on the construction of the first sewage-disposal plant in Canada and also assisted in planning the high-level bridge at Hamilton. Since 1909 he has been a member of Barrow & Hunting, contractors, of Toronto.

Civil Service Examinations

United States.—Examinations will be held Aug. 8 at the usual places for structural-steel draftsmen at $4 to $8 per day. Another for senior highway engineer, salary $2,200 to $4,000, will be held Aug. 8. An examination for mechanical draftsman, salary $1,000 to $1,200, will be held Aug. 22. One for laboratory assistant, salary $900 to $1,200, will take place Aug. 23 and 24. Form 1312 should be filled in by applicants for these positions. Examinations for aid in U. S. Coast and Geodetic Survey and draftsman in the engineer department will be held Sept. 13. Further information may be obtained at the usual places.

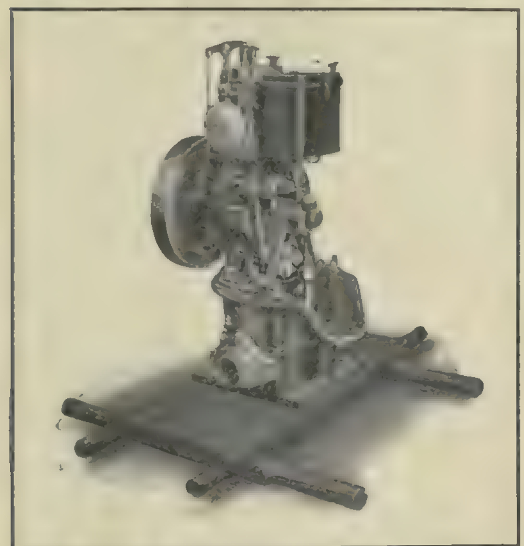
Examinations Previously Announced

Date		See Eng. Record
Aug. 5.	Assistant Sanitary Engineer, Illinois	July 8
Aug. 21-25.	Second Lieutenant, civilian candidates	April 1

Trench Pump Operated by Gasoline Engine or by Hand

Those of our readers who have excavating problems will be interested in a new optional power or hand pump suitable for excavating soft or fluid materials, recently placed on the market by the Edson Manufacturing Company of Boston, Mass. The outfit consists of an Edson air-cooled gasoline engine attached to an Edson No. 3 diaphragm-trench pump, which in turn is mounted on a wooden skid (as shown in the illustration) or a four-wheeled hand truck, depending on the intended use.

The engine is bolted to the pumphead in



PUMP MOUNTED ON SKID

such a way as to be readily detached should it be necessary to operate the pump by hand. It will exert a pull or lift of 1000 lb. per stroke and is guaranteed to drive the pump to its full capacity at a fuel cost of two to five cents per hour. In order to limit the weight as much as possible, an air-cooled type of motor was adopted, with the result that the complete outfit may be readily transported from place to place by two men. "Drawn-into-gear" accidents have been entirely eliminated by carefully guarding all gears.

In a recent test conducted by D. A. Sutherland, superintendent of the water department of Lynn, Mass., two of these Edson outfits were used continuously for sixty-six days, and in this time pumped 9,000,000 gal. of water and sand. One gallon of gasoline was sufficient to run a pump 12 hours and the work of each was equivalent to that of four men using a hand pump.

John H. Allen Is Dead

John H. Allen, for the past fifteen years president of the John F. Allen Company, New York City, died July 22 at his home on Kattskill Bay, Lake George, N. Y. Mr. Allen was in his fifty-eighth year and was for many years an active member of the board of trade of the Borough of the Bronx, New York City.

Organize New Turbine Company

The Moore Steam Turbine Corporation, Wellsville, N. Y., has been organized with an authorized capitalization of $160,000 to build an improved type of single and multi-stage steam turbine in sizes from 5 to 1000 hp.

The officers of the corporation are: J. L. Moore, president, formerly chief engineer of the Kerr Turbine Company; J. B. Laird, vice-president, formerly factory manager of the Kerr Turbine Company; E. D. Spicer, secretary and treasurer, formerly chief draftsman and acting chief engineer of the Kerr Turbine Company.

Plans have been drawn and the contract will be let at once for a modern fireproof reinforced-concrete factory building, power house and testing plant.

Spark Plug Has Heat-Proof Composition Insulator

Contractors who use motor trucks and other gasoline engine equipment have no doubt experienced trouble with broken spark-plug insulators. A plug designed to eliminate that trouble has been designed by the Hartford Machine Screw Company, Hartford, Conn. That company's "Master Calorite" spark plug has been heated white hot and plunged in cold water several times in succession without breakage. The steel shell is designed to give ample space for expansion and contraction. As proof that Master Calorites will stand the heavy service demanded by contractors, their continued use by the Fifth Avenue Bus Company, New York City, and other large companies is cited.

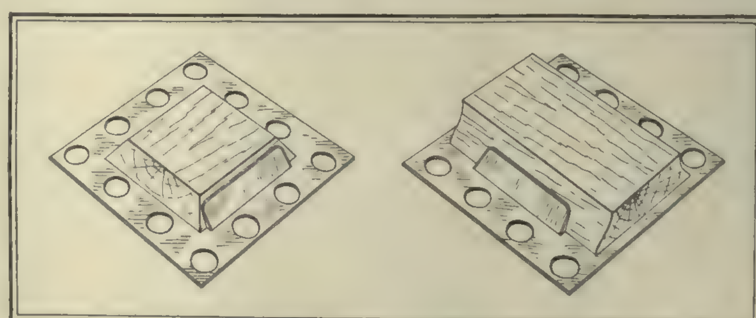
To Study South American Materials and Machinery Markets

The U. S. Bureau of Foreign and Domestic Commerce is completing arrangements for an investigation of the markets for construction materials and machinery in South America. W. W. Ewing, a civil engineer with 27 years' experience in engineering and construction work, will spend the next three months conferring with manufacturers in the United States, after which he will sail for South America.

Spot Ground Saves Labor and Supports 500-Lb. Load

A comparatively new spot ground is that manufactured by the United States Spot Ground Corporation, Omaha, Neb. The device is made in two types—one for use on floors and the other for walls and ceilings. The Merritt spot ground, as illustrated, consists of a metal plate on which is fastened a wood block to which base boards, carpet strips, electric-light fixtures and furring can be nailed. The device eliminates anchoring, bracing, wedging and cutting plugs. It also makes unnecessary the digging out of mortar joints so that plugs can be driven into the wall with the accompanying breakage in plugs and possibly in the wall itself.

WALL SPOT GROUND ON LEFT; FLOOR GROUND ON RIGHT



A quick-setting molding plaster is applied to the back of the metal plates. The spot ground is then pushed against the wall until the plaster is forced through the holes in the plate and the face of the ground brought to the desired alignment. Portland-cement mortar is used in applying the spot grounds to floors. One Merritt ground has withstood a straightway pull of more than 500 lb., and grounds placed on walls have supported a load of nearly 600 lb.

Studebaker Buys Ottofy Patent on Street Flushers

The Studebaker Municipal Utilities Company has bought the Ottofy patents on street-flushing machines from the Sanitary Street Flushing Machine Company. Flushers manufactured under that patent will be marketed through the vehicle division of the Studebaker organization.

For more than five years suits between the Sanitary Street Flushing Company and various infringers have been fought in the federal courts. The Ottofy patent, which covers "any flushing machine made or that can be changed or adjusted to deliver a flat stream of water under pressure, forward and laterally, at an angle of 20 deg. or less," was recently sustained and almost immediately purchased by the Studebaker interests.

Fifty Years of a Business Man's Life

In a fifty-page booklet, Frederick A. Riehlé, of the Riehlé Brothers' Testing Machine Company, relates his business experiences during a period of fifty years. The narrative tells of the beginning of the present Riehlé company and discusses the scale and testing machine businesses in general. Several pages are also devoted to personal reminiscences by Mr. Riehlé.

Business Notes

W. R. Hulbert, sales manager of the Goldschmidt Thermit Company, New York City, gave an illustrated lecture July 25 before the members of the Clinchfield Railway Club at Erwin, Tenn. The theory and practicability of making thermit welds were discussed and practical demonstrations made.

Melbert W. Taber has resigned as manager of maintenance and construction for the Packard Motor Car Company to become manager of the Detroit office of the Asbestos Protected Metal Company.

The Hollow Building Tile Manufacturers' Association has moved its offices from Cleveland to Chicago. Charles T. Harris has resigned as secretary.

Keuffel & Esser Company, Hoboken, N. J., has perfected a new flexible curve rule made of black xylonite. On one edge is a ruling strip of the black material and on the other a wire for retaining the rule in the curve to which it is bent. Each extremity ends in a tangent.

The General Filtration Company, Rochester, N. Y., is doubling the capacity of its works to meet the increasing demand for air diffusers used in the activated-sludge process of sewage treatment.

Trade Publications

The following companies have recently issued trade literature:

American Blower Company, Detroit. Series 3 and 4 of Bulletin 17. Devoted to heaters for industrial buildings.

Ingersoll-Rand Company, New York City. Catalog, 6 x 9 in., 124 pages, illustrated and indexed. Printed in Spanish and describes full line of that company's pneumatic drills, hammers, turbines, pumps and other appliances.

W. A. Zelnicker Supply Company, St. Louis, Mo. Bulletin 200, 3 x 8 in., 24 pages. Lists equipment for sale.

Toch Brothers, New York City. Catalog, 6 x 9 in., 32 pages. Pictures of large structures on which R. I. W. preservative compounds have been used.

Engineering Record

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Helping the Young Engineer

APROPOS of the suggestions outlined in the Engineering Record of June 24 for improving the service which the American Society of Civil Engineers renders its members, it seems worth while to call attention to the part local associations can play in helping the young engineer. At the last meeting of the San Francisco Association of Members of the society it was proposed that once a year a meeting be held especially for juniors, whether affiliated with the association or not, with the idea of helping them broaden their acquaintance among their seniors. It was found that although 250 students in civil engineering have been graduated from two colleges near San Francisco in the past four years there are now registered in the San Francisco district only 74 junior members of the society, and of this small number less than 8 per cent have affiliated with the local association. Cause and effect in this situation are probably closely related. The San Francisco organization is a live one, however, and in the territory it serves this condition is being changed. Inducements to junior membership are to be offered and plans are being discussed. Through this sort of activity the society may expect to gain new members and strengthen its hold on the territory. The Pacific Coast is so far removed from the society headquarters that were there no local associations the society would make only an indirect, impersonal appeal to an engineer who did not find its publications useful and could not expect to command prestige by virtue of his standing in the society. That is particularly true of most of those eligible to junior membership.

Flood Protection for Erie

AFTER some big catastrophe there are a general bustling about of officials, countless inquiries and "probes" and other time-consuming formalities which drag along until finally the public forgets all about the matter until the next accident occurs. Occasionally, however, the lesson of a great disaster is taken to heart and constructive work done to prevent a repetition of it. A case in point is that of Erie, Pa., which was inundated by the flood in Mill Creek about a year ago. Thirty-nine lives were lost and the property damage was estimated at $3,000,000. Last week, on the date of the anniversary of the flood, flood-control works were formally inaugurated. The main feature of the project is a reinforced-concrete tube, 22 ft. wide and 18 ft. high, which will be bedded into solid rock the entire length of the city, about 2 miles, and will cost approximately $1,000,000. It is expected that the main portion of this work will be well under way this fall. With the completion of this project the flood menace in Erie will be effectively removed. There is a moral here for other cities where the possibility of flood damage still exists. Erie is profiting by its harrowing experiences of a year ago. Other towns can begin the construction of flood-prevention works now, without waiting for a toll in lives and property.

Failures in Army Examinations

WHY have so large a percentage of civilian candidates failed to pass the examinations for commissions in the Corps of Engineers of the U. S. Army? In some quarters this question is answered by stating that the tests have been unduly difficult —made so purposely, in fact, because of a reluctance on the part of the officers of the corps to admit citizens to this branch of the service. In the light of these comments and the fact that examinations for commissions in the corps are to be held week after next, the letter from General Black, on page 210, is interesting and timely. General Black disclaims emphatically any prejudice against the commissioning of technically qualified civilians. In fact, he has been making a special effort to secure a supply of officers from the country's leading technical schools. He holds—and in his contention he is supported by the dean of a prominent engineering college—that the examinations are not too severe. In his opinion the failure of 40 per cent of the candidates at a recent test must be accounted for either by the fact that the education now given by our technical schools is not thorough or else that the candidates who tried this examination were not really representative graduates.

Working with the Public

WHAT is the best way to convince a skeptical public that a certain municipal improvement is necessary, and to secure funds for its construction? Chicago's method is illustrated by the activities of its Association of Commerce in support of the plan for filtering the city's water supply and installing meters. The association publishes in the Chicago *Examiner* each week a four-column article on some civic subject. In the case of the water-filtration project an engineer of experience was employed to make the necessary investigations. The data were well digested and the resulting "stories" were examples of some of the best publicity engineering works in Chicago ever received. Coupled with the filtration proposition was a plea for meters, for Chicago wastes 60 per cent of the 250 gal. credited daily to each individual. Only one citizen in fifteen purchases water by meter. To engineers and waterworks officials no arguments for meters are necessary, but the layman must be educated to realize the necessity for their installation. Articles from authoritative sources such as the ones published in the Chicago papers will make the acquisition of desirable public improvements much easier. Other cities with similar problems could well afford to copy Chicago's publicity methods.

Engineer as "Silent Partner"

DURING the construction period of the Panama-Pacific Exposition engineers were made the executives in administering the $18,000,000 budget. The result was completion on time and within the funds assigned—a world's record. In the "destruction period," now well advanced, engineers are still handling the funds and managing the business affairs with great satisfaction to the exposition company. Dynamite is being used in a way which causes only slight loss of salvable material and makes it possible to get out the remainder for less than 1 per cent of what it would cost to dismantle and dismember the structures by hand. A review of the entire wrecking project is presented on page 203 of this issue. The executive responsibility intrusted to engineers in the exposition work marks a long stride toward a higher standing for the profession among financial interests; but with the less thoughtful public the engineer played his usual rôle of "silent partner." The monumental achievements of the engineering department were entirely finished, and for the most part covered up, before the opening date. Visitors came then to marvel at the work of sculptor, architect and landscape gardener, but comprehended little of the prodigious undertaking which the engineer had to carry out —the transformation of 600 acres of bay and tide flats into an "enchanted city," with every modern convenience. With the closing of the gates it was popularly considered that the exposition was history. Not so with the engineer. He had stood in the background during the festal season, but after the last visitor had gone decorations were stripped off and wrecking and salvaging operations transformed the exposition into a scene of devastation and chaos. The engineer is now fulfilling the second half of his commission to build up and then to tear down. His work will not be finished until the site is restored on the first of next year. Meantime it is his part to care little for the absence of popular attention and to find sufficient reward in showing a gross salvage income of $550,000, with a wrecking cost of only $250,000.

Admission to Reserve Corps

IN PRESCRIBING definite requirements for admission to the grades of first and second lieutenants, captain and major of the Engineer Officers' Reserve Corps of the U. S. Army the War Department has taken the initial step in building up a nation-wide organization of technically trained men as a defense measure. General Black's announcement on page 193 will be widely read by engineers who, during the past year, have been eager to place their services at the disposal of the nation. Before the National Defense Act was passed last month there was no official federal channel into which the military enthusiasm of engineers could be turned. Nevertheless this interest sought outlets through attendance at military engineering lectures, in courses of reading and in armory drill and outdoor maneuvers. Technical men who have participated in preliminary work of this sort now have an opportunity of receiving official recognition in the Officers' Reserve Corps.

The proper procedure to follow in applying for examination is explained in detail by General Black elsewhere in this issue. It is important to note that provision has been made for two grades of service—combatant and special. The former is intended primarily for the younger men of the profession, physically capable of performing rigorous duty at the front; the latter for the senior members, not so robust, but still well qualified technically to perform invaluable service on lines of communication, at sea-coast defenses or in other special duties. The age limits applicable to other branches of the Officers' Reserve Corps, as set forth in the new Army Act, do not apply to the engineer section, so that men of ripe experience in design and construction are eligible for appointment.

When the bill was first drafted a maximum age limit was specified which would have stripped the Reserve Corps of some of its most valuable material. At that time the Engineering Record, in an editorial, made a plea for the revision of this feature of the bill. Before the bill became a law this revision was made. The gates to the Engineer Officers' Reserve Corps are now open. Those who are qualified to pass them should lose no time in sending in their applications for examinations.

Business Basis Advocated for New York Street Cleaning

IT IS fairly certain that any private corporation engaged in work involving the regular employment of 7000 men and the expenditure of $9,000,000 annually would, first of all, decide upon a definite policy of administration for its business, then select as general manager a man qualified by past experience to produce results, and, finally, keep this executive in office as long as he "made good." The New York Street Cleaning Department is an organization whose activities are on precisely the scale outlined above. Yet during the last seventeen years its administrative control has changed, on an average, once every two years, while in the four-year term of one mayor there were five street-cleaning commissioners. The most astonishing fact, from a business point of view, however, is that of all the commissioners who have held office since the department was created in 1881 only one, the present commissioner, had any previous experience in conducting street-cleaning operations. These and other important facts are cited, in a report on New York street-cleaning methods and personnel, which Richard T. Fox has submitted to Commissioner John T. Fetherston, to indicate why so few improvements in personnel, methods of work or equipment have been made during almost a score of years, in spite of the fact that the department's employees have the highest pay and best working conditions, as to vacations, sick time and pensions, of any labor of this class in the United States. What New York City needs most, Mr. Fox finds, is a continuous street-cleaning policy, and this will be possible only when the commissionership is regarded as a job demanding expert qualifications and long tenure of office, rather than as a means for the payment of political debts. The taxpayers of New York, who are saddled with the burden of the city's huge bill for street cleaning and snow removal, will do well to give Mr. Fox's recommendations more than passing notice. It will mean money in their pockets.

So much for the general administrative phase of the department's activities. As to methods of work Mr. Fox makes a number of constructive criticisms, which are applicable to street cleaning in other cities as well as in New York. Under the present condition of affairs the cleaning and flushing of sidewalks is nobody's business. Mr. Fox would place this work under the control of the street-cleaning department. Few cities to-day, it is believed, follow this practice.

One of the department's most pressing needs is improved and up-to-date street-cleaning equipment. To-day there are available many improved mechanical devices, but no funds have been provided for their purchase, and, with a few exceptions, the methods of work and the equipment of to-day are the same as were used in Colonel Waring's time, seventeen years ago. Contractors in private practice have not been slow to avail themselves of the many labor-saving devices which manufacturers have developed in the field of general engineering construction. They realize that investment in first-class plant eventually results in increased profits, but in the case of the work of the New York Street Cleaning Department the municipal pursestrings apparently have been tightened regularly at any suggestion of purchases of improved equipment.

Mr. Fox finds need for a system by which the accountability of men and machines may fairly be fixed and by which comparisons of costs may be made. Another of his suggestions is that a school of instruction for both officers and men, dealing with the best methods of work and the best use of equipment, be encouraged. This is highly desirable, and it could be organized somewhat on the lines of noncommissioned officers' schools in military organizations.

If city officials with appointive power really wish to give the people the "business administration" which they promise so glibly in their stump speeches before election day, they must realize that real efficiency is not a mushroom growth. It is the result of continuous application in the investigation and study of organization, of the control and direction of men, of scientific methods of work and of equipment. This general principle applies not merely to street cleaning but to the operations of all public-works departments.

Intelligent Publicity

TIME-HONORED custom dictates that when a railroad suffers a wreck, or a washout, or a bridge collapse, the company's officials, big and little, immediately assume a clamlike attitude. They know nothing about it, or the reports have been greatly exaggerated, or a statement will be issued later—"later" being far enough off so that the public will have lost interest and will be content with a short cut-and-dried story. Meanwhile reporters, photographers and other born maligners of the hapless railroad are held off, as far as possible. And by this very means the railroad company goes far to convince the public that whatever the accident or its cause the railroad was to blame.

A most interesting violation of tradition has been committed by the Cincinnati, New Orleans & Texas Pacific Railway, better known as the Queen & Crescent route. Last week's issue of this journal, page 170, described the replacing of a span of that company's bridge over the Tennessee River, destroyed by a blow or blows from a shifted load on a car. This description and the illustrations were taken from a 52-page booklet issued by the railroad company, labeled "Accident at Tennessee River Bridge."

Eight pages are devoted to a short account of the accident itself, being followed by a complete story of the repair work. Pages 9 to 51 inclusive are full-page views of the successive stages of reconstruction, while on the last page are the names and titles of the thirty-eight officials "who took part in removal of wreckage, rebuilding of span and handling of traffic." True, the booklet is addressed to the officers of the Queen & Crescent route, but the copy that came to this office was not accompanied by instructions that it be kept under lock and key and read only in a dark room. And yet, think of the risk the company took! The very word "accident" puts it on the defensive. What right has a railroad to have accidents? Are they not proof of inefficiency and watered stock? If the evidence was incontrovertible that the bridge span was knocked down and did not merely fall down from overwork, it may be asked how the load on the car came to shift. In fact in certain advanced localities—advanced in railroad baiting—the question why the bridge was not designed to withstand such blows as it received would probably be her-

alded as highly pertinent and public-spirited.

The Engineering Record is glad, nevertheless, that the Queen & Crescent decided to run this risk and give out the facts of the case in such an interesting way. The public is bound to be benefited by the truth. The engineering world is enlightened by the account of how the bridge was repaired so quickly. The men who effected the repair are helped by the credit given therefor, and this in turn must inure to the railroad by improving the *esprit de corps*. The example of the Queen & Crescent is a shining light. Will other roads follow it?

A Step in the Right Direction

THE Rio Grande irrigation project is one of the number of privately controlled projects which were taken over by the United States Reclamation Service. Projects of this type, it will be remembered, were severely criticised in the report of the Central Board of Review in its discussion of the Carlsbad project, and also by this journal when it commented upon the board's review in its issue of July 15, page 66. To just what extent speculative interests have profited on the Rio Grande project this journal does not know. The organization, however, by the Elephant Butte Water Users' Association of a co-operative land selling bureau, for the express purpose of eliminating the speculator and his methods, indicates that he was probably just as much a pest and an obstacle to the best progress of the project that he has proved on other government developments, either wholly or largely under private ownership. The step of the Elephant Butte Water Users' Association is in the right direction, and a knowledge of what it is doing is, therefore, of interest to all engineers who follow the progress of private and public irrigation work.

The scheme is extremely simple. Owners of land on the Rio Grande project have been invited to list their properties, when for sale, with the secretary of immigration of the association. The secretary, in turn, endeavors to get in touch with those seeking to buy land, and when he has located a prospective purchaser he takes him immediately to the landowner, and negotiations, therefore, are directly between the principals. The brokers and the speculators, who have little thought for the ultimate success of those who settle on the project, are eliminated. Furthermore, since the secretary of immigration is a representative of all of the water users, and therefore concerned in the success of the project as a whole, it is to the interest of his employer—the whole community—to see that the prospective settler gets a tract on which he will probably "make good" and be an asset in the upbuilding of the community. The water users' association well knows that the projects profit nothing if settlers come in, lose all they have and are obliged to abandon the land. Under the speculators' system the holdings again enter the market and once more a failure crop is the result.

The immigration secretary is not interested—at least primarily—in selling land. His business is to secure promising settlers, home makers, community builders. Consequently he interests himself in the available capital of the prospective settler, in his experience, even in his mental attitude. He advises him against taking a holding that is beyond the financing power of his operating capital. He tries to find a farm that will yield best under the newcomer's previous experience. Such a course, it is needless to say, if persisted in will be a boon to the project. It has not been in operation long enough to warrant much talk about results, but in its brief life of about a year it has fulfilled the expectations of its promoters—has been a home-finding rather than a real-estate speculating bureau. It has received the endorsement of the Reclamation Service and has become the pattern of similar co-operative land-selling bureaus on several other projects.

The West knows well the value of co-operation. Its purchasing and selling organizations are the model for the agricultural sections of the entire country. Moreover, new ideas get a respectful hearing much quicker there than they do east of the Mississippi River. Once, therefore, the benefits of co-operative land selling are fully demonstrated, there is but little doubt that bureaus established to apply the scheme will appear on practically every project. Many of the mistakes that have been made in our reclamation policy cannot be rectified, but there are enough left that will yield to sounder policies, firm administration and co-operation of the right-minded settlers to bring about a new era in our irrigated West.

The speculator must be eliminated, the Central Board of Review said. The co-operative land selling of the Elephant Butte Water Users' Association is the first important step in that direction.

The Other Eighty Per Cent

A MOVEMENT that may go far toward convincing Congress of the folly of the present lack of legal restraint on the four brotherhoods of railroad men, though started scarcely two weeks ago, is rapidly gathering momentum. The movement is a monster petition to Congress from the 80 per cent of railroad employees not members of the brotherhoods. It points out that they are threatened with curtailment of income by the proposed general strike and that they, as well as the general public, have a clear and definite right to be protected against such destructive methods of a few; and it urges "that some definite legislative action be taken whereby the vast majority of the people of the country shall be protected from a destructive interruption of interstate commerce due to the wholly selfish action of a small group of men, and that all differences which may arise between railway and employee shall be settled by proper arbitration. In this way," concludes the petition, "you would recognize the fundamental principle of the republic that no small group of men ought to be permitted directly or indirectly to conspire to an end calculated to benefit them only and directly or indirectly work wrong and loss upon the great majority."

If this petition accomplishes anything, as the Engineering Record hopes it will, a liberal measure of credit must go to Robert T. Frazier, an engineer in the valuation department of the Nashville, Chattanooga & St. Louis Railway. He was the originator of the plan, and no longer ago than July 27 he secured the first signature to his petition. In four days he states that 5500 signatures had been secured on his own road, and then he went to Chicago. Two days' work brought him 4000 Rock Island signatures, and at the end of a third he had enlisted lieutenants to cover the Chicago and St. Louis railroads. This journal's representative saw him shortly after he reached New York, where he hoped to conduct a similar campaign before proceeding to Philadelphia, Baltimore and Washington. There is no day-to-day canvass of the signatures, and it is not known how many have been secured. It is hoped, however, that in a very short time 100,000 will have signed, when the petition will be submitted to Congress.

Two points emphasized are that the movement does not attempt to pass judgment upon the merits of the trainmen's contentions, but only points out the unfairness of their peremptory methods, and that it is strictly an employees' movement. At the same time it has the approval of the railroad managements, for its success will benefit the companies as well as the 80 per cent and the public.

The signatures represent employees of low and high degree. Of about 1400 in the main shops of the Nashville, Chattanooga & St. Louis, 1289 signed. On the other hand, the name of at least one high official of the road can be found there.

As this page goes to press the crisis in the basic eight-hour demand of the trainmen is at hand. The vote of the trainmen, announced Tuesday, was overwhelmingly for giving the brotherhood leaders authority to declare a strike if they saw fit. The leaders have "put it up to the railroads," and the railroads have not yet replied. Pressure will doubtless be brought to force the brotherhoods to arbitrate, but there is grave doubt as to the outcome.

Whether or not the 80-per cent movement started in time to be effective in the present crisis, it seems admirably designed to spur a dilatory Congress to action. The men are not organizing to make any demands on the railroads. To do so would only antagonize their employers to no good end, as their demands would hardly reach the public. The railroads are not fathering the movement; if they were they would be accused of clouding the trainmen's issue. It is the voluntary act of the 80 per cent and the weight of their signatures that ought to make their impress on public opinion and Congress. The petition simply points out in a sane way what nobody who stops to think can gainsay, and the number of signatures, if the campaign is as successful as it bids fair to be, will be striking proof of the large number of men and families concerned. The Engineering Record wishes the movement speedy and complete success.

Steel Spans and Concrete Arches Combined to Form Unusual Bridge at Ninetieth Street, Cleveland

Spans Crossing Diverted Holton Avenue and the Pennsylvania Tracks Are So Limited by Clearance Requirements That Complex Skew Construction Is Necessary

OWING to the unusual conditions fixing overhead and lateral clearances in the layout of the four-track bridge of the Cleveland & Youngstown Railroad crossing East Ninetieth Street, Holton Avenue and the Pennsylvania Railroad in Cleveland, it was necessary to adopt steel-truss and deck-girder spans in combination with reinforced-concrete arches. In one case steel deck-girder spans for the two north tracks are contrasted with the concrete arch spans carrying the two south tracks.

The limits in clearance, both overhead and lateral, were fixed by the necessity for carrying the two sets of double tracks of the Cleveland & Youngstown Railroad over the Pennsylvania Railroad and over Holton Avenue, as well as Ninetieth Street, with the additional requirement that provision should be made for the future depression of Holton Avenue to pass under the Pennsylvania tracks. It will be seen by the plan view herewith that both abutments and all piers are skew structures, that Holton Avenue had to be diverted in order to make the crossing feasible and that variable span lengths for the arches were a necessity. The special construction of the piers and the details of the 82-ton double cross-girder supporting the expansion ends of deck girder spans are illustrated.

General Plan and Layout

The four-track bridge of the Cleveland & Youngstown electric railroad is built as two adjacent double-track structures practically independent of each other except at the through-truss span over the Pennsylvania Railroad tracks, where three main trusses are used—two of the same length, 147 ft. 3 in., and one 170 ft. 4½ in. long on account of the skew. The next spans to the east are deck-plate girders of 109-ft. span for the north track, deck-plate girders of 53-ft. span for the next track to the south and two arch ribs with a reinforced-concrete beam-and-slab floor for the two south tracks. As shown by the plan, clearance over Holton Avenue is provided by cross-girders supporting the ends of the deck-plate girder spans indicated on the drawing.

In general, reinforced concrete was found to cost no more than steel, and it was used wherever possible. Limited by the side and overhead clearance requirements, reinforced-concrete arch spans were adopted for the east end of the bridge. The most easterly span, of 88 ft. 4 in. clear opening, crosses East Ninetieth Street. Where the piers were too close for arches, a solid paneled connecting wall, of effective design, was used, as seen in the elevation and in one of the photographs. Separate piers for each of the four arch ribs were built on monolithic foundations, as illustrated by Pier 1.

The bridge was designed for Cooper's E-60 live loading, using the specifications of the New York Central Lines, 1910, with the exception that impact was allowed for on the steel spans by a formula giving lower impact factors; that is, a factor of $225/(L + 300)$ was used instead of $300/(L + 300)$.

FIVE CONCRETE ARCH SPANS AT EAST END OF BRIDGE SEEN FROM THE SOUTH

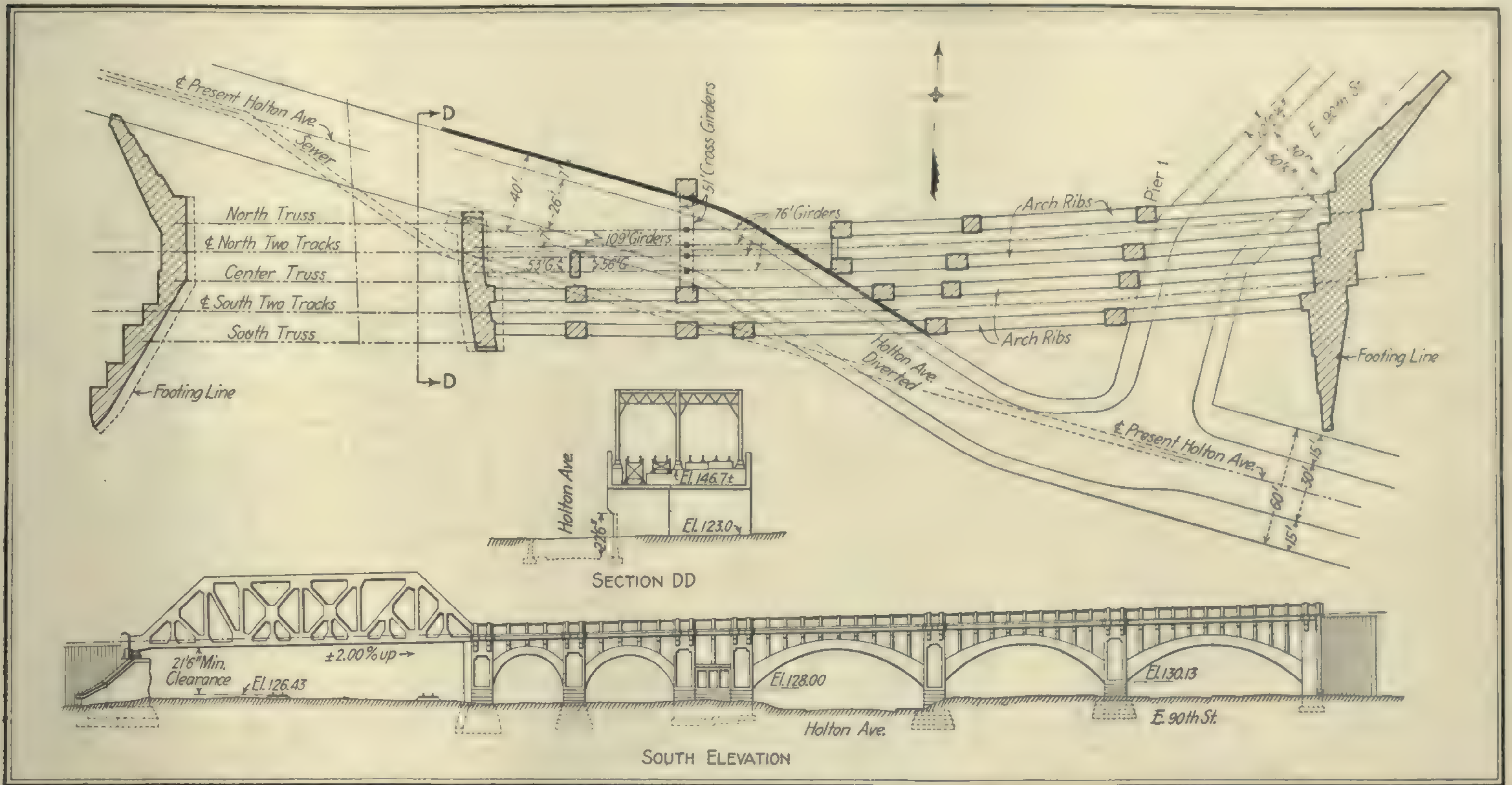
For the concrete parts of the structure an impact of 50 per cent was adopted, and the unit compressive stress in concrete caused by combined bending and direct thrust was kept within 650 lb. per square inch. An allowable shear in the concrete of 50 lb. per square inch was used.

Truss and Girder Spans

The west span over the railroad tracks consists of three subdivided panel trusses of standard type, with Bethlehem I-beam stringers, the panel lengths varying from 14 ft. 7½ in. to 18 ft. 2⅜ in. All trusses are 32 ft. deep between centers of chords, providing 22 ft. overhead clearance and 7 ft. 6 in. side clearance for the trains crossing the structure, and 21 ft. 6 in. minimum clearance above the tracks below, which will be raised in the future to allow Holton Avenue to be carried beneath them. A timber open floor is used on this part of the bridge, with 2-in. planking outside of the tracks, and maximum open spaces of 1 in.

The deck-plate girder spans are also of typical construction, except the reinforced-concrete floor, which is lightened by the use of 6 x 12-in. pyrobar between the steel beams in the reinforced-concrete slab deck. As shown on the plan view and the detail drawing, varying span lengths fixed by clearance requirements for Holton Avenue, which located the piers, had to be adopted. The 109-ft. girders for the north track were made 10 ft. deep and supported at the expansion end on 51-ft. cross-girders over the street, as noted. The other spans, of 53, 56 and 76 ft., for the girders were made as economical as the conditions permitted.

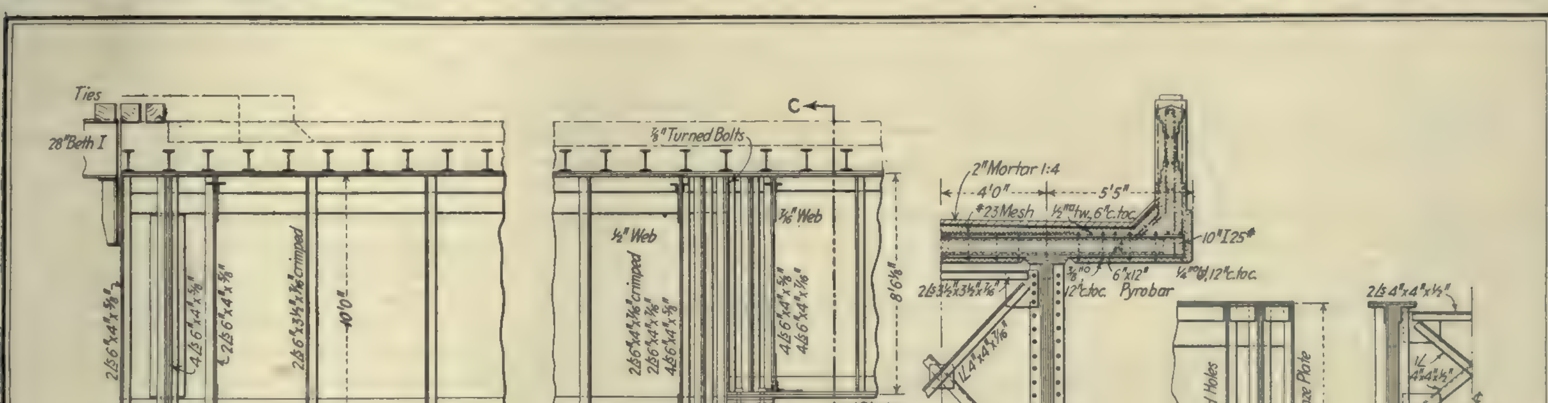
VIEW FROM EAST NINETIETH STREET LOOKING WEST SHOWS FOUR RIBS AT PIER 1



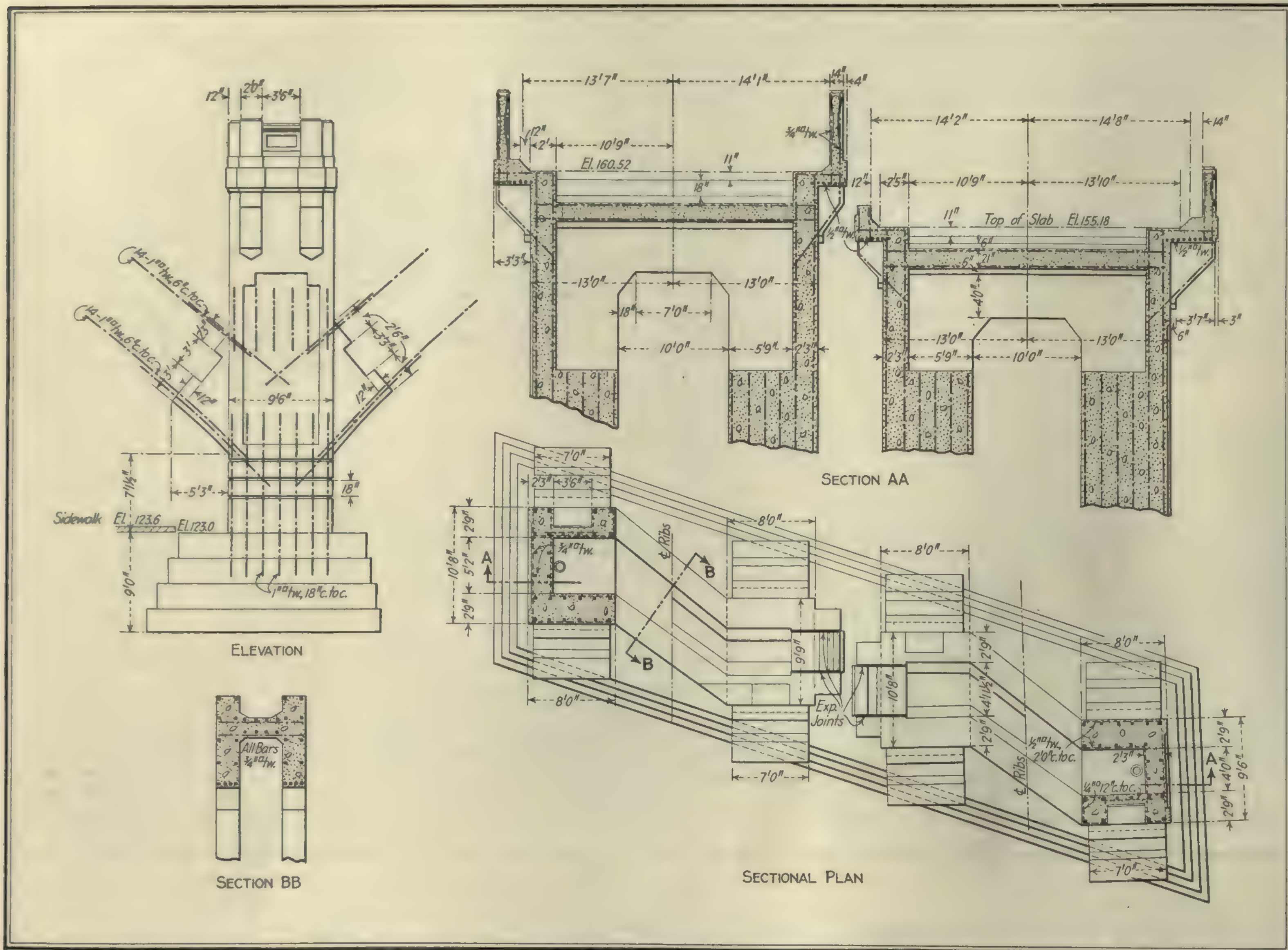
PLAN AND ELEVATION SHOW INFLUENCE OF CLEARANCE REQUIREMENTS ON DESIGN

The heavy 51-ft. cross-girder, 9 ft. deep, composed of two plate girders on 6-ft. centers, was riveted up complete in the shop and shipped to the site. The total shipping weight was 82 tons. As shown in the detail drawing, this cross-girder carried the expansion pedestals of the main girders, the roller nests resting upon 1¼-in. plates on the 24-in. I-beams between the two girder webs.

The top and bottom flanges of these two girders are securely braced by 12-in. channels spaced to clear the pedestals of the longitudinal girder spans. Cross-frames below the girder seats and an end cross-frame,

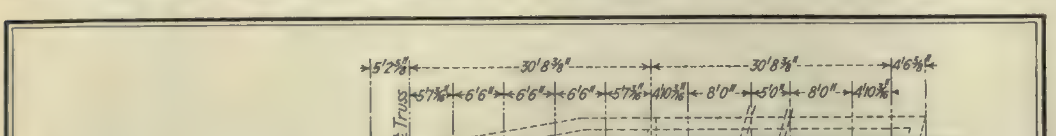


LONGITUDINAL DECK GIRDERS, WITH REINFORCED-CONCRETE FLOOR SUPPORTED AT EXPANSION ENDS BY HEAVY CROSS-GIRDERS



DETAILS OF PIER 1, SHOWING SPECIAL CONSTRUCTION, WITH MONOLITHIC BASE SUPPORTING SEPARATE ARCH-RIB PILASTERS

as shown, provide the necessary rigidity for unsymmetrical loading caused by expansion. Cast-steel shoes designed to conform to the requirements for girders of unequal depth are used to transmit the load through a 9¼-in. pin to the built-up steel pedestal.



DETAILS OF PIER BETWEEN TRUSS SPAN ON WEST AND GIRDER AND ARCH SPANS

The typical arch span is 88 ft. 4 in. clear between springing lines, with a rise of 19 ft. The crown thickness of each of the four main ribs is 5 ft., and the thickness at the pier is 8 ft. 3 in. The ribs are of constant width, 7 ft. throughout, and the reinforcement consists of fourteen 1-in. square twisted rods top and bottom.

The spandrel columns are of the usual type, 3 ft. 6 in. wide, reinforced with eight 1-in. square twisted rods, and supporting reinforced-concrete transverse floorbeams on 7½-ft. centers. A slab 11 in. thick, reinforced with ¾-in. square twisted bars in the longitudinal direction, with alternate rods bent up over the beams to resist negative moment, supports the ballasted roadway for the tracks.

The design of the skew piers involved many special problems. The drawing indicates the solution of these problems for Pier 1, west of Ninetieth Street, and for the east pier of the Pennsylvania crossing. Pier 1, with its double connecting cross-girders and economical central opening with reinforced walls, is particularly complex. The projecting rods for the connection of the main arch ribs are indicated in the drawing.

The lateral clearance requirements for Holton Avenue at the east pier of the Pennsylvania crossing made it necessary to cantilever the north end of this pier slightly, as is seen in the east elevation, to support the north truss of the west span. The reinforcement for this part of the pier is indicated. The top of the pier, with bridge

seats at various elevations for the truss and the girder span, is further complicated by the stringer seats for the two south tracks.

The bridge was designed by Wilbur J. Watson & Company of Cleveland, bridge engineers of the Cleveland & Youngstown Railroad, of which W. E. Pease is chief engineer. The contractor was the Walsh Construction Company, and the structural steel was fabricated by the American Bridge Company.

Engineer Officers' Reserve Requirements Fixed

General W. M. Black, Chief of Engineers, U. S. Army, Explains Proper Procedure to Follow in Applying for Commissions

REQUIREMENTS for admission to the Engineer Officers' Reserve Corps of the U. S. Army, for which provision was made in the new National Defense Act, have been fixed by the War Department. The following information regarding the procedure in making appointments to this branch of the service has been sent to the Engineering Record by Brig.-Gen. W. M. Black, Chief of Engineers, U. S. A.:

A copy of the complete regulations will be furnished on request, which should be addressed to the Chief of Engineers, U. S. Army, Washington, D. C.

PRINCIPAL REQUIREMENTS

Applicants commissioned in the Officers' Reserve Corps will rank in the various sections according to grades and to length of service in their grades. Commissions will be issued for periods of five years. No age limits apply to the Engineer Officers' Reserve Corps.

Except as otherwise herein provided, a member of the Officers' Reserve Corps shall not be subject to call for service in time of peace, and whenever called upon for service shall not, without his consent, be so called in a lower grade than that held by him in said reserve corps. In time of actual or threatened hostilities the President may order members of the Officers' Reserve Corps, subject to physical examination, to temporary duty with the Regular Army, or as officers in volunteer or other organizations that may be authorized by law, or as officers at recruit rendezvous and depots or on other duty. They may be promoted to vacancies in volunteer organizations or to temporary vacancies in the Regular Army, as prescribed in the act. While reserve officers are on such service they shall be entitled to the pay and allowances of the corresponding grades in the Regular Army.

Department commanders and the chief of engineers, when authorized by the Secretary of War, may order reserve officers of their departments or corps to duty with troops in the field or at field exercises or for instruction for periods not to exceed 15 days in any one calendar year. While so serving such officers shall receive the pay and allowances of their respective grades in the Regular Army. These periods will not be extended except with the consent of the reserve officers concerned.

Enlisted men of the Regular Army and of the National Guard, both active and retired, if citizens of the United States, are eligible for examination for commissions in the Engineer Officers' Reserve Corps. No applicant will be examined who is an officer of the Regular Army on the active list or of the National Guard or who is not a citizen of the United States.

The examining boards will ordinarily be composed of one officer of the Corps of Engineers, one member of the Engineer Officers' Reserve Corps, and one officer of the Medical Corps or Medical Officers' Reserve Corps.

The mental examination of no applicant will be undertaken who, in the judgment of the board, is not physically qualified to discharge in active service all the duties of an officer of the grade in which the applicant seeks a commission in the Officers' Reserve Corps; nor of anyone who has any mental infirmity or deformity of body, or whose moral fitness has not been duly established.

No person shall be examined for appointment in the Engineer Officers' Reserve Corps unless he has a letter from the Chief of Engineers authorizing his examination. Such a letter to an applicant will be the acknowledgment of the receipt of his application.

If an applicant has served in the Regular Army of the United States, or in any of the volunteer forces of the United States, or in the organized militia of any state or territory or the District of Columbia, he shall submit his discharge papers for each term of service; if still in service of any of the organizations named, he shall submit recommendations of his immediate and higher commanders.

If an applicant has attended or pursued a regular course of instruction in any military school or college of the United States, or has graduated from any educational institution to which an officer of the Army or Navy has been detailed as superintendent or professor pursuant to law, he shall, if a graduate, be required to present a diploma or certificate of graduation from such military school, college, or educational institution, or, if not a graduate, a certificate showing the amount and character of training, theoretical or practical, satisfactorily completed thereat.

Every applicant will be subjected to a rigid physical examination, which shall include the ordinary analysis of the urine, and if there be found to exist any cause of disqualification which might in the future impair his efficiency as an officer, he will be rejected. Defects of vision resulting from errors of refraction which are not excessive, and which may be entirely corrected by glasses, do not disqualify unless they are due to or are accompanied by organic disease.

COMBATANT AND SPECIAL SERVICES

Candidates for appointment in the Engineer Officers' Reserve Corps will be examined either (a) for duty with combatant Engineer troops or other duties in the service of the front, or (b) for special service on the lines of communications or other points in rear, including Engineer work in connection with seacoast defenses, as hereinafter indicated. Officers appointed under (b) will not ordinarily be assigned to combatant duties, but will be subject to such assignment whenever needed. The examinations shall be especially directed to ascertain the practical capacity of the applicant, and the record of previous service and training of the applicant shall be considered as a part of the examination.

Military experience or training in the Regular Army, Volunteers, or National Guard, or at training camps or educational institutions will be noted and reported by the board and considered in making the recommendations.

(A) Qualifications for reserve officers, service of the front:

FIRST AND SECOND LIEUTENANTS

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must either hold or have qualified for the grade of junior engineer, civil, electrical, or mechanical or higher grade in the civil service, or he must be a graduate from an approved engineering college, or have been in the active practice of engineering for at least two years.

CAPTAINS

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must either hold or be eligible for the grade of assistant engineer in the Engineer Department at large, or a corresponding Engineer grade in the civil service in another department of the government service, or have held a commission in the Corps of Engineers of the Regular Army, or shall be a professional engineer not less than 28 years of age, who shall have been in the active practice of his profession for at least eight years and have had responsible charge of work as principal or assistant for at least two years. The graduation from a school of engineering of recognized reputation shall be considered as equivalent to two years' active practice.

(c) Knowledge of the principles of military organization and operations, as illustrated in Infantry Drill Regulations, Parts I (to include School of the Company) and II, and Field Service Regulations, Part I and Part II (Articles I, II, IV, VI); and of the general principles of field fortifications, as illustrated in the Engineer Field Manual, Chapter V.

MAJORS

(a) The applicant must be an engineer in the active practice of his profession or some business immediately connected with, or concerned in, engineering matters.

(b) He must hold the grade of Assistant Engineer in the Engineer Department at large, or corresponding Engineer grade in the civil service in another department, or have held a commission in the Corps of Engineers of the Regular Army not more than two grades below that for which he desires to be listed, or shall be a professional engineer not less than 35 years of age, and shall have been in the active practice of his profession for fifteen years, who shall have had responsible charge of work for at least five years, and shall be qualified to design as well as to direct engineering work. Graduation from a school of engineering of recognized reputation shall be considered as equivalent to two years of active practice.

(c) In addition to fulfilling the qualifications given in paragraph 3 (a) and (b), the candidate will be required to pass an examination on the following subjects:

Drill Regulations—Parts I (School of the Company and Battalion only), II, III, Infantry Drill Regulations.

Field Service Regulations, entire text.

Duties of Engineer officers and troops in war, as illustrated in the Engineer Field Manual and Bulletin No. 4, Vol. I, of the office of the Chief of Staff.

Co-operation between the various arms of the service, as illustrated in "Technique of Modern Tactics" (Bond and McDonough), Chapters VIII, IX, XI, and XII.

All examinations will be oral.

(B) Qualifications for reserve officers, special services:

Candidates desiring appointment in special services must be qualified for at least one of the duties assigned to the Corps of Engineers by the following extracts from Army Regulations:

"1493. The duties of the Corps of Engineers comprise reconnoitering and surveying for military purposes, including the laying out of camps; selection of sites and formation of plans and estimates for military defenses; construction and repair of fortifications and their accessories; . . .

LETTER OF APPLICATION FOR EXAMINATION FOR COMMISSION IN ENGINEER OFFICERS' RESERVE CORPS

........., 19...

The Chief of Engineers, U. S. Army,
Washington, D. C.

Sir: I have the honor to apply for examination for a commission as (1)......of Engineers, in the Officers' Reserve Corps, organized under the authority of Congress.

I have served......years in (2).......

I have pursued a regular course of instruction for ....years in (3).......

I graduated in the year....from (4)......, after having creditably pursued the course of military instruction therein provided.

I was born........, 1.., and am (5)....a citizen of the United States. My business is ....
My experience is..

(6) I inclose letters of recommendation and addresses of three citizens who know me, as follows:

....
....
....

Respectfully,

....

Permanent P. O. Address:........................

The correctness of the statements above made was sworn to and subscribed before me, ..., 19...

(7)..........,
....
....

(1) Insert grade—1st or 2d Lieutenant, Captain or Major.

(2) Insert service in Regular Army of the United States, or volunteer forces of the United States, or Organized Militia of any State, Territory, or District of Columbia; also state in what capacity.

(3) Insert name and location of the school or college.

(4) Insert name and location of the educational institution.

(5) Insert "not" if in accordance with fact.

(6) If a member of an engineering society, state society and grade of membership.

(7) Oath to be taken before, and signature to be made by, officer authorized by law to administer oaths.

the installation of electric power plants and electric power cable connected with seacoast batteries; . . . construction and repair of military roads, railroads, and bridges; military demolitions; . . . In time of war within the theater of operations it has charge of the location, design, and construction of wharves, piers, landings, storehouses, hospitals, and other structures of general interest, and of the construction, maintenance and repair of roads, ferries, bridges, and incidental structures, and of the construction, maintenance, and operation of railroads under military control, including the construction and operation of armored trains."

No oral or professional examinations will be required, but recommendations of boards will be required in lieu of such examinations. Candidates will submit evidence of their actual employment in corresponding or higher positions in civil life and references to persons under whom they have been or are employed. The boards will communicate with such persons and with any others that they deem fit, and upon all the evidence submitted or otherwise obtained will base their recommendations and recommend the appropriate grades for which they deem the successful candidates qualified.

Reserve officers from the following civilian occupations will be required for the special services of the Corps of Engineers: Bridge engineers; constructing engineers (earth and concrete); constructing engineers (wharves, piers, and buildings); electrical engineers (for small plants and power lines); highway engineers; mining engineers (skilled in tunneling and use of explosives); railroad engineers (construction and maintenance); railroad operating officials; sanitary engineers; topographical engineers.

Special Strain Gage Has One-Piece Welded Frame

D. E. Hooker, of Seattle Building Department, Designs Instrument for Measuring Reinforced-Concrete Buildings

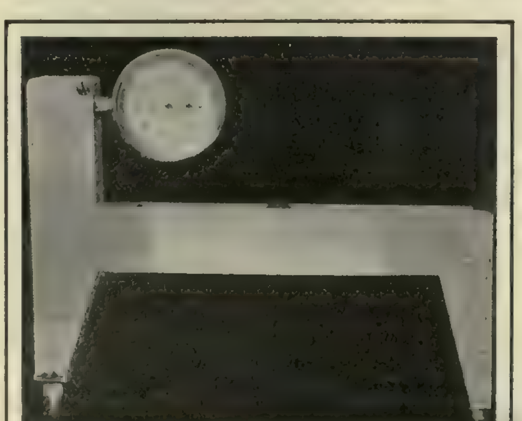
A SPECIALLY constructed strain gage to measure strains in reinforced-concrete buildings has been purchased by the Seattle Building Department from Prof. H. C. Berry of the University of Pennsylvania. The unusual features of this Berry gage include a frame without rivets or screws, the side plates being joined to the spacing lugs by the electric welding process; checkered side plates to give a better grip for the hands; a clearance of 3 in. to enable readings to be made on steel embedded deep in the concrete, and a special fulcrum joint for the movable leg.

The one-piece frame is so rigid that side pressure, given unconsciously when making observations, has comparatively little effect on the readings, and there are no rivets or screws to work loose or throw unequal interior strains in the frame. The 3-in. legs allow measurements on the deepest layer of steel in four-way flat slabs and the checkered plates reduce the strain of continued reading by giving a better grip of the hands on the instrument.

TRUNNIONS HELD BY SPRING

The trunnions of the movable leg are held up into position in the notches of the frame by a spring, guarded by a cover plate. Both the spring and the cover plate are square, with a square hole in the center of each through which the movable leg passes. The cover plate is held in place by four countersunk screws, which are screwed home in the frame, and thus have no tendency to work loose.

As the instrument is to be used only in testing buildings, the gage length is fixed at 8 in., this length being considered most practicable for general use. It is constructed throughout of invar steel. The dial can be revolved any part or all of a revolution to eliminate parallax in reading on floors, ceilings or columns, and to permit the dial



STRAIN GAGE WITH ONE-PIECE FRAME

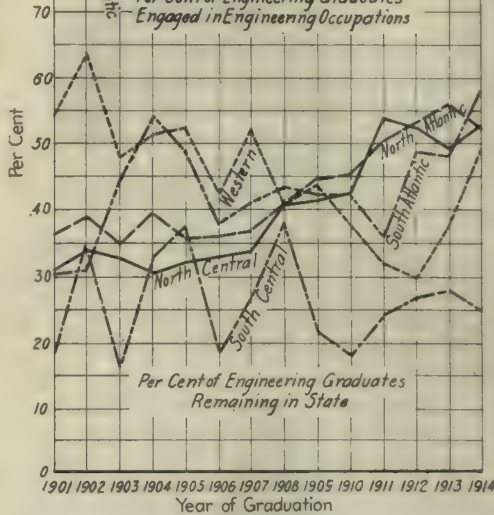
end of the instrument to be held in either the right or left hand. The dial is an Ames gage, graduated to thousandths of an inch, and as the proportions of the movable leg are one to five, the instrument records strains of 0.0002 in.

The complete instrument is shown in the photograph herewith. The gage was designed by D. E. Hooker, assistant superintendent, Seattle Building Department, and constructed by F. F. Metzger, of Philadelphia.

Graduates in Engineering Hold to Profession

Investigation Shows That More Than 90 Per Cent Remain in Engineering—About 60 Per Cent Leave States Where Educated

CONTRARY to generally expressed opinion, only a small percentage of graduates of engineering schools leave the profession, according to the results of an investigation of more than fifty representative engineering colleges in the United



PERCENTAGES OF GRADUATES REMAINING IN ENGINEERING AND IN STATE WHERE EDUCATED

States made by A. A. Potter, dean of the division of engineering, and M. R. Bowerman, instructor in machine design, Kansas State Agricultural College. Nearly 23,000 comparatively recent graduates (from 1901 to 1914 inclusive) whose occupation and residence were known, including all sections of the country, have been included in this investigation, and the result by sections is shown on the accompanying diagram.

The total general average of all graduates shows that 90.1 per cent of all the graduates for these years remain in engineering occupations as practising engineers, engineering draftsmen and designers, construction engineers, engineering salesmen, teachers of engineering and engineering executives. Of the total graduates, only 41.1 per cent remained in the state where they were educated—a fact of great significance to the state institutions largely supported by state taxation. The diagram shows, however, that larger percentages of the northern and western sections where such state institutions are found remain in the state where their education was received.

Arched Gravity Dams to Be Built at Lower Otay and Barrett Sites

San Diego City Council Accepts Recommendation in Report of M. M. O'Shaughnessy for Immediate Construction of Two Dams

SINCE the failure of the Lower Otay dam on Jan. 27, noted in the Engineering Record of Feb. 12, page 225, San Diego, Cal., has faced the necessity of immediately providing new reservoirs in which to store the city's water supply. M. M. O'Shaughnessy, city engineer of San Francisco, was retained as consulting engineer to advise the city in the matter, and his report to the city council of San Diego recommends the immediate construction of two arched gravity dams, one to be built at the point where the Lower Otay dam formerly stood and the other to be at Barrett site on Cottonwood Creek. This report was accepted by the city council on July 17, and arrangements are being made for the required bond issue.

The principal features of Mr. O'Shaughnessy's report are presented in the following extracts:

Two Excellent Sites Available

"At present the city owns in fee simple two excellent dam sites, available for immediate occupation and use, namely, Barrett and Lower Otay, and I recommend that work on these sites be immediately undertaken.

"A reservoir at Barrett, with 7,000,000,000 gal. capacity, will more than conserve 7,000,000 gal. daily average waste now taking place at that point from lack of adequate storage, and is the cheapest stored water that can be added to San Diego's supply. The dam at Lower Otay, besides collecting water from its adjacent watershed, can also be used to hold such overflow from Cottonwood Creek as may be diverted by the Dulzura conduit, and conserve the same in a balancing reservoir within 20 miles of San Diego.

"There has been a substantial amount of preliminary work finished for the two above-named sites, such as roads which make the work readily accessible, diversion tunnel, partial foundation explorations, the Dulzura conduit from Barrett and the pipe line and distributing branches from the Lower Otay. Should the city of San Diego attempt to initially utilize some of the other available sites, of which there are several in the county, practically all of the above-mentioned work or its equivalent would have to be duplicated, water rights and rights-of-way would have to be obtained either by direct purchase or condemnation proceedings, with the consequent legal entanglements, etc.—all of which would entail unnecessary expense and delay at this time.

"The city should therefore realize the importance of immediately beginning and diligently prosecuting the work on the Barrett and Lower Otay dams in order to meet the needs of the rapidly increasing population.

Barrett Dam Given Preference

"The most desirable program of construction would be to carry on both dams simultaneously. However, should the city decide to build only one dam immediately, I recommend that Barrett dam be given preference. The Barrett reservoir would act not only as a balancing unit for the Lower Otay reservoir, but would also make full use of the completed Dulzura conduit and bring into immediate service the water now wasting at Cottonwood, thus supplying a very desirable link in the ultimate plan of development.

"It is clearly evident from the location and physical characteristics of these two watersheds, and from measurements heretofore made, that the runoff from Barrett is, in normal years, much more than that from the Lower Otay shed, while exactly the reverse is true of the available economic storage at the two dam sites—15,000,000,000 gal. at Lower Otay and 7,000,000,000 gal. at Barrett. This condition demands that the excess waters of Barrett reservoir be transmitted by means of the Dulzura conduit and stored in the Lower Otay. This in turn will make available more storage space for waters from the Cottonwood shed.

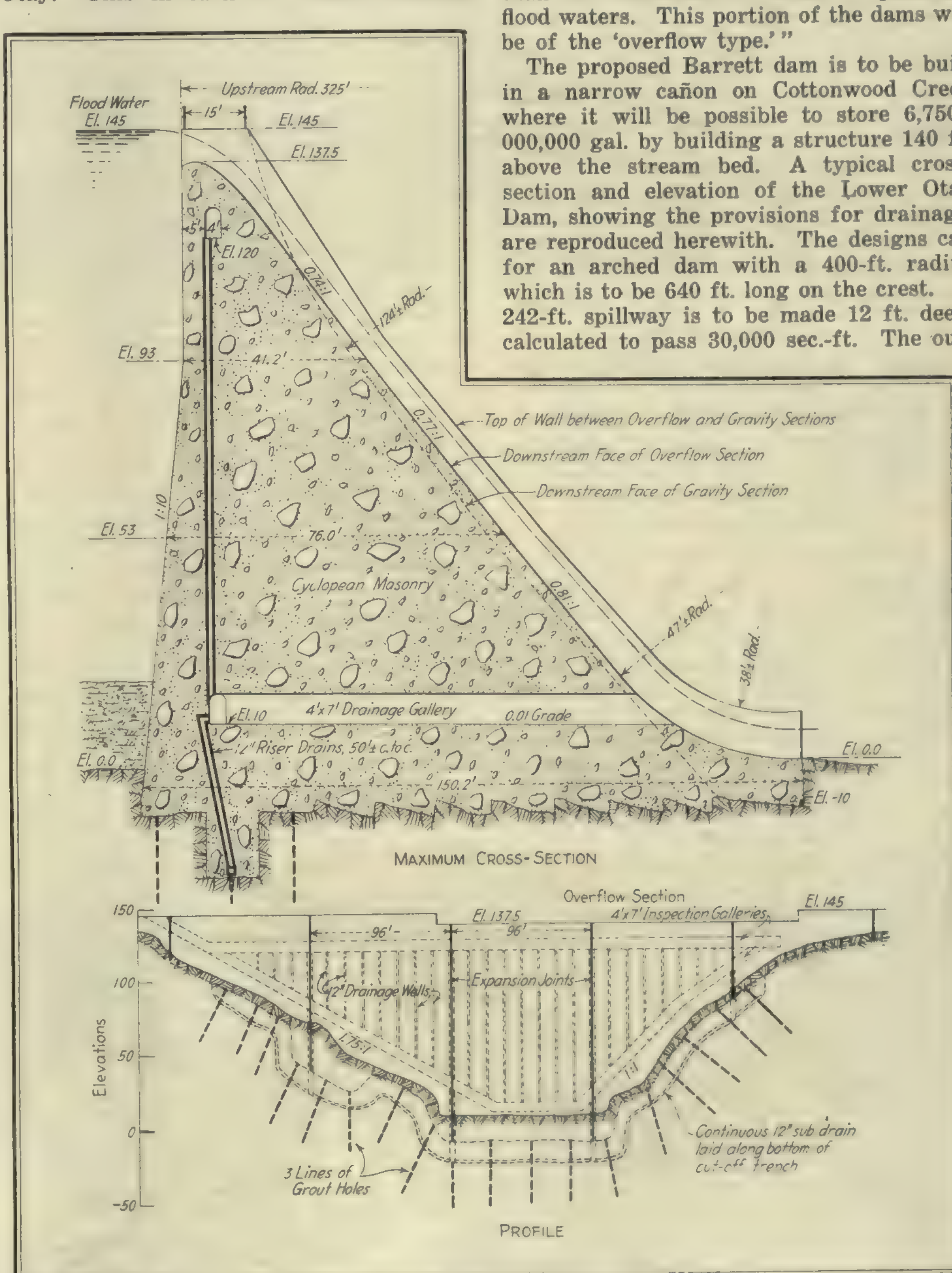
"With these two dams built, a much more complete utilization of the waters from the two sheds now in city ownership will be possible, and the available city supply will be increased in average years by approximately 10,000,000 gal. per day.

"If the Barrett dam alone be built at present, the stored water from the same can be passed down to the Upper Otay and the lower smaller city reservoirs near San Diego and practically directly into the city distributing system by the direct connection to the Dulzura conduit.

Types of Dams

"The type of dam proposed for both the Barrett and Lower Otay sheds is the 'arched gravity, cyclopean concrete.' Previous exploration work at the two sheds (for the original dam in the case of Lower Otay) has proved that the foundations are amply able to withstand all the pressures and thrusts which may develop. These pressures will not exceed 10 or 11 tons per square foot for either structure. For both dams there is a central portion made lower than the remainder in order to pass the flood waters. This portion of the dams will be of the 'overflow type.' "

The proposed Barrett dam is to be built in a narrow cañon on Cottonwood Creek where it will be possible to store 6,750,000,000 gal. by building a structure 140 ft. above the stream bed. A typical cross-section and elevation of the Lower Otay Dam, showing the provisions for drainage, are reproduced herewith. The designs call for an arched dam with a 400-ft. radius which is to be 640 ft. long on the crest. A 242-ft. spillway is to be made 12 ft. deep, calculated to pass 30,000 sec.-ft. The out-



MAXIMUM CROSS-SECTION AND LONGITUDINAL ELEVATION OF LOWER OTAY DAM
Barrett dam is designed with exactly similar outlines and provisions for drainage.

let tower is provided with 30-in. valves for drawing off water either at the bottom of the reservoir or at a point 45 ft. above. From the tower the water flows in a tunnel around the west end of the dam and empties into the main channel below. A concrete roadway 15 ft. wide is to be built along the crest of the dam, supported on piers across the spillway section. The volume of masonry required in the dam will be about 89,000 cu. yd. and the cost is estimated at $690,400.

Proposed Lower Otay Dam

The proposed Lower Otay dam is to be built on the site of the structure that failed last January. At this point a dam 137.5 ft. above stream bed will afford a storage capacity of 15,000,000,000 gal. Mr. O'Shaughnessy recommends an arched dam with a radius of 325 ft. and which will be 750 ft. long on the crest. The section, illustrated herewith, is to be very similar to that of the Barrett dam. The outlet tower will be provided with 24-in. valves for drawing off water at four levels to be passed through a 48-in. steel pipe set in concrete-lined tunnel. It is planned to concrete the inside of this pipe later. The spillway capacity is to be 26,000 sec.-ft. and the roadway will be carried across its 267-ft. length on concrete piers. The volume of the dam will be approximately 86,000 cu. yd. and the cost is estimated as $682,200.

The probable time required for constructing these dams is estimated to be about 15 to 18 months if the construction of both is carried on simultaneously. If they are built in sequence the time allotted for construction is from 30 to 36 months.

Public Speaking Made Part of Engineering Course

"Discussion Classes" Are One of Several Departures Introduced at Swarthmore to Develop Executive Ability

By MARC P. DOWDELL
Swarthmore College, Swarthmore, Pa.

"I WANT you to help me find a fifteen-thousand-dollar man for this job," said the president of a large public-service corporation to Prof. George F. Blessing, head of the department of engineering at Swarthmore College, a number of years ago.

"What's the matter with Jones?" asked the professor, referring to the man in charge of the technical work of the corporation. "It seems to me that he is admirably fitted to fill your position."

"I've been considering Jones," replied the president, "but he won't do. He's a first-rate mechanical man; but the man I am looking for must be something more; he must have technical ability, of course, but his chief work will be executive, and he will have to be especially prepared to meet boards of trade, town councils and other bodies of business men. He will have to do this impressively—be a creditable representative of our company."

The president searched for more than three months before he found the man he could pay fifteen thousand dollars a year. This incident deeply impressed Professor Blessing and he began to examine his department to see what were the business qualities of the students he was graduating. He immediately discovered that few of them could talk in public, that very few of them could stand before a class and explain an engineering problem with ease or assurance; they hesitated, and stammered, and made anything but clear-cut recitations. On inquiring of Prof. Paul M. Pearson, head of the public-speaking department, he learned that there were few engineering students enrolled in public-speaking courses.

"I have been working on a plan," said Professor Pearson, "which I think will help to solve your problem. Public speaking should be a valuable study for every student who intends to enter business or professional life, and next year we will begin a course in extemporaneous speaking which will have such students especially in mind."

"That's the very thing I want," said Professor Blessing. "I want my men to learn to talk about their business in public; I want them to be able to talk about engineering so that an ordinary audience can understand them and be interested in what they have to say."

Professor Blessing kept his promise to send his students to enroll in the new course. The other departments had also been consulted about it, and they, too, seized the opportunity. Students crowded "Public Speaking 88," as it was officially known, from its very inception.

Public-Speaking Classes Organized

The method employed in this course was to divide the class into sections of a half-dozen students each. They studied at first an outline text written especially for the work in hand, but commenced actual practice in speaking almost with the first meeting of the class. Each department of the college furnished a list of subjects from which the students drew suggestions, and the instructors encouraged "talking shop" —at first only for five minutes at a time, but as proficiency developed, for longer periods, until twenty-minute extempore speeches wound up the year's work.

The students named the conditions for their speeches in every case before they began, and were judged according to what they tried to do. "I will give a toast at a chamber of commerce luncheon," one student would announce, whereupon the remainder of the class would resolve itself into the group of supposed "lunchers" and would demand to be entertained, congratulated and convinced that the speaker was a "good fellow" and that his business was "all right." Salesmanship often occupied the attention of the class, and many a bill of merchandise was disposed of to critical boards of directors. An engineer interested in certain improvements on his father's farm gave a series of talks on the construction of sanitary pig pens. A girl interested in grand opera spent most of the year in telling the stories of the operas which were appearing from week to week. Economics and political-science students expounded the doctrines of every school of belief, from Herbert Spencer to H. G. Wells. Biologists spouted "survival of the fittest" and "evolution." After each speech the class spent a few minutes to discuss it and to decide whether it was a success or a failure.

While the public-speaking department solved one of his difficulties, Professor Blessing worked out several problems in his own department. In order to develop executive ability among the men he introduced a system of shop accounting designed according to the principles of the Emerson school of scientific management. The men made their first acquaintance with this system through actually "ringing in" on the time clock. At first they did not take very kindly to it, and a second supply of "demerit slips" had to be ordered from the printer in a very short time; but the students soon began to be more careful, and "demerit slips" became a rarity. In operating the system the department provided that every man spend some part of his time in the shop office, where he learned to see efficiency methods from the executive's point of view.

Professor Blessing also introduced "discussion classes" for all the junior and senior engineers. In these classes the students met their professors informally and brought up practical problems encountered in laboratory or field work during the week. The students did the talking, and helped one another to solve the difficulties. Quite frequently the professors absented themselves, or when they did attend, did more listening than talking. Comfortable leather upholstery of the engineering library furnished the environment for these classes, and perhaps helped create the atmosphere of a conference between factory foremen and the shop superintendent.

Personal-Record Cards

This is the system as thus far developed; but beginning next year a file of "personal-record cards" will enable Professor Blessing to keep track of every phase of the activity of his men. In addition to the record of a man's scholarship, these cards will provide space for "extra-curricular" activities. If he belongs to a fraternity, the card will state that fact; if he becomes manager of the *Phœnix*—the student weekly—or manager of an athletic team, or a player, his card will show that fact. At the end of four years the department will have an accurate index of the qualities of the man. Professor Blessing will be able to tell whether any particular man will be likely to make good as an executive, and will be able to place him in line for such a position; while, on the other hand, he will know whether his man is best suited to enter a field where technical ability alone will count.

It has taken six years to bring this work of Professor Blessing's to its present stage —too short a time to foretell just what percentage of improvement it is effecting. A judgment based on the qualities of the undergraduates themselves points to its success. The enthusiasm these men display toward their work is greater than the enthusiasm of any other group of students in the college. Recent graduates, placed since this system has been working, have made exceptionally good records for the short periods of their employment. The houses which employed them are asking for more Swarthmore graduates. The next decade, however, will show the real results of this work. It will require a long period for the men now graduating to reach their high planes of earning power, and when they do, many of them will be found in the fifteen-thousand-dollar class.

Gasoline Engines May Supplant Mules

Gasoline engines are being tried as a substitute for mules on road work near Sherman, Tex. Demonstrations in two precincts have shown that the amount of work accomplished with mules is just half of that when gasoline engines are employed.

Interesting Concrete Plants Illustrate Modern Methods

Tall Spouting Plant Used on Railroad Bridge

Main Tower 280 Feet and Tail Tower 110 Feet High Place Concrete in Arch Structure Across River at Pottstown, Pa.

PERHAPS the highest concrete tower on record has been used in building the bridge of the Pennsylvania Railroad across the Schuylkill River at Pottstown, Pa. The double track, reinforced-concrete arch bridge contains seven 84-ft. spans.

Five of the piers were constructed in cofferdams, the shale rock being about 12 ft. below normal river stage. The other pier and the abutments did not require cofferdams. One of the coffers was made with a single row of steel-sheet piling, and the other four consisted of double lines of wood sheeting filled with cornstalks and clay. The excavation was handled by a derrick boat built at the site.

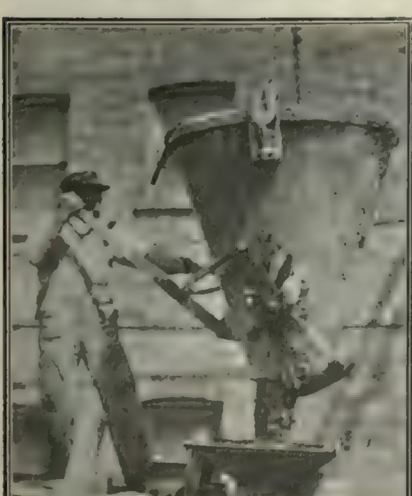
The concrete plant at the base of the main tower was located 100 ft. south of the south abutment at the base of the existing railroad fill. A side track over the material bins made it possible to dump sand and stone into them from railroad cars, but little stone was received in this way. A quarry was opened about 500 ft. from the plant, and stone, brought to the mixer in narrow-gage cars, was hoisted into the bins by a stiffleg derrick using a clamshell bucket. Cement was shot direct to the charging platform from cars on the siding or from the cement shed at the same elevation.

The tail tower was located about 800 ft. from the main tower on the opposite bank of the river. The north abutment, near the base of this tower, was 750 ft. from the main tower. Concrete was distributed from three points on the main tower, depending on the distance it had to be spouted. It is stated that the chutes worked satisfactorily on a slope as flat as 1 to 2.7.

The piers were completed first through the umbrella sections. The arches were then poured, one at a time, the full double-track arch being poured in one operation. Each complete arch is poured in three sections, varying from 70 to 400 cu. yd. each.

The bridge is being built for the Pennsylvania Railroad by the James McGraw Company of Philadelphia.

Mixer Train and Novel Bucket Handled by Crane Used at Baltimore & Ohio's Chicago Freight Terminal



BUCKET FOR THIN WALL FORMS

CROSS-RUNWAYS KEPT LOADING FROM DELAYING WHEELERS

BULK CEMENT WAS USED HERE

Concrete Plants in the Vicinity of New York City

The upper photographs show the plant at the west shaft of the Hudson siphon, Catskill Aqueduct. Materials were received in barges and unloaded by derrick to a hopper over an inclined belt conveyor, which delivered them to a cross-conveyor on top of the bins at the shaft. Sand and stone were proportioned in a steel car which was drawn up an incline to the cement shed and mixer at the shaft. The plant was built by the T. A. Gillespie Company.

The lower photographs show another Catskill Aqueduct plant—that used by the American Pipe Company in concreting several miles of open-cut section near Walden, N. Y. Dry cement, sand and stone were drawn into buckets on flat cars at the crushing and proportioning plant, handled by locomotive to the mixer car at the point of work and fed to the mixer by crane. Another crane dumped the mixed concrete into the forms.

The center picture shows a mounted concrete plant on railroad work, which is supplied by wheelbarrows from piles of material on the ground. Consequently it does not require a work train in operation. A work train is out of the question in this case, as the plant is busy widening from two to four tracks a mile of the Brighton Beach rapid-transit line in Brooklyn. This work, between Prospect Park and Church Avenue, is being done by the Inter-Continental Construction Company.

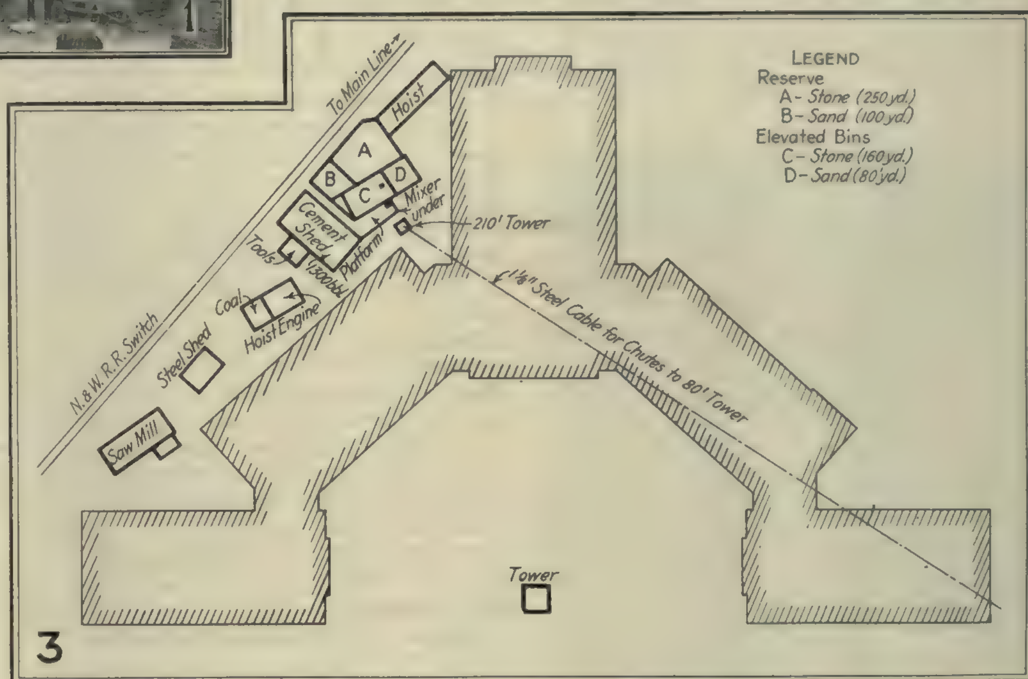
Two Plants of the Ferro-Concrete Construction Company at Cincinnati

1—Endless bucket conveyor, with a capacity of 20 yd. an hour, feeds gravity storage bins of spouting plant from 200-yd. hopper under delivery track. Building for Ubiko Mining Company.

2—Gravity rollers handle cement in this plant. Dry batch is drawn into measuring car running on platform above mixer. Reinforcing and form lumber are also unloaded by rollers.

3—Layout of plant (shown in photographs 2 and 4) for concreting the East Side High School. Five main buildings (within outline of group) and small bridge (not shown) require 7700 cu. yd. of concrete, on which basis labor cost of erecting plant amounted to 41 cents a yard. Plant designed for average speed of 40 yd. an hour.

4—Hoist elevated so runner can see into car. Capacity, 300 cu. yd. a day. Space between main bins and siding taken advantage of for extra storage.



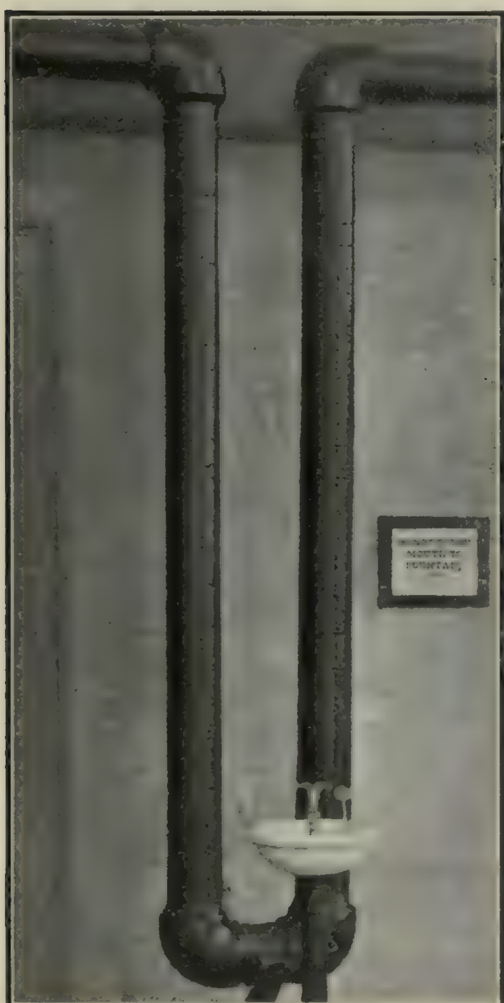
Ultra-Violet Ray Purifies Water at Cement Plant

River Water Filtered, Refrigerated and Sterilized—Supply to Employees Costs Less Than Former Distribution in Barrels

RIVER WATER is filtered, refrigerated and sterilized, then circulated through 12,000 ft. of 1-in. galvanized pipe to thirty-five sanitary drinking fountains in the plant of the Atlas Portland Cement Company at Hannibal, Mo., by a supply system recently installed at an expense less than the old system of supplying the workmen with cooled water in barrels.

The refrigerating plant consists of a 7½ x 7½-in. two-cylinder, vertical single-acting, inclosed, self-oiling, 12-ton York ammonia compressor, driven by a variable-speed 20-hp. motor and a Shipley double-pipe, flooded condenser. The cooling tank contains 1200 ft. of 1¼-in. pipe in expansion coils. Besides refrigerating the drinking water, the plant freezes 600 lb. of ice daily for use around the plant.

The 12,000 ft. of pipe through which the water is circulated is broken up into loops



PIPES INSULATED BY CORK LAGGING

through which the refrigerated water is pumped. The longest of these loops contains about 5000 ft. of pipe. Most of the pipe is laid 3 ft. under the ground, with no other insulation than the clay, the piping above the ground being covered with a cork lagging.

Fifteen hundred gallons of water is circulated per hour, leaving the pump at an average temperature of 40 deg. Fahr. and returning to the cooling tank at temperatures fluctuating between 50 and 55 deg. Fahr. Thus a fairly uniform temperature is obtained at the fountains, varying between 40 and 50 deg. Fahr., depending on their location in the several loops.

The sterilization of the water is one of the unique features of the installation. The apparatus, known as an RUV sterilizer, utilizes the ultra-violet ray as produced by a special mercury-vapor lamp sending its rays into the water through a quartz tube. The new drinking water system reduced the expense and trouble connected with supplying the workmen with water and ice in barrels, at the same time giving the employees the benefit of a drinking water that is both pure and cold.

Make Compression Tests of Electric Conduits

Conduits Embedded in Floor of Railroad Building, St. Paul, Show Strength Equal to That of Concrete

By W. E. KING
Treasurer, Toltz Engineering Company, St. Paul

TESTS made to determine whether it would be safe to embed electric conduit in the compressive side of the concrete floors in the Railroad Building, St. Paul, show that the conduits tested developed ample strength as compared with the concrete displaced. By avoiding the necessity for a 3-in. cinder fill in which to embed the conduit, an estimated saving of 10 per cent in the cost of the tile arch floors was obtained.

In the Railroad Building now being constructed in St. Paul there will be an area of more than 700,000 sq. ft. of reinforced-concrete floor. The framework of the building is the usual steel-skeleton type, with steel beams extending between the columns only. The floors consist of 4-in. concrete joists, separated by 12-in. tile. The concrete above the tile, forming the "tee" of the joist construction, is 3 in. thick. The usual construction would provide for a 2-in. thickness of concrete over the top of the tile.

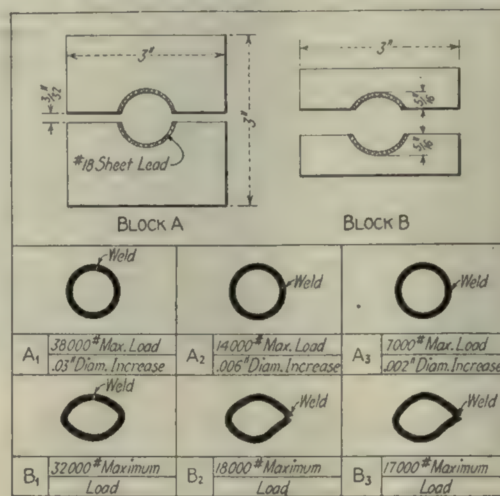
How Economy Was Attained

This additional thickness of 1 in. was allowed in order to provide a space for the electric conduits, which are to be placed before the concrete floors are poured. This arrangement results in a considerable saving over the usual plan of placing the conduits in a 3-in. cinder fill above the top of the rough slab. In this case the cinder fill was rendered unnecessary for fastening the floor surface down, because the floor finish is to be 1¼-in. cement or "Terrazza." The use of this construction results in a saving of about 10 per cent over what the cost would be for tile arch floors with 3-in. cinder fill on top for bedding the conduit.

As this construction makes it necessary to embed the electric conduits on the compression side of the slab, the conduits as hollow tubes must resist a compressive stress of about 650 lb. per square inch, in approximately the same manner as a boiler flue.

Conduits Tested in Compression

The question was raised as to what is the safe crushing strength of such electric conduit. The writer was unable to find records of any tests having been made to determine this, so it was decided to make an accurate test. For this purpose six samples of ¾-in. "Greenfield Duct," manufactured by the Sprague Electric Company, were cut in pieces 3 in. long. Three of these pieces, A1, A2 and A3, were tested by placing them between the two halves of block *A* and subjecting them to compressive pressure in a testing machine. Block *A* consists of two pieces of 3 x 3-in. cast iron with a hole drilled through as shown in the accompanying sketch. A strip of sheet lead was inserted around the conduit in order to reproduce, as nearly as possible, the conditions of uniform pressure under which the conduit would act when



BLOCKS AND SPECIMENS USED FOR TESTS

embedded in the concrete. The experiment was varied in the three specimens by turning the weld in the conduit to a different point on the circumference relative to the slot between the two cast-iron blocks.

None of these test pieces were tested to destruction, but the test was carried far enough to show that the strengh of the conduit was considerably greater than the ultimate strength of the concrete in which it was to be used, as shown in the accompanying table.

In order to duplicate the condition of a conduit coming close to the outer surface of the concrete, slab test-block *B* was prepared. It differs from block *A* only in the fact that the slot between the two halves of the block is made considerably greater. As was expected, the B specimens were distorted at a less load than the A specimens.

MEASURED DIAMETERS AND APPLIED LOADS IN ELECTRIC CONDUIT TESTS

Specimen	Weld at	Outside Diameter Original, in.	Outside Diameter After test, in.	Load applied, lb.
A1	Top	1.042	1.072	38,000
A2	Side	1.057	1.063	14,000
A3	Side	1.056	1.058	7,000
B1	Top	1.042	1.101	15,600
B2	Side	1.056	1.128	14,400
B3	Side	1.056	1.128	14,400

Seam opened for B2 and B3 at load of 14,400 lb. The maximum load applied to B1 was 32,000 lb.; to B2, about 18,000 lb.; and to B3, about 17,000 lb.

Attention is called to the fact that the position of the weld with reference to the unsupported part of the conduit greatly affected the strength of the conduit; that is, in the cases of specimens B2 and B3, where the weld was brought opposite the slot between the two blocks, the strength of the conduit was found to be a little more than one-half that of specimen B1, where the weld was placed at the top.

The elastic limit of the conduit is reached at a load of about 3600 lb. per square inch, and failure thereafter is at a very gradual rate. The strength of all three specimens B is above the ultimate compressive strength of 1:2:4 concrete.

Six pieces of conduit were cut 6 in. long

and embedded in 6-in. cubes of mixer-run 1:2:4 gravel concrete. These cubes were tested at the age of 28 days and failed by the crushing of the concrete without damage to the conduit. The strength of the cubes averaged a little more than 2500 lb. per square inch.

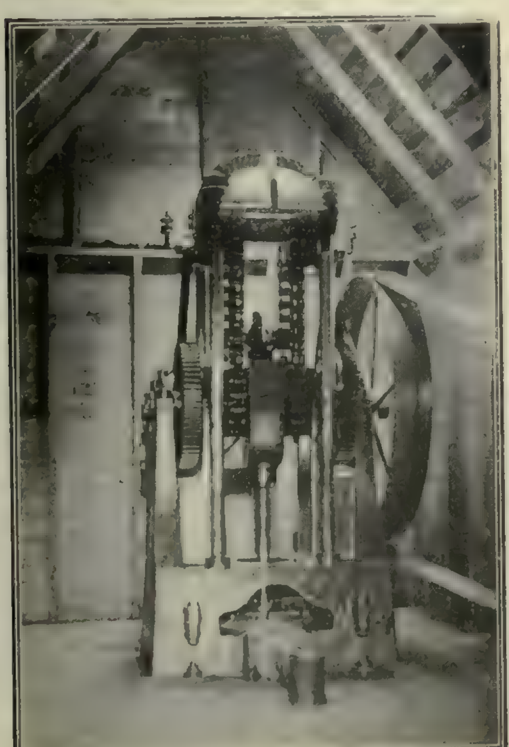
No tests were made to determine whether the insertion of conduits running crosswise of a concrete beam will lessen the shear strength of the beam. This factor should be taken into consideration in case the conduits occur close to the support and in case the area cut out represents any considerable portion of the shear value of the slab or beam. Larger sizes of conduit would probably show a less compressive strength in crushing than the ¾-in. size tested.

These tests were made under the direction of the writer by J. O. Meyer, chemist, and O. B. Robbins, assistant engineer, of the Great Northern Railway Company. The designs for the floor slabs were prepared by the Toltz Engineering Company, consulting engineer for the Railroad Building, under the direction of R. Budd, assistant to the president of the Great Northern Railway Company.

Kinks and Operating Costs at Small Pumping Plant

Concrete Mufflers Replace Ordinary Type, While Simple Device Supplies Warmth for Engine Room

DEEP-WELL pumps, a lighting system and commercial motors are supplied in the village of Downer's Grove, Ill., by a municipal electric plant consisting of two horizontal two-cycle 120-hp. Snow Diesel engines. To cut down the noise of the exhaust the original mufflers were replaced by large reinforced-concrete mufflers designed by H. A. Gardiner, superintendent. They have conical roofs and a steel stack projecting 3 ft. above the top. The outside diameter is 8 ft. and the height 10 ft. The structure rests on six concrete piles, because if set on a solid foundation the ground in the vicinity starts vibrating in harmony with the exhaust. The size of the mufflers was determined by the piston displacement and scavenger air volume per stroke. The exhaust enters at the bottom and on the side, where a circular brickwork makes the gases whirl about the center of the muffler. This circular motion has a tendency to pull a vacuum behind the gases. On top of the brickwork forming the first stage is a system of grate bars, and on top of these are ordinary brick in loose layers which act as a baffle to break up the noise of the exhaust. On top of this is a fine wire screen with a layer of crushed stone to further break up the report. The conical-shaped top is merely to keep out the rain. A connection to the sewer is made to drain the interior condensation.



NEW TYPE OF PUMP IS USED

In order to keep the concrete from getting too hot when running continuously under heavy load, a ½-in. pipe is tapped into the exhaust pipe just outside of the muffler. Water is thus carried into the muffler as steam and keeps the temperature down. Frequently an accumulation of carbon in the muffler will catch fire, but it is allowed to burn out until the concrete begins to get too hot, when water is turned on full in the small pipe to put out the fire. This process makes the muffler self-cleaning. The mufflers are so effective that the exhaust cannot be heard or any vibration of the air or ground felt when standing immediately beside them.

ENGINE INTAKE MAKES HEATING PROBLEM

When both engines are running their intakes exhaust about 4000 cu. ft. of air per minute from the room. After the installation was made it was found to be practically impossible to keep the engine room warm enough in winter. This was ingeniously overcome by making an air intake to the room and at the same time utilizing a portion of the waste heat of the exhaust. The iron exhaust pipe on one side of the station was bricked in, leaving about a 6-in. space around the pipe and with the outer end of the brickwork open. The inner end of this brickwork opens into the floor of the engine room near the intake ports of the engine. The air is thus drawn in over the hot exhaust pipe. The advantage is twofold—the warmed air produces a better mixture for the cylinders and gives the needed warmth for the engine room.

The exhaust pipe from the other engine is carried through the oil-tank room and the whole room is used as an intake flue for the engine. Incidentally this heat in the oil-tank room keeps the oil in good shape in the coldest weather.

WATER SUPPLY PROVIDED BY DEEP WELLS

The village water requirements are supplied from two deep wells, and in order that the pumping could be done entirely by electrical means a special type of deep-well pump, manufactured by the Deming Company, was used. These two deep-well pumps are belt driven by 15-hp. variable-speed motors. These were the first pumps of the kind to be installed and their operation is considered very satisfactory. During peak load on the electric system the deep-well pumps are slowed down to the bare requirements of the system. They discharge into a 60,000-gal. cistern from which the water is supplied under 60-lb. pressure to the mains and standpipe by two centrifugal, two-stage, 350-gal.-per-minute pumps, driven by 20-hp. variable-speed motors, which are also slowed down during peak-load periods.

CONCRETE MUFFLER FOR DIESEL ENGINE

Scalped oil is purchased in 10,000-gal. lots from the Texas Company and stored in the 12,000-gal. tank in the station. The average fuel cost for the year 1915, placed in the tank at Downer's Grove, was 2.94 cents per gallon. The average cost of oil at the switchboard for the same period, including that used in trial runs, testing out, tuning up, etc., was 0.331 cent per kilowatt-hour. The oil consumption was found on test to be 0.50 lb. of oil per brake horsepower hour full load; 0.52 lb. of oil per brake horsepower hour three-quarters load, and 0.60 lb. of oil per brake horsepower hour one-half load, for oil having a heat value of 19,000 B.t.u. per pound. The overall efficiency of the station is above 30 per cent.

Absorbing Overhead

California's state highways are fast being completed and the overhead is therefore rapidly being absorbed. According to the July *Bulletin*, 1320 miles of road have been built at a cost of $13,746,396, with 84.32 per cent going directly into the roads. The cost of administration, technically known as "overhead," amounts to $604,926, or 4.41 per cent. In this "overhead" are included the purchasing, auditing and disbursing departments, the commission's attorney and its secretary, the engineering assistants at headquarters, the division engineers and their assistants, and the clerical force, both at headquarters and in the divisions, including salaries, expense accounts, rentals, etc. The greater part of the 15.68 per cent other than the technical "overhead" has been apportioned and charged directly where it originated. The technical "overhead" cannot be so charged until the completion of the work makes possible a proportional distribution. Figured in the gross percentage is 1.19 per cent for equipment and stores on hand, also 1.9 per cent for field and drafting work for 850 miles of highway in advance of contracts. Deducting these items leaves 12.59 per cent on an expenditure of a trifle more than two-thirds of the original $18,000,000.

Depreciation as Applied to Valuation

Normally, in Well-Maintained Railroad, No Indication of Withdrawal of Capital, and Should Not Be Deducted

By R. B. SHEPARD, JR.

Office Engineer, Valuation Department, Atlantic Coast Line Railroad, Wilmington, N. C.

THE WORK now being done by the engineering department of the Division of Valuation, Interstate Commerce Commission—namely, that of inventorying and pricing the units of physical property of the railroads and estimating the physical condition thereof—is in compliance with that section of the Valuation Act which enjoins the ascertainment of the cost of reproduction new and the cost of reproduction less depreciation. The data collected under this provision of the act are to be considered, among other "relevant facts," in fixing the final values of the properties; and, for the uses to which the federal valuation is most likely to be put, will probably be given predominant consideration as representing the present-day equivalent of capital retained in railroad service, the interest on which forms part of the cost of conducting transportation. It is the feature of capital equivalent retained in transportation service that it is desired to emphasize, and especially its bearing on the logical treatment to be accorded depreciation.

An owner of any manufacturing plant has certain obligations to the business which constitute "prior liens" on the receipts from operation and must be discharged before he can take any portion of the earnings for himself. Included in these obligations are running expenses, labor and supplies; maintenance of plant, embracing renewals of parts worn out, damaged or destroyed in service, and pecuniary liabilities arising from the use of borrowed capital. There are certain inexorable economic laws which enforce the meeting of these obligations under penalty of sure bankruptcy or loss of control of the plant. It is not necessary, though it may be advisable, to be able to show on the books of the industry at any instant that the accrued operating liabilities have been charged to operating expenses and credited to appropriate reserve accounts, though it is absolutely essential to show ability and intent to meet them when they fall due. Past performance and the condition of the property taken in conjunction with the temper of the management are sufficient indications of the policy of the company toward maintenance and the ability to fulfill its requirements.

Purpose of Depreciation Accounts

That depreciation is part of the maintenance expense no one denies, and the advocates of special depreciation accounts merely claim that such accounts tend to more conservative bookkeeping in that they reduce the surplus which would otherwise appear and prevent the loading of operating expenses in years of heavy renewals with charges which accrued over a period of preceding years. This, of course, is good theory, but is very much more applicable to plants of a comparatively small number of relatively large units than to a railroad, made up as it is of a vast number of units of all degrees of magnitude. In the case of a railroad the charges due to renewals and replacements are very nearly uniform from year to year; or rather are not subject to violent fluctuations. It is extremely doubtful that years of heavy renewals for any well-managed railroad can be determined from inspection of the total charges to operating expenses over any number of years, although depreciation accounts have been decidedly exceptional. The reason is that after a railroad has been in operation for a sufficient length of time to have become settled and adapted to the work to be performed the maintenance feature has become so systematized that excessive renewals do not become due in individual years; the expenditures for replacements being fairly evenly distributed from year to year producing results identical, so far as operating expenses are concerned, with those which depreciation accounts are calculated to effect. The practical result is that renewals are charged directly to operating expenses instead of indirectly through depreciation accounts which have become constant because of approximate balancing of yearly credits and debits, releasing any depreciation funds which may have been accumulated.

Depreciation and Capital Retained in Property

The interest of valuation engineers in the subject of depreciation is wholly in respect to its effect on capital equivalent retained in the property after construction has been completed and through the years of operation. The effort to determine the cost of reproducing the railroads is purely an endeavor to reveal the capital which is confined in them, or which it would be necessary to withdraw from other fields in order to replace them were they to cease to exist. It follows that depreciation is important from the valuation viewpoint only insofar as it affects the volume of capital held in service, or rendered unavailable for other uses. The mere fact of the existence of accrued depreciation is no more significant nor objectionable than the fact of accrued taxes, or interest, or wages, or any other of the numerous charges that continuously result from the operation of the property; nor is it any more possible to eliminate the one than the others. They are all operating liabilities to be met when due and are sustained by the same economic laws. Default in one or all is visited with the same inevitable penalties.

There is one circumstance, and one only, which could justify the reduction of the cost of reproduction new by the amount of accrued depreciation in estimating the capital equivalent of the property; namely, that an amount equal to the theoretical depreciation reserve had been withdrawn from the plant and made available for other service. Should it be developed that it has been customary in the past, or would be the practice in the event of reconstruction, to withdraw this fund when it had become no longer necessary, because of the balancing of its debits and credits, or that maintenance had been neglected to the detriment of the property, then an appropriate reduction in the statement of capital retained in service should be proper. In the former case the amount of depreciation might be regarded as a loan by the owners to the property to be repaid with interest when it could safely be withdrawn from service; in the latter there would exist an obligation on the part of the owners which would certainly have to be met in some way some day, but which, while it existed, constituted a fact of withdrawal of capital of an amount necessary completely to rehabilitate the property; this amount, in a specific instance, to be determined from consideration of relevant facts.

Early Deficits of Railroads

The proposition that the amount of the accrued depreciation fund might be returned to the owners seems to be effectively refuted by the early financial histories of all railroads and of newly constructed branches of old roads. It is common knowledge that during the early years of operation few railroads or branches have made ordinary operating expenses and fewer have made fixed charges. It is obvious that any depreciation reserve, naturally built up, must have been provided from revenues earned during this early or development period, further increasing the negative margin between earnings and expenses. It is also fairly well established that a sum is to be added to the product of physical units into prices to provide for development expenses, and that this expense shall include, among other items, the deficit resulting from operation during the initial period of service.

It follows, therefore, that a depreciation fund, provided out of earnings which themselves were deficient, would have caused a further sacrifice on the part of the owners and constituted a corresponding investment in the property to be capitalized as a development expense. The real origin of the depreciation reserve can be traced still further back, or into the construction period, when it should properly have been charged to the construction account; but it certainly has not been the custom to charge construction with depreciation of rail, ties, equipment or other units to be retained in the operating service. Thus, had depreciation funds been provided, they would have been at the expense of the owners and an appropriate charge to capital account.

It seems very clear that normal depreciation in a well-maintained railroad is no indication that there has been a withdrawl of capital; and as it is with the requisite permanent capital to replace the railroads were they to cease to exist that the "reproduction" feature of the valuation has to do, it follows that there can be no subtraction of normal "accrued depreciation" to subserve its ends.

One Motor Truck Collects Manure and Waste Bedding from 1300 Horses

For the last two years one 5-ton motor truck has collected the manure and waste bedding from 1300 horses stabled throughout the city for use in the Baltimore parks. The horses are those of the various fire departments, street-cleaning and street-railway stables, contractors and other large owners of horses scattered about the city. The park department owns three 5-ton trucks—two Pierce-Arrows and one White. Though no careful detail records have been kept in connection with the operating expenses and work accomplished, William S. Manning, general superintendent of the department, states that, from a practical standpoint, it is known they are an economy. For the manure and waste-bedding work one of the Pierce-Arrows was first used exclusively, working 16 hours every day except Sunday and using two shifts of four men each.

Dynamite Proves Effective in Wrecking of Panama-Pacific Exposition

Use of Explosive with But Slight Breakage Keeps Wrecking Cost Down to $250,000—Site Will Be Restored as Required by Jan. 1, 1917

IN WRECKING the building and other physical improvements of the Panama-Pacific International Exposition and restoring the site there are the same elements of unique conditions that were so often met in the construction work. An engineering organization is in full charge of the disposal and dismantling of structures, and the work is being expedited in a manner carefully calculated to return the maximum revenue to the exposition company and at the same time comply with the agreement which calls for the complete restoration of the site by Jan. 1, 1917. The post-exposition work is divided into two independent classes—salvage operations and restoration of the grounds.

No Good Bids for Entire Job

Shortly after the close of the exposition it was decided to prepare an elaborate bill of sale covering the disposition in a single contract of all improvements not involved in preservation schemes. With minor exceptions no large improvements west of the Palace of Fine Arts were owned by the exposition. It was therefore decided to solicit proposals for the purchase of all physical property exclusive of real estate owned by the exposition east of the Palace of Fine Arts, except only the California Building, which is being retained for a proposed State Normal School, and the Palace of Fine Arts itself, which certain organizations purpose to preserve as a permanent art gallery, provided funds are forthcoming.

RAZING THE ARCH OF THE RISING SUN

Photos by Cardinell-Vincent Company, San Francisco

FELLING ONE OF THE ITALIAN TOWERS

This call for proposals was based on the plan that the bidder was to make a cash offer for all the improvements in question, which were to be removed under certain conditions outlined in the proposed bill of sale, with the understanding that all the salvable material was to become the property of the successful bidder. When these proposals were opened on Dec. 31, 1915, it developed that offers ranged from $4,775 to nothing and up as high as $175,000, named as the sum for which the bidder would remove the structures. These offers clearly indicated that the exposition could not expect tenders which it would be willing to accept.

To sell practically all of the improvements east of the Palace of Fine Arts, which cost upward of $11,000,000, for a sum under $5,000 would have created unfavorable comment. Furthermore, it was believed that a very substantial net sum could be realized by the exposition in doing the wrecking itself. This was borne out by an estimate prepared at this time showing a net income from salvage operations of about $200,000. Since the exposition would have to engage in a great deal of work in restoration, and an overhead organization would be required for this, it was decided that wrecking operations could be economically conducted by the exposition at the same time.

It was found, however, that it would be very desirable to contract for the removal of all small buildings, certain parts of most of the structures and a few structures in their entirety. Also it was desired to sell in place as much of the salvage as would command a price near its actual value, in order that, so far as possible, the funds of the purchasers rather than those of the exposition would be employed in the wrecking.

Classification of Accounts

Having settled this policy, it was found desirable to classify all post-exposition expenditures as follows:

1. Wrecking of exposition improvements.
2. Restoration of leased lands, federal, municipal, and corporation properties; return of leased apparatus.
3. The conduct of remaining utilities.
4. General overhead expense to conduct the three classes of work named above.
5. Maintenance accounts.

Of the foregoing, the only two which have corresponding income accounts are 1 and 3.

Under the scheme proposed the Tower of Jewels was sold for $9,000 in place. This structure is being dismantled piece by piece, and the purchaser expects to save intact some 1400 tons of structural steel. It will be recalled that the tower, which had a total height of 435 ft., was supported on a two-hinged steel arch frame which extended the full height of the structure. The exposition company estimated that it would cost about $20,000 to get out the salvable material in the tower.

Among the other more important contracts were the floors and roofs—that is, the joists, girders, sheathing, flooring, roofing material and glass of the eight exhibit palaces of the main group—which were sold for $26,500; the pipe and fittings in these eight buildings and in the palace of machinery, which were sold for $25,000; the street mains, including the high and low pressure water systems, and the auxiliary water-supply system, which brought $23,000; and the Palace of Horticulture, sold for $5,000. All these contracts required the purchaser to remove the material.

In removing the structural frames of the several buildings it was first intended to pull them down section by section and bent by bent, by means of donkey engines and the necessary winches and lines. This plan was abandoned after it had been employed to some extent, and the frames are now being razed by dynamite, as it was found possible to do this with but little more loss of material. In many cases, such as in taking down the domes of the main palaces, the cost of dynamiting is less than 1 per cent of what it would have been if the structures were dismembered and dismantled by hand.

To explain the wrecking operations, it should be said that the heavy timber columns and trusses are each made up of a number of unit members separated by spacers and rigidly bolted together. This condition naturally tends to prevent shattering, so that when one of the heavy trusses falls and is broken, it is practically always found that the break is local so far as the timber is concerned. This means that the broken section of the timber can be cut out, usually leaving about 80 per cent of the piece uninjured by the fall. Of course the long tension rods are badly twisted when the trusses fall, but as their junk value is measured only in pounds it does not matter. All splintered timbers and small trash are being left where they fall in the expectation of burning them after all salvable timber is removed. After the burning there

will be a second combing of the grounds for old iron from the burned timbers, and then the concrete fire walls will be wrecked, probably by dynamite, and the reinforcing rods recovered.

The usual procedure of bringing down the domes, which stand 162 ft. high and cover an area of 102 ft. square, is to cut the dome and its supporting columns entirely free from other portions of the structure and dynamite the two corners on the side toward which the dome should fall. Previous to the falling, all of the walls, studding and braces are stripped from the skeleton, leaving only the heavy timber columns which carry the weight of the dome proper. The dome itself consists of segmental timbers supported on a circular girder, which in turn rests on four trusses each carried by two columns. At each corner of the dome there are thus two columns, each consisting of four 12 x 12-in. timbers. The method of dynamiting is to bore each timber and insert a stick of dynamite about 6 ft. from the base, connecting all eight sticks by wire for simultaneous firing by battery. Bringing down the domes this way costs, for labor and powder, about $6.50 for each dome. From the dynamited domes about 60 per cent of the timber in the trusses is salvaged and about 70 per cent of the timber in the columns.

Much Material Salvable

Lumber in the larger dimensional sizes is salvable if not less than 6 ft. long, and all the structural iron, such as bolts, rods, washers, plates and nuts, is collected and sold as scrap iron. The value of the salvaged lumber varies from $5 to $20 per thousand, according to condition, size and length, the average being about $8. The iron brings about $16.25 per ton. It is notable that in the skeleton structure of the domes and supporting columns about 1 lb. of iron is salvaged with every board foot of timber, and in the skeleton columns and trusses of the structures, other than in the domes, the iron averages about ¾ lb. per board foot of timber recovered. The timber which was recovered by these operations is sold direct to individual purchasers, if they are available; if not, the same is classified and yarded for future disposition. Before lumber is yarded, all bolts, keys and plates are removed. The average cost of salvaged lumber in the yard is $5.50 per thousand; the cost of recovering steel, f.o.b. cars Exposition Grounds, is $10 per ton.

The work of restoring the site consisted of bringing the land up to specified grade, repairing and replacing streets and sidewalks, installing utility mains which had been removed, and other similar work. During this time certain general overhead and maintenance expenses go on. These consist of guards, ground lighting and other operations which are required as long as physical property remains.

In bringing the site up to grade, fills ranging up to a maximum of 11 ft. will be required in some sections. Some of this filling and that required for smaller parcels of land will be obtained from available material on the site, some from inorganic débris resulting from wrecking operations, such as sand, loam, clay, gravel and crushed rock, and the remainder from the bay by dredging operations, unless the required amount of suitable fill may be obtained by making the Exposition Grounds a free dump for excavation operations in San Francisco during 1916. Wood, paper, organic matter and other similar rubbish will not be used by the exposition for filling materials, nor will it permit the participants or their wrecking contractors to leave upon the grounds such débris as may accumulate from wrecking operations.

TYPICAL VIEW OF DOME WRECKAGE

It is the intention to leave piles which were driven for support of buildings, the idea being to cut them off 1½ ft. below the uniform ground level at which the exposition is required to leave the surface of the various blocks. The piles can be pulled for about their value, which, as far as the exposition is concerned, would result in neither profit nor loss. However, as a matter of economy, it was thought far better to leave the piles in place, which would thus become of some value to the owners of the property, without at the same time resulting in any loss to the exposition.

Some work must be done to restore certain properties belonging to public-service corporations, including pole lines, gas and water mains and railroad tracks. In general, the site will be restored to its original condition, in addition to filling in to specified grade those portions not so filled before the exposition period. Overhead-maintenance expense consists largely of the general office, guard service, fire protection, health service and sanitation, and general work about the buildings and grounds, all of which will decrease continually and will cease with the closing of operations.

WINCHES PULL SKELETON FRAMES OVER

It is expected that the wrecking expense will be approximately $250,000 and the income from salvage about $550,000. The restoration expense proper will be about $310,000; utility expense, about $95,000 (with a post-exposition income from this source of $18,000), and the overhead expense a total of $55,000, with a maintenance expense of about $200,000.

The wrecking of the exposition and the restoration of the site are being done under the direction of the division of works, of which H. D. H. Connick is director of works and A. H. Markwart assistant director of works and chief of construction. William Waters is in immediate charge of wrecking and restoration work, with L. I. Fulcher conducting field operations. C. H. Munson is in immediate charge of salvage sales.

Argues for Fuller Use of Niagara Water

True Conservation, Dr. Edward Acheson Says, Uses Inexhaustible and Preserves Exhaustible Power

On July 13 the committee on foreign relations of the House of Representatives visited Niagara Falls in order to study the power situation. At a meeting under the auspices of the Niagara Falls Board of Trade leading men in Niagara's electrochemical plants explained to the congressmen the influence which the Niagara products had on the industries and the welfare of our country. Though most interesting, space will not allow their reprinting here. They will be found in full in the Aug. 1 number of *Metallurgical and Chemical Engineering*. Moreover, a brief summary of the products depending on hydroelectric energy appeared in this journal May 20, this year, page 679.

One of the addresses at Niagara Falls, however, was especially pertinent. It referred to a larger use of Niagara water, a proposal which has had the hearty endorsement of the Engineering Record. The speaker was Dr. Edward Acheson, the discoverer of carborundum and of artificial graphite, with its various adaptations. He spoke in part as follows:

A National Question

"My purpose in giving you statistics regarding these enterprises [carborundum and graphite production] is not with the hope of your rendering me assistance to advance my own interests, except as they may be advanced with others. I am presenting them to illustrate what may be done with Niagara Falls power in furthering the interests of our country at large. Many of the products produced in this city are absolutely essential to the successful operation of industries in cities and towns far removed from Niagara Falls.

"You may say this is all very good, but why not manufacture these materials somewhere else and preserve the Falls? This brings us to the very heart of this whole matter. Previous speakers have already answered this question better than I am prepared to do. This subject is, however, very much greater than the simple matter of supplying more power and greater facilities to the factories of Niagara Falls. It is nation-wide in importance. You, as a

committee of the national congress, have a duty to perform and a great responsibility rests upon you.

AN INDUSTRIAL COMMUNITY

"While you are with us, you will not fail to be impressed with the fact that this is a novel industrial community. Niagara Falls is no longer the pleasure resort of former years. The scenic beauty of the Falls is still with us, but the true value of the Falls and this community, in so far as the country at large is concerned, consists in the vast quantities of manufactured products distributed throughout the world from our local factories, many of which were only made possible of commercial production by the generation of electricity through the diversion of water from the Niagara, and in the invisible, vibrating current of power sent out on radiating threads of copper to cities, towns and villages within a radius of 100 and more miles. Many of the factories located here on account of the power being cheaper. They have grown to large magnitude, and it is not an easy matter to move them to other localities.

"I wish I had the gift of ready language, that I might better impress you with what appears to me to be your opportunity to use your great influence and directing power in bringing about a movement which would be of incalculable benefit to our entire country, and more particularly to our posterity. Would that I might make one small remark that would cause you to depart from what, to me, seems a wicked course—the failure to properly use our great natural resources. We are at the present moment within hearing of the roar of one of the most stupendous forces in the world. Magnificent and grand from the scenic point of view it certainly is, but to me it would be much grander and more impressive were a large portion of this vast power being utilized for the present and future welfare of man.

"I consider it a veritable crime against our posterity to preserve this great natural, inexhaustible resource in its entirety, or as it now is, for reason of its scenic beauty, while we at the same time press forward to the exhaustion of the coal deposits of our country.

EXHAUSTION OF COAL SUPPLY

"We are advised our coal supply will be exhausted in another century. Certainly a goodly time, but still not great as we measure the life of nations. There is nothing visionary or fanciful about this early exhaustion of our coal supply. True, we are told of immense coal fields in Alaska, but one cannot readily imagine the factories of New York, Pennsylvania, Ohio, or, in fact, any of the states being supplied from these deposits in the frozen North. Let me impress upon you the fact that a century is not a long period. Three generations will more than cover it. An instance in my own family will well illustrate this. Among the treasures of the family is an invitation from President Washington to one of my grandfathers to dine with him, my grandfather at that time being a member of the Pennsylvania Legislature, and this was more than a century ago. Our own grandchildren may witness the practical exhaustion of our coal if no steps are taken to conserve it.

"I have here a few statistics coming from the U. S. Geological Survey: The production of anthracite coal in 1913 was 91,524,927 metric tons. Compare these figures with the production in 1820, which I find was no more than 365 tons, and this was two years after the birth of my father. Here are figures on the production of bituminous coal in the United States: In 1895 it amounted to 124,627,000 metric tons. In 1900 it had increased to 191,256,000 tons, and in 1913 it had jumped to the great figure of 478,523,000 metric tons. You will not find it difficult to see the exhaustion of the coal deposits a century hence.

"Perhaps you are not interested in the welfare of the people who will live a century hence, but I assure you that if those people find that a great natural, inexhaustible resource for power, as is the Falls of Niagara, has been preserved to them on account of its scenic beauty, while at the same time the country has been denuded of its coal supply to produce power, these faraway people will be very, very much interested in what you and all of us, of this present generation, have been doing. Unless we have already done so, they will find themselves under the necessity of diverting the water from the river for power purposes; *hence they will have neither coal*, which we will have used, *nor scenic beauty*, which we are trying to preserve.

"In closing, gentlemen, permit me to leave with you the question, *What is the true, the real conservation of our natural resources? Is it not the full and economic use of the inexhaustible for the preservation of the exhaustible?*"

Mission Bridge in Canadian Northwest Designed as Adornment to Its Location

Special Provision Made Against Abutment Sliding, While Falsework Scheme Saves Lumber—Unusual Flood Successfully Passed Before Completion

By JOHN F. GREENE
Bridge Engineer, City of Calgary, Canada

ONE OF THE FIRST bridges in the Canadian Northwest to be constructed of reinforced concrete is the Mission bridge at Calgary. A highway arch structure containing massive piers designed in simple lines to emphasize the historical mission style, with adequate provision for unbalanced thrust between the unequal arch spans, the bridge demonstrated its stability even before completion by successfully withstanding an unusual flood. Although the sidewalk forms were washed out, the concrete only a few days old showed no cracks or signs of failure.

BRIDGE SUCCESSFULLY PASSES FLOOD WATER IN JUNE, 1915, BEFORE COMPLETION

The bridge, located on a main highway running south from Calgary, Alberta, Canada, spans the Elbow River at a point about a mile and a half from the center of the city. It replaces a three-span light steel bridge which stood near the site of a ford leading to an old Catholic mission, from which the bridge derives its name.

DETERMINING CONDITIONS

The bridge floor connects with paved streets at both ends, therefore rendering it desirable to make the connection between these paved streets with a straight grade. The former bridge floor stood 4 ft. above that of the new bridge, with steep approaches at both ends. A careful investigation of conditions led to the conclusion that, although the Elbow River was subject to sudden and excessive floods, it would be feasible to adopt the ideal straight grade and still provide enough waterway under the arch openings, by excavating portions of the river bed, to pass the floods.

The city electors had appropriated sufficient money to build a bridge which would not only carry traffic but also conform to the surroundings, both natural and artificial. The bridge stands in a very desirable residential district; the banks of the river are wooded and a boulevard skirting the river affords a good view of the bridge from both the upstream and downstream sides. The Elbow River forks about 800 ft. above the bridge and flows past the site in two streams, with a wooded island between. Only during extraordinary floods is this island submerged.

With this thought in mind, in addition to the historical consideration mentioned, the bridge was laid out along its present lines. The piers and abutments were made wide and massive, to accord with the mission type, and all outside faces were left simple, with only enough projections to relieve the monotony of the dull concrete surfaces. Two small arches were used on the island because of the fact that floods of sufficient magnitude to submerge the island are of rare occurrence and because a long span would be an apparent incongruity. This was done even though it entailed an increase in the cost of about $1,200 over the estimated cost with one span over the island. A concrete baluster handrail of effective design was adopted.

GENERAL DIMENSIONS

The bridge consists of four arch spans carrying a roadway 40 ft. wide, with two cantilever sidewalks each 6 ft. wide. The arches are of the barrel type, with earth backing; one span of 86 ft., two of 34 ft. and one of 76 ft. The arches have been designed to carry 50-ton cars on two tracks, with the line of resistance inside of the middle third. Stresses were determined for a temperature drop of 100 deg. and steel provided for the tension existing under this condition.

Unusual methods were adopted to obtain increased resistance against sliding. In the abutments at both ends of the bridge, with an earth backing of 14 ft., concrete bulkheads 10 ft. high were placed. On the island ends of both of the longer spans a reinforced-concrete core wall extending 6 ft. below the base offered in-

creased resistance against both sliding and the possibility of undermining through scour. The lack of earth backing behind these foundations and the undesirability of transmitting thrusts from the longer arch spans through the smaller made some extra provision necessary. In addition to the foregoing, battered piles were driven in the foundations at both ends of both of the longer spans.

Expansion joints were placed at the third points and haunches in both the spandrel walls and the overhanging sidewalk, and lead strips 12 in. wide were used over each joint to intercept water. Drains were provided for the earth backing at all sumps.

Special Falsework Details

An unusual feature of the falsework is the combination of planed boards for stringers carrying the load from bent to bent, with cross-blocks resting on the bents to give the proper arch in the panel. The lagging was nailed to longitudinal planks sprung to the curve, these planks in turn resting on the cross-blocks. The advantage of the method lay in the fact that in a region of expensive lumber the waste incident to cutting ribs to curves and the extra caps used with wedges was eliminated. The cross-blocks were odds and ends from previously used form lumber, and served the purpose of wedges for striking centers. Stringers and longitudinal planks came out intact.

On June 26, 1915, after a period of six weeks during which daily rains had been prevalent, the Elbow River experienced a severe flood. At the Mission bridge the supports holding the cantilever sidewalk forms and resting on piles were washed out. The concrete thus deprived of support was from one to three days old. A thorough examination revealed no cracks, and after two weeks the walk was loaded with no evidence of failure. With much of the waterway restricted with falsework and rubbish, the bridge passed the flood with only a slight backing up of the stream. At the crest of the flood a wooden trestle bridge which had been washed out several miles upstream was thrown against the north arch, broken to pieces and dragged through the arch opening.

The bridge was thrown open for traffic on Sept. 1, 1915, the construction work having been done by day labor, and was completed at a cost of $3.10 per square foot. The following prices for labor and material prevail in Calgary: Common labor, 30 cents an hour; carpenters, 50 cents; lumber, $22 to $25 a thousand; cement, $2.40 a barrel; sand, $1.70 a yard; gravel, $1.60 a yard; steel, $51 a ton.

The bridge was designed and constructed under the direction of George W. Craig, city engineer of Calgary, with the writer in charge of the design, assisted by Lieut. Frank Lawson, 56th Canadian Overseas Contingent. C. M. Arnold was resident engineer on construction and J. Patterson was superintendent.

EFFECTIVE USE OF MASSIVE PIERS MARKS THE DESIGN OF MISSION BRIDGE IN CANADIAN NORTHWEST

Difficult Construction in Sewer Changes

General Electric Company Makes System Conform to That of Schenectady Without Interference with Usual Activities

By PAUL G. KOCH

TO MAKE its sewerage system conform to the general plan of the system of the city of Schenectady, undertaken to prevent the pollution of the Mohawk River, the General Electric Company recently completed changes at its own expense that involved the expenditure of $100,000 and included the construction of 7 miles of sanitary sewers and a sewage pumping station. The work was carried out without interfering with the customary activities of the plant. The system serves 20,000 employees, besides providing for the usual wastes in such works. The pumping station has several interesting features, notably an ejector for removing the screenings.

Construction of Sewers

In the excavation, water was encountered 8 ft. below the surface. The material was mostly sand. This combined with the presence of pipes of all kinds, for water, gas, oils, steam and air, already installed, made the laying of the new sewers extremely difficult. Many of the lines were located beneath storage yards filled with tons of castings and lumber, and serious difficulties were encountered in avoiding interference with the network of industrial tracks about the plant, a condition in prosecuting the work being that the business of the plant should not be interfered with in any way. All sewers below ground-water level were laid with watertight joints, mostly of Jointite; and tests made after construction showed that the allowable infiltration of 1 gal. per 24 hr. per foot of sewer was more than lived up to.

The average quantity of sewage from the works is about 1,250,000 gal. per day, with maximum rates, of course, much greater than this. Previous to designing the system, measurements were taken in the old system with Bristol recording gages to determine as nearly as possible the flow of sewage and trade wastes.

The pumping-station excavation was mostly in fine sand with large quantities of water, and had to be sheeted all the way round with 3-in. splined piling, braced with 12 x 12 timbers across the opening. The bottom of the excavation was about 25 ft. below the surface of the ground, or about 17 ft. below the surrounding ground-water level. The building is about 22 x 28 ft. on inside lines and is entirely of concrete. Windows and doors are steel covered. The station is equipped with three centrifugal pumps, motor driven, and the operation is entirely automatic. The electrical equipment was designed and furnished by the General Electric Company.

One of the motors is supported on a base somewhat different from the other two. The thrust bearing is placed beneath the floor and its normal place occupied by a pulley, so that in case of emergency a gasoline engine can be attached to the shaft to operate the pump. The starting switches are so arranged that the pumps will start at different elevations of the sewage to provide for varying rates of flow and for emergency conditions should anything happen to put one or more of the pumps out of condition.

Ejectors Remove Screenings

The unique feature of the design is the installation of an ejector for removing the screenings. Trouble is usually experienced in these small pumping stations in taking care of the suspended matters removed from the sewage. In industrial plants such as this, this removal would be particularly objectionable. The sewage reaches the station in a very fresh state, solids not being appreciably broken up, and the quantity of screenings is large. Burying of this matter is not practicable and incineration is costly and otherwise objectionable. The ejector is located in the pump room, and there are 12-in. connections to a depression in the floor in front of each of the screens. When the screens become clogged the operator pumps the sewage down to a low level in the pump well, pushes the matter collected on the screens to the depression in the floor with a rake and opens the hydraulic valves to the ejector, forcing the screenings to the ejector pot. The valves on the inlet pipes are then closed, the discharge opened and the screenings forced by compressed air into the force main. Generally this operation is repeated until the screens and floor are perfectly clean.

The new layout and the pumping station were designed by James C. Harding, consulting engineer, New York City, and constructed by Brown & Lowe, contractors, of Schenectady, N. Y. Mahlon G. Milliken was resident engineer.

New Harbor Basin at Copenhagen Formed by Long Caissons Floated to Place

Reinforced-Concrete Units 162 Feet Long, with Fourteen Compartments, Are Built in a Drydock and Towed to the Site

By O. BLUME
Engineer, Harbor Department, Copenhagen, Denmark

HUGE reinforced-concrete caissons, built in a large drydock and floated to position, form the walls of the new basin being constructed at Copenhagen, Denmark, to increase the harbor facilities at that port. When completed, a harbor of 31 ft. depth of water will have been created. Many special details in the design and construction will be found unusual and of particular interest to American engineers.

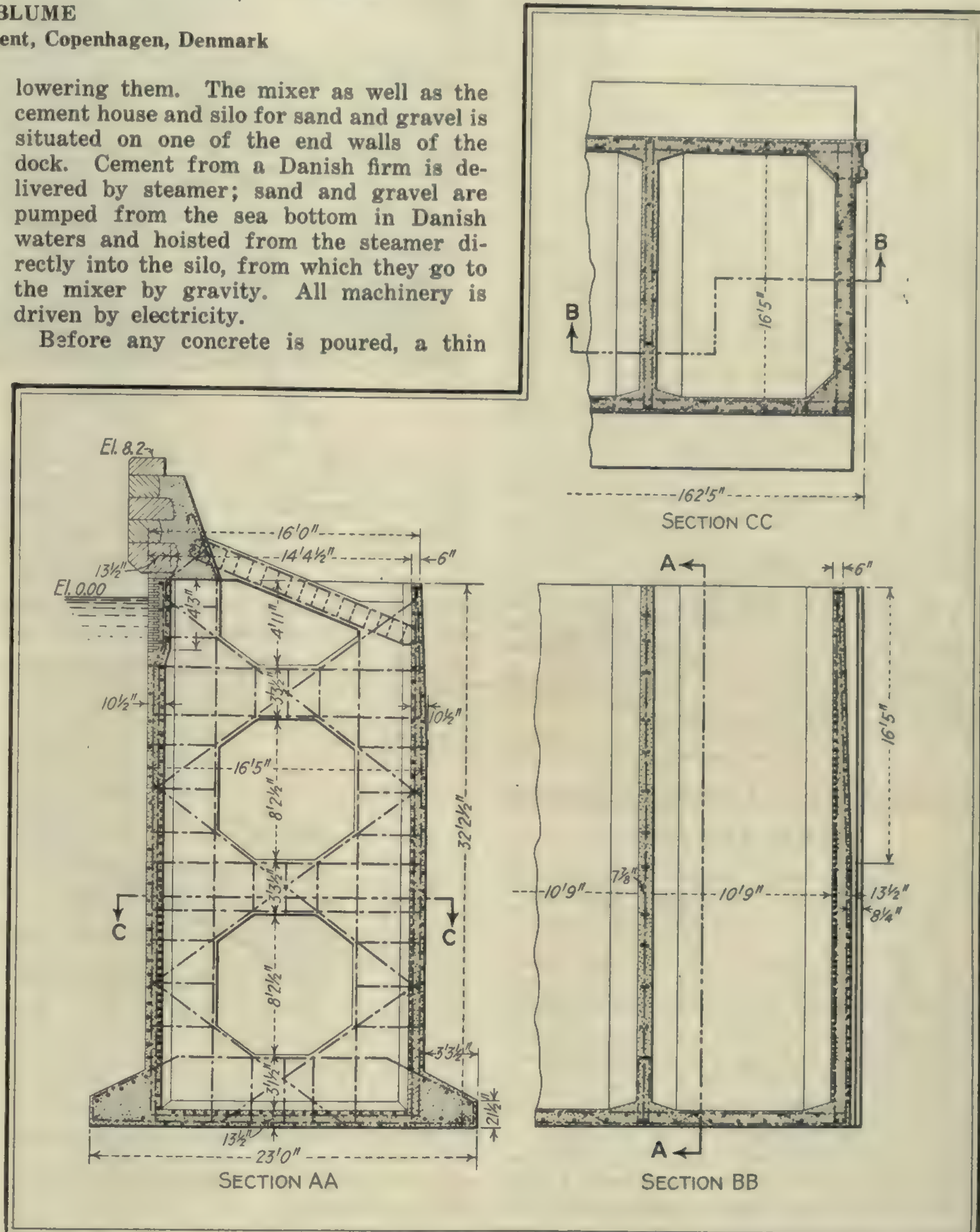
General Dimensions

The basin will be of rectangular shape, with three sides respectively 876 ft., 407 ft. and 202 ft. long—in all 3304 ft. of wall. The front part consists of a row of twenty-two reinforced-concrete caissons. The length of each typical caisson is about 162 ft. The caissons in the corners and one end are shorter. Each caisson is over 32 ft. high and over 16 ft. wide, with a toe on each side. Fourteen compartments are formed by cross-walls running the full height of the caisson, as shown in the drawing herewith, built with three large openings in order to save weight. Reinforcement consists of plain round rods of diameters varying from ⅜ to 15/16 in. The caissons contain about 13,900 cu. yd. of concrete and 700 tons of steel. The concrete is of 1:2:3 proportions.

In order to construct the caissons a drydock was built. This dock has at one side a narrow tongue of land, separating part of the existing harbor from the Sound. Each of the other three sides was constructed by driving two rows of 6 x 6-in. timber, 16.4 ft. apart. These were sheathed, connected with cross-rods and the space between them filled with sand. A gate was constructed in one end. The dock was then pumped out, the bottom leveled and covered with gravel about 1 ft. thick, the upper surface of this gravel being nearly 15 ft. below near water level. Room is provided in this dock for three caissons of the usual size, the dimensions of the dock being 115 x 177 ft.

Construction of Caissons

Forms are erected in the dock, one row along each side and two rows near the middle in such a way that each caisson is being built with forms on each side. These forms and scaffolding are built in three stories. On both the lower and the upper stories are tracks for concrete cars, which are readily brought to and from the mixer and over turntables, an elevator raising and lowering them. The mixer as well as the cement house and silo for sand and gravel is situated on one of the end walls of the dock. Cement from a Danish firm is delivered by steamer; sand and gravel are pumped from the sea bottom in Danish waters and hoisted from the steamer directly into the silo, from which they go to the mixer by gravity. All machinery is driven by electricity.



DETAILS OF REINFORCED-CONCRETE CAISSON USED IN COPENHAGEN HARBOR

Before any concrete is poured, a thin layer of sand is laid on the gravel; on this sand is placed one layer of thick wrapper paper, on which is poured about 3 in. of concrete. The bottom sheet is placed on this and the rest of the bottom is poured. The concrete is now carried up in the usual way, pouring 3.3 ft. at a time until the caisson is 22.3 ft. high. The Smith mixer used is capable of producing 118 cu. yd. in a day. The lagging and steel for the upper 3 in. are now placed, all lagging below this removed, and about 80 tons of sand is loaded into each caisson to steady it. The scaffolding is removed, the dock is filled and the caissons, whose draft at this stage is about 14 ft., are hauled out. The dock is now pumped out, forms again erected and the next set started.

After the caissons have left the dock they are moved close to the place where they are to be sunk—about 1300 ft. from the dock—and the rest of the concreting is done from a floating plant, while sufficient ballast to steady them is put in as required. When

ONE CAISSON SUNK, ANOTHER READY TO SINK INTO POSITION

APPEARANCE OF CAISSONS AFTER REMOVAL FROM THE DRYDOCK

finished, the caissons are hauled into position. The sea bottom where they are to stand has previously been dug out, leveled and covered with a layer of gravel, and on this they are sunk. When ready for sinking, their bottom is only 1 ft. over sea bottom, and they are sunk by letting a floating crane, moored at each of the ends, drop a heavy load on them. The caissons that have been sunk at the time of writing stand within ½ in. of their correct position. Each end has a key fitting close to the next end key, and these keys are later filled out with grout.

The caissons, when set, are filled with sand, although 1:5:10 concrete is poured the full height and length of the caissons with a thickness behind the face wall of 3.28 ft. The dock wall proper, consisting of 1:3:5 concrete, with granite face, is now erected and the space behind the caissons filled in partly with the material previously dug out. The new basin and warehouses are erected, railroad tracks laid, and modern appurtenances pertaining to a dock installed.

The work is being done by two Danish contracting firms, N. G. Monberg and Christiani & Nielsen, both of Copenhagen. The former is doing the digging and filling, the latter the concrete work. The contract was let by the Copenhagen Harbor Department, of which G. Lorenz is chief engineer. It was signed in May, 1915, and the work is to be completed by August, 1917. The writer, in the employ of the Harbor Department, is supervising the concrete work.

Protecting a Beach Highway from the Sea

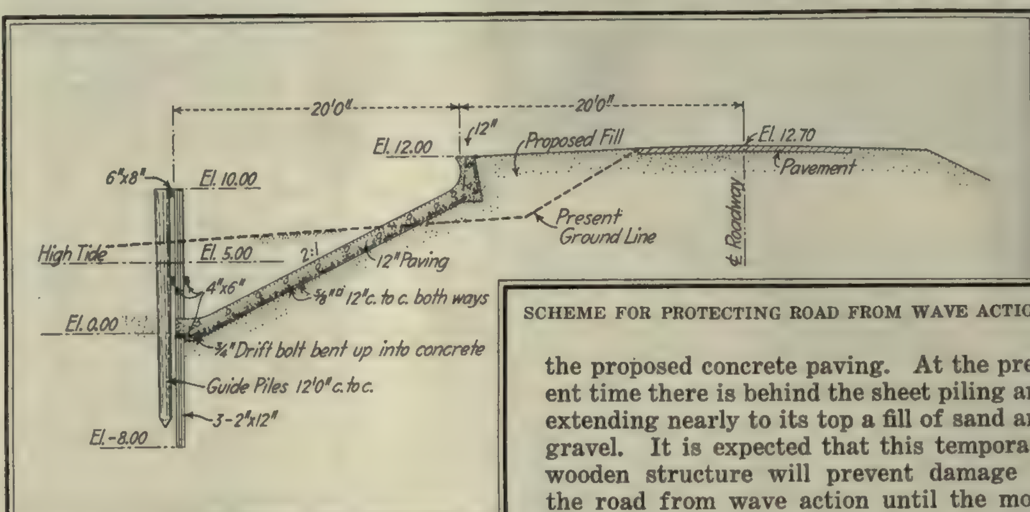
Sheet Piling Along Dike Carrying Roadway Near San Diego, California, Will Ultimately Support Toe of Concrete Paving

ABOUT 30 miles north of San Diego a natural dike parallels the shore just above the high-tide line, and has withstood the winter storms since the earliest records of local conditions. The main highway from San Diego to Los Angeles was laid out on top of this dike because of its reputation for permanence and because the best alternative route would have been considerably longer and construction would have cost about $100,000 more, exclusive of right-of-way. Furthermore, it was estimated that protection of the dike along the beach, in case it became necessary, would cost only about $50,000.

Early in 1915, for the first time, a series of heavy storms began to cut away the dike. About $1,500 was spent in protecting three-

STORM DAMAGE ON THE LAND SIDE OF THE DIKE

quarters of a mile of its length with bags of sand, but in spite of all that could be done the road foundation was seriously damaged in places. An accompanying illustration shows how severe was the cutting action on the land side of the dike. Plans were immediately prepared for protecting the roadway from further damage of this sort, and the first stage of the protection work has been completed.

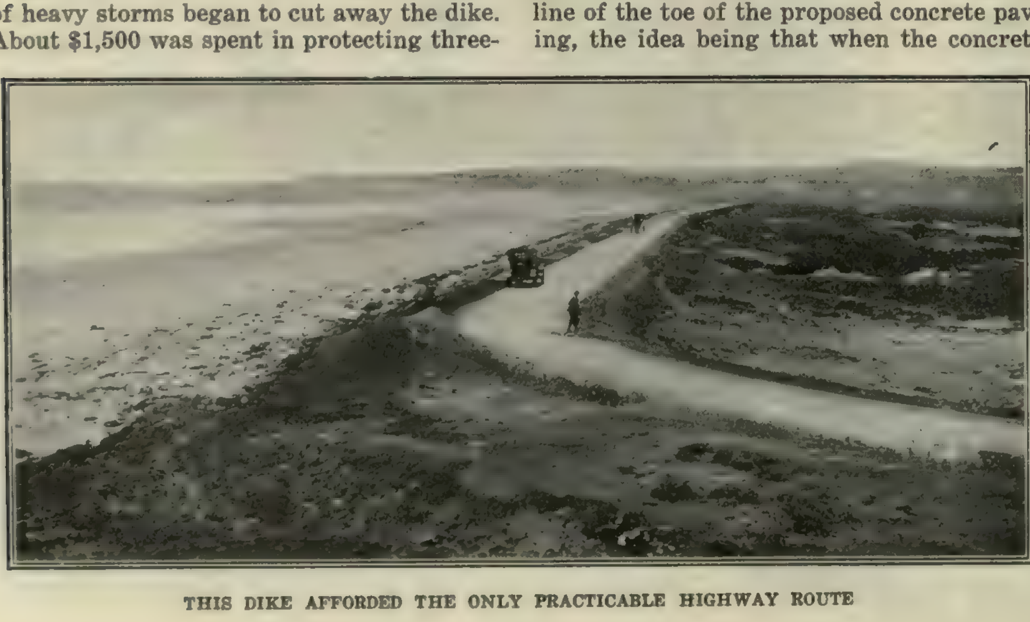


SCHEME FOR PROTECTING ROAD FROM WAVE ACTION

The design of the structure for protecting the roadway shown in the drawing is that which it is intended to use ultimately. The present protection consists of the triple-lap sheet piling driven along the line of the toe of the proposed concrete paving, the idea being that when the concrete is to be put in the sheet piling will be cut off and the toe of the paved slope supported upon it. This plan of doing the work in two stages was adopted because of the limited funds now available for highway work.

The triple-lap sheet piling is made up of three 2 x 12-in. planks, 18 ft. long, and is driven to a depth of 8 ft. below the toe of the proposed concrete paving. At the present time there is behind the sheet piling and extending nearly to its top a fill of sand and gravel. It is expected that this temporary wooden structure will prevent damage to the road from wave action until the more permanent work can be undertaken. The 2700 ft. of completed concrete work and fill is estimated to cost about $50,000.

The recent work, as well as the original construction of the highway, was under the supervision of Austin B. Fletcher, chief engineer, California Highway Commission.



THIS DIKE AFFORDED THE ONLY PRACTICABLE HIGHWAY ROUTE

Template Should Be Used to Shape Crown in Resurfacing Old Macadam

In resurfacing old macadam with Topeka specification or other bituminous surfaces of similar type it is best to shape the crown by using a template, according to a statement made by J. H. Huber, resident engineer of the New York State Highway Commission, in a paper presented at Good Roads Week at Cornell University. This can be done by spiking down side forms of timber at least 6 in. in width, and of the necessary thickness. Holes should be bored to take an ordinary boat spike fitted with a large washer. On these side forms a wooden template should be run. This is not for screeding purposes, but merely to aid in spreading and raking the material for depth and crown, which not only insures a better crown for every foot of the highway, but also eliminates the wavy appearance so often seen in this type.

Literature

For the Civil Engineer and Contractor

New Publications

STRUCTURAL TIMBER HANDBOOK ON PACIFIC COAST WOODS. By O. P. M. Goss, assisted by Carl Heinmiller. Flexible leather, 5 x 8 in.; 289 pages; illustrated. Seattle, Wash., West Coast Lumbermen's Association. $1.

SPIRIT LEVELING IN WEST VIRGINIA, 1896 TO 1915. By R. B. Marshall, chief geographer. Bulletin 632, U. S. Geological Survey. Paper, 6 x 9 in.; 168 pages; illustrated. Washington, Government Printing Office.

GEOLOGY AND GROUND WATERS OF NORTHWESTERN ARKANSAS. By L. W. Stevenson and A. F. Crider, with discussion by R. B. Dole. Water Supply Paper No. 399, U. S. Geological Survey. Paper, 6 x 9 in.; 309 pages; illustrated. Washington, Government Printing Office.

WATERWORKS HANDBOOK. Compiled by Alfred Douglas Flinn, deputy chief engineer, Board of Water Supply, New York City; Robert Spurr Weston, professor of public health engineering, Massachusetts Institute of Technology, and Clinton Lathrop Bogert, assistant engineer, Board of Water Supply, New York City. Flexible cloth, 6 x 9 in.; 824 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $6 net.

HANDBOOK FOR HIGHWAY ENGINEERS. Part 1, Principles of Design; Part 2, Practice of Design and Construction. By Wilson G. Harger, first assistant engineer, and Edmund A. Bonney, supervising engineer, New York State Department of Highways. Second edition, entirely revised and enlarged. Flexible leather, 4 x 7 in.; 609 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $3 net.

STRENGTH OF WEBS OF I-BEAMS AND GIRDERS. By H. F. Moore and W. M. Wilson. Bulletin 86, Engineering Experiment Station, University of Illinois. Paper, 6 x 9 in.; 50 pages; illustrated. Urbana, Ill., Engineering Experiment Station, University of Illinois.

RAILWAY EXPANSION IN LATIN AMERICA. By Frederic M. Halsey, statistician, James H. Oliphant & Company, New York City. Stiff paper, 5 x 7 in.; 170 pages; illustrated. New York, James H. Oliphant & Company.

HEAVY TIMBER MILL CONSTRUCTION BUILDINGS. By C. E. Paul, construction engineer, Chicago. Paper, 6 x 9 in.; 66 pages; illustrated. Bulletin 2. Chicago, National Lumber Manufacturers' Association, Engineering Bureau.

Issued as a special edition for members of the National Fire Protection Association. Gives clear description of timber-mill construction, distinguishes it from the "slow-burning" type and covers in detail the design of walls, floors, columns and roof. Fire protection methods are discussed, and comparative costs of mill construction given. A short chapter is devoted to the standard mill construction recommended by the Associated Mutual Fire Insurance Companies of New England. Formulas and tables to aid in design are given in complete detail in the last 15 pages. Engineers will find in this booklet much valuable information, covering all phases of the subject of timber mill buildings, with special reference to fire-resistive construction.

Books Reviewed

Theory and Practice of Modern Framed Structures

Authors, the late J. B. Johnson, C.E.; C. W. Bryan, C.E., chief engineer of the American Bridge Company, and F. E. Turneaure, C.E., dean of the College of Mechanics and Engineering, University of Wisconsin. Ninth edition, rewritten by F. E. Turneaure and W. S. Kinne, associate professor of structural engineering, University of Wisconsin. Cloth, 6 x 9 in.; 486 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.

REVIEWED BY F. H. CONSTANT

Professor of Civil Engineering, Princeton University, Princeton, N. J.

Although the present volume is called the ninth edition, it is in reality the third and last of the new series which constitutes the complete rewriting of "Modern Framed Structures," first published in 1893. The first two volumes, pertaining to stresses in simple and indeterminate structures, issued several years ago, are well known to the engineering public. The present volume covers design and replaces Part II of the original large book. It bears, however, no resemblance to the earlier work. Many of the topics treated there, relating especially to building construction, elevated tanks, swingbridges and trestles, are omitted. One misses, likewise, the pleasing chapter on æsthetic bridge design. On the other hand, it comes up to all expectations in the thoroughness and modernness of its treatment of the detailed analysis of bridge design. In this field it presents much new material and methods based upon present-day accurate knowledge of stress distribution throughout all parts of a structure.

This is noticeably so in regard to secondary stresses, in which field the authors have themselves made important experimental and analytical investigations. While it is generally permissible to neglect the calculation of secondary stresses in ordinary designing, some knowledge of how they act, and of their relative magnitudes and importance in various types of structures, is essential if they are to be kept within reasonable limits. Subconsciously they should be present in the mind of the designer as he works with the primary stresses. In large and important structures they must, of course, be separately calculated. This attention to secondary stress strikes a new note in bridge design and to a certain extent forms a background for the present work.

The book contains 486 pages. The first half deals with fundamental principles. Chapter 1 gives a brief discussion of styles of structures and determining conditions. Chapter 2 discusses working stresses, the effects of impact, vibration and repetition, alternating stresses and tension members. Chapter 3 gives the fundamental principles of column action and reviews the various working formulas. The theory of the eccentrically loaded ideal column is developed and the strength of the ordinary column is related thereto by the selection, from column tests, of an equivalent eccentricity (or eccentric ratio) to cover the effect of imperfections in the column, or imperfect centering. The extreme fiber stresses, the effect of secondary stresses on the bending strength, and shear in columns are readily deduced therefrom. The design of latticing and tie plates follows from the discussion of the shear.

Chapter 4 covers combined direct and bending stresses and secondary stresses. The latter include bending stresses in the plane of the main truss due to rigidity of the joints, stresses in members of a transverse frame due to deflection of floor beams, stresses in a horizontal frame, especially in floor beams and their connections, due to the longitudinal deformation of chords, and variation of axial stress in different elements of a member. Diagrammatic sketches clearly show (by shaded areas) the nature and percentage of the secondary stresses in all members of the common types of bridge trusses. From these the designer is enabled to draw general conclusions and is guided in the choice of design.

Chapter 5 is on riveted joints and includes the principles of stress transmission, friction of joints, eccentric connections and the reduction of section by rivet holes. Chapter 6 contains a very adequate treatment of the plate girder. The moment-of-inertia method for flange areas and rivet spacing is given and compared with the usual approximate formulas. Thirty-five pages are devoted to the detailed numerical designs of 70-ft. deck and through girders.

Chapter 7 is mainly descriptive of the general features of truss design. In the remaining four chapters the principles of design discussed in the preceding chapters are illustrated by detailed designs of a pin-connected railway bridge (Chapter 8), a riveted railway bridge (Chapter 9), a riveted highway bridge (Chapter 10), and a steel roof truss and building frame (Chapter 11). In the last chapter special attention is given to the design of beam purlins where the plane of bending does not correspond with a principal axis of the section. The theory of unsymmetrical bending is worked out at length in an interesting manner in Appendix C by the aid of the "S" (or section-modulus) polygons.

The General Specifications for Steel Railway Bridges, adopted by the American Railway Engineering Association, 1910, are reprinted in Appendix A. Several tables of the most frequently used standards follow in Appendix B.

The book is intended, primarily, as a text book on bridge design. It is clearly written and abundantly illustrated by completely worked out numerical examples. At the same time the original treatment of many parts of the work and the practical introduction of the results of recent tests and researches will give the book an interest and value to the older engineers. The book contains many text drawings and eight folding plates. The typographical work is excellent.

Mechanical Engineer's Handbook

Based on the Hütte handbook prepared by a staff of specialists, Lionel S. Marks, professor of mechanical engineering, Harvard University and Massachusetts Institute of Technology, editor-in-chief. Limp leather, 4½ x 7¼ in.; 1836 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $5 net.

Although this handbook is based upon the well-known German standard work by Hütte, in only a few of the more theoretical sections is the original text followed at all closely. The greater part of the book, especially that dealing with engineering practice, is wholly new, and is contributed by specialists of this country, who cover their particular fields in contributions to each of the fifteen main sections into which the book is divided. This most satisfactory procedure for developing a modern and authoritative handbook is similar to that adapted by Professor Merriman in preparing the American Civil Engineer's Pocket Book. The new book gives every evidence of a most comprehensive and satisfactory treatment of the whole field of mechanical engineering.

No attempt to give in detail the nature of the treatment of the many fields covered can be made in this short review. It is sufficient to state that among the contributions in fields which directly interest civil engineers will be found the names of Prof. W. K. Hatt of Purdue University, on strength of materials, including the theory of reinforced-concrete design; Sanford E. Thompson, on materials of engineering, treating the subject of cement, mortar and concrete; Prof. Hugo Diemer of Pennsyl-

vania State College, on cost and other factory accounts; H. A. Gardner of the Institute of Industrial Research, Washington, on paints and protective coatings; Richard Moldenke, consulting metallurgist, on iron and steel castings; Prof. W. G. Raymond of the State University of Iowa, on surveying; Prof. E. Schmidt of the University of Illinois, on railway engineering; Prof. E. W. Schoder of Cornell University, on hydraulics, and Dr. Hermann von Schrenk, consulting timber engineer, on wood.

It is evident from the foregoing names and topics that the book not only covers mechanical engineering subjects, but contains much of interest to the civil engineer. It undoubtedly presents the most comprehensive and authoritative data on all subjects connected with the work of mechanical engineering in condensed, tabular form, put in excellent shape typographically, and with especially careful attention to details, such as references and listed notation in mathematical discussions. A very comprehensive index occupies 56 pages.

Not only is this new book indispensable to mechanical engineers, but all civil engineers who meet mechanical problems in their work will find it to be most essential as part of their working library.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Examinations for Corps of Engineers Not Severe

SIR: The law passed by Congress in July, 1911, requires as a prerequisite to taking the examination for a commission in the Corps of Engineers of the Army that a civilian candidate must be eligible for appointment as junior engineer in the Engineer Department at Large in accordance with civil-service regulations, and this requires that he qualify through the civil-service examinations for appointment as junior engineer in the Engineer Department at Large. These examinations are under the United States Civil Service Commission. The questions are prepared, the examination held and the marks given by examiners under the sole jurisdiction of the commission.

An examination of this character was held in April, 1916, and the fact that it was not unduly hard has been certified to recently by the dean of one of the most noted engineering colleges in this country. The questions were submitted to him, and he stated that they were very fair, and he could not understand why a graduate of any of our technical schools should not be able to pass.

The facts are, however, that more than 125 candidates took this examination, and of these only about 60 per cent received the passing mark of 70. Omitting the cases where schools were represented by only one or two candidates, there remain ninety-eight candidates distributed among sixteen of our most noted technical schools, each of which was represented by no less than four candidates.

Of the candidates who had graduated from these sixteen schools, only 63 per cent passed this easy examination, and from this it would appear evident either that the education now given by our technical schools is not thorough or else that the candidates who tried this examination were not really representative graduates.

The facts above stated have a bearing upon some articles that have appeared in the recent past in our technical journals to the effect that the examinations for commissions in the Corps of Engineers of the Army were unduly severe and that they were purposely made so because the officials of that corps did not look with favor upon admitting civilians into the corps.

This is not true, for the Chief of Engineers for a number of years has been making special efforts to obtain a supply of officers for the Corps of Engineers from the graduates of our good technical schools. At his request a special civil-service examination was held last August in order to furnish an opportunity to graduates of that year to become eligible for the examination for second lieutenant to be held in the following October, and at his request special arrangements were made by the Civil Service Commission this spring enabling those about to graduate to take the civil-service examination so that they might become eligible to take the examination for commission in the Corps of Engineers to be held throughout the country on Aug. 21-25, 1916.

The results of the civil-service examination noted above would appear to indicate that the reason why a greater percentage of civilian candidates have not heretofore passed the examination for commissions in the Corps of Engineers has not been due to the severity of these examinations.

W. M. BLACK,
Chief of Engineers, U. S. Army.
Washington.

Larceny

SIR: The editorial entitled "Larceny" in your issue of July 22, 1916, is very pertinent in calling attention to a regrettable evil in the practice of engineers; but you fail to indicate the obvious remedy. The patent laws of this country are premised on the principle that the laborer is worthy of his hire, and in return for the public disclosure of his invention the patentee is granted a monopoly for the limited term of 17 years, provided the inventor is so fortunate as to be able to meet the expense of necessary litigation.

Inspection of your issue for July 22 discloses that approximately one-half of the advertising space (exclusive of the Searchlight Section) is devoted to patented devices and processes. From this it is inferred that civil engineers make extended use of such patented devices and processes. In fact it is common knowledge that civil engineers are quite willing to use patented H-beams in building construction, to use patented deformed bars in bridges, to use patented machinery in hydraulic constructions. The use of such patented devices can be justified only on the ground that the engineer specifying them believes their use will insure a better structure for the same money or an equally good structure for less money.

How different is the attitude of the civil engineer when it comes to a Bone patented retaining wall, a Luten patented bridge or a Cameron patented sewage-disposal plant. Use of any of these secures a better result for less money, but the civil engineer is opposed to such patents. Why is the opposition? Is it that the engineer who "on ethical grounds is opposed to patents" is willing to pay royalty only when that royalty is concealed from his client by reason of being included in the purchase price of a manufactured article? Is it that the civil engineer makes mobility the criterion of patentability? Or, as pointed out by you, is it that civil engineers are opposed only to patents on such new and useful improvements as can be easily pirated?

Indianapolis. DANIEL B. LUTEN.

Engineers and the New Nationalism

SIR: The article by Frances A. Kellor entitled "Engineers and the New Nationalism," in your issue of July 1, page 12, has been noted with considerable interest. With most of this article I generously concur. Personally, however, I do not share the general feeling of most American engineers that I have talked with on the question as to the desirability of engineers' aggressiveness in militarist developments. I should like to see engineers devote considerable energy to the study and the elimination of the causes which have made militarism a necessity.

Is there not a great opportunity for American engineers to lead the way in a movement toward the elimination of the economic causes of war? Is not the American engineer better qualified to study and to broadly analyze the whole question which underlies the economic causes of conflict? It seems to me that although this problem has usually been left to political economists and to the ministry, it could be more constructively treated by men whose mental processes have been developed by engineering training and practice and who are peculiarly trained to plan and co-ordinate the intricate problems of organization.

Miss Kellor's deduction that the "Americanization pioneer in the new community is the engineer," although perhaps overstating the case somewhat, yet undoubtedly is the trend of the time, and I hope that the young native-born engineer of the future will do his share in preserving American traditions and will help to teach them to the strangers that come within our borders. May our technical papers lay emphasis upon the fact that American traditions demand the development of the individual and not encourage, but positively discourage, the development of a top-heavy, unwieldy and dangerous octopus—Militarism.

D. ROBERT YARNALL.

Philadelphia, Pa.

Brick and Tile Production in 1815

The value of the brick and tile products of the United States in 1915, according to a bulletin of the U. S. Geological Survey, was nearly $125,800,000—a decrease of 3 per cent compared with the previous year. The product that showed the greatest decline was sewer pipe, although common brick and terra cotta fell slightly.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Field-Office Accounting: Finding Costs

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company,
Scranton, Pa.

ASSUMING that the monthly estimates rendered by the engineer for the owner are at least approximately correct, the following method may be followed for finding the unit costs for a given month. An equitable proportion of the local office expense, compensation insurance, charges for repairs and other incidentals, is added to the labor and material cost for the item for the month and divided by the yardage allowed for that class of work on the estimate. The quotient represents the approximate unit cost, excluding interest on the investment in equipment, general office expense and other overhead charges with which the local agent or manager cannot be expected to be familiar. These additional charges should be taken into consideration by the contractor in connection with the reports furnished from the job.

Excavation, 19408.9 cu. yds. @ .59......	$11451.25
18" sewer pipe in place, 462 ft., @ .80...	369.60
Concrete masonry, 1307.5 cu. yds., @ 8.47.	11074.53
	$22895.38
Less previous payments, etc., etc.	

Such an approximate unit cost obtained each month will probably turn out to have no permanent value, though it may serve to indicate the fact if any foremen in the organization have not produced results proportionate to the expense involved. The unit cost from month to month will fluctuate considerably, as it will be affected by weather conditions, variations in the character of material excavated, variations in the relation between volume of concrete placed to area of finished surface, and other factors which enter into the actual production. Moreover, some engineers have a way of making up their monthly estimates anywhere from the 25th of the month to the 5th of the following month, as the result of which a very fat month of about 40 days may be followed by a very lean one of about 20 days.

SUMMARY OF COST OF WORK AT DOANE'S CROSSING.

		Concrete	Sewer	Excavation
Cement, 1587 bbl. at $1.59	$2523.33	....	....	....
Less 5760 sacks redeemed	576.00	....	....	....
		1947.33	....	....
Crushed stone, 1085.75 tons at 0.70		760.03	....	....
Sand and gravel, as per invoices		666.54	....	....
Oil and fuel, as per invoices		54.32	....	337.8[illegible]
Miscellaneous items, including freight		1173.33	....	1011.12
Lumber for forms		682.45	....	....
Cost of bond		65.00	....	50.00
Compensation and liability insurance		335.38	....	570.49
18-in. vitrified pipe, 462 ft., including bends and tees		....	204.54	....
Explosives as per invoices		....	....	255.00
Labor, as per payrolls		4003.77	109.69	5704.90
		$9688.15	$314.23	$7929.37

1307.5 cu. yd. concrete totalling 9688.15 figures cost per cubic yard	$7.41
462 ft. sewer, totalling 314.23, figures cost per foot	0.68 plus
19408.9 cu. yd. excavation totalling 7929.37, figures cost per cubic yard	0.41

Quantities	Unit Cost	Contract Price	Unit Profit	Total Cost	Contract Total	Total Profit
1307.5 concrete	7.41	8.47	1.06	9688.15	11074.53	1386.38
462 sewer	0.68	0.80	0.12	314.23	369.60	55.37
19408.9 excavation	0.41	0.59	0.18	7929.37	11451.25	3521.88
				$17931.75	$22895.38	$4963.63
					17931.75	
					$4963.63	

The attempt to figure monthly unit costs does help to keep a line on the situation, however, and the average taken over a period of three or four months will prove fairly accurate. At the completion of the job, with the final estimate taken, a correct tabulation can be made. Assuming that a final estimate has been compiled giving the quantities in the small table shown herewith, the total and unit cost and profit may be summarized as outlined in the large table. In actual practice there would be many more divisions of the work, and the final summary would not be so simple as that shown herewith for the purpose of illustration.

Of course, the figures assumed are used only to outline the methods. Minor discrepancies in extension result from the unit costs having been carried out only to the nearest cent. If the reader objects to the profit shown of more than 25 per cent, he should remember that although we cannot make money at this rate on a real contract, it is pleasant to visualize such possibilities on paper.

Transferring Stone from Trucks to Train Simplifies Road Work

TRUCKS TAKE STONE TO BINS, INDUSTRIAL TRAIN DISTRIBUTES IT ALONG ROAD

THE COMBINATION of motor-truck transportation to a convenient point and distribution along the work from this point by industrial train is coming into favor with contractors for concrete roads. On the job illustrated in the photograph a narrow road with a street-car line at one side was being paved with concrete 16 ft. wide. The materials for this concrete, dumped on the subgrade in advance of the mixer, could scarcely be piled so as to avoid blocking the road. This feature, aside from the damage that might be done by trucking over the subgrade, made it necessary to provide some other way for keeping the mixer supplied with cement. The industrial railway, with fifteen $1\frac{1}{2}$-yd. cars and a 13-ton locomotive, was therefore installed to handle all the concrete materials. This outfit could make a $1\frac{1}{2}$-mile round trip in 20 minutes, including the time consumed in dumping the material.

The trucks which deliver the material to the transfer bins hold 2 yd., and each trailer holds 4 yd. All the units are bottom dump. The road, $4\frac{1}{2}$ miles long, is being built from Birmingham, Ala., to Pontiac by R. D. Baker.

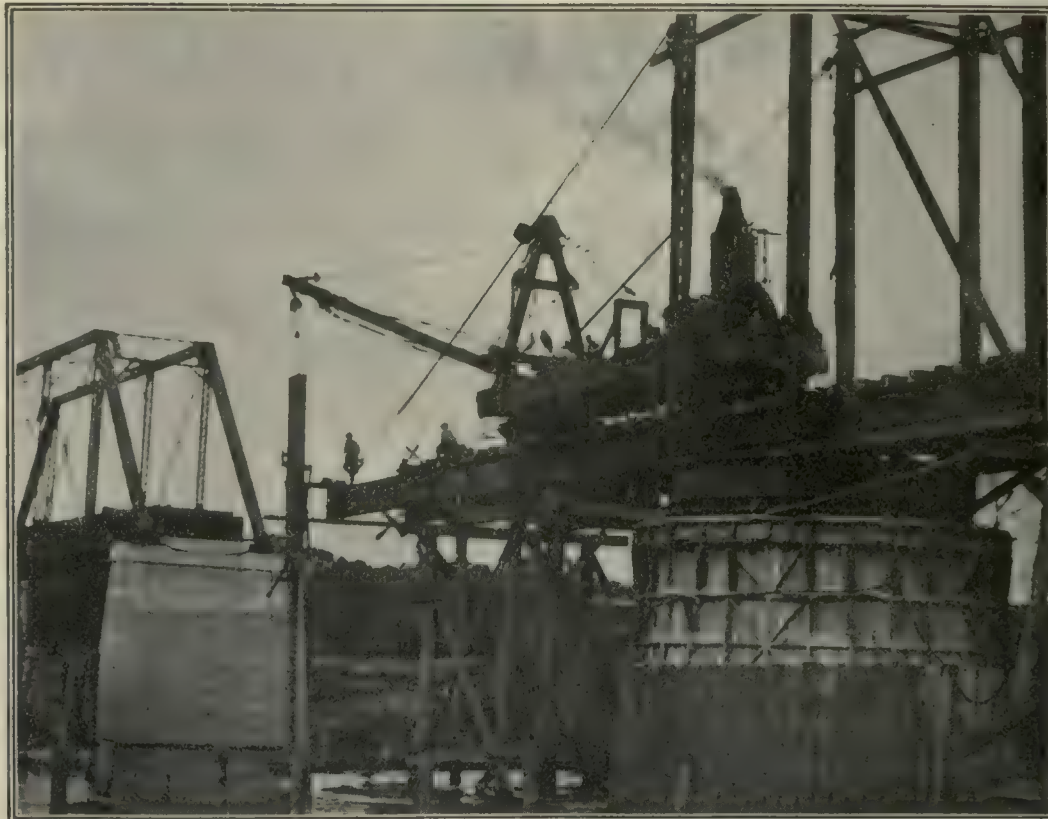
Leads Bolted to Cantilevered Floor Steel to Drive Falsework

By T. V. GARNES
Rome, Ga.

WITH A LIGHT derrick car and swinging leads attached to floor stringers cantilevered out from the last bent of falsework erected, the writer drove the piling for and erected successfully and economically two 150-ft. fixed spans and a 264-ft. swingspan at Macon, Ga. The bridge, which is shown in the photograph, crosses the Ocmulgee River and was erected for the Macon, Dublin & Savannah Railway.

After the first bent of falsework was erected and the first panel of the floor system placed, the second panel of stringers was set, overhanging the full panel length of 24 ft. To the ends of these stringers were clamped two 8 x 8-in. timbers to which the leads could be bolted at the location of each pile. The leads were carried by the hammer in moving, and it was only a matter of a few moments after one pile was down to unbolt them and set them in the next position. A runner line was used to handle the piles. To remove the entire rig after a bent of falsework was driven, the leads were unbolted, the four bolts securing the crosstimbers were loosened and slipped off the ends of the stringers, the car was run ashore and the driving rig set down. The bents could then be capped and the next panel of floor system erected.

It was necessary to maintain a 35-ft. channel in the river for small boats. In order to do this two panels of the floor system were allowed to overhang at once, being guyed back, as shown in the photograph, with two sets of falls. The bent of piles at the end of this cantilevered section was then driven and capped, and sufficient long timbers were placed on it and on the last bent driven, two panels behind, to carry the intermediate panel point.



TWO PANELS OF FLOOR SYSTEM SET IN ADVANCE OF DRIVING FALSEWORK

30-Foot Horizontal Test Boring Made with Hand-Hammer Drill

By H. L. HICKS
Great Neck, N. Y.

THE Portland Contracting Company of Pottsville, Pa., in driving a tunnel for the Harleigh-Brookwood Coal Co., at its Stanton Colliery was approaching some old workings. The exact depth at which these would be encountered was not known, and to make sure that they did not contain water it was decided to drill a test hole.

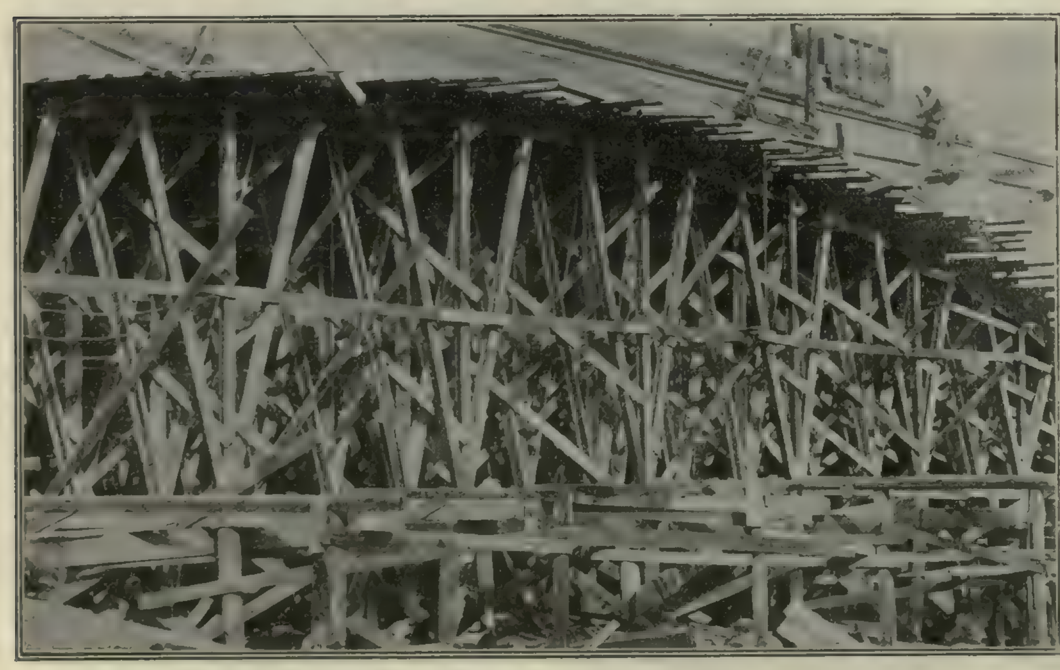
No prospecting drill was available, and as time was of the utmost importance, to avoid the delay of calling in a drilling contractor they determined to try drilling a deep hole with a jackhamer.

The hole was started with four pieces of steel, 3, 6, 9 and 12 ft. long, sharpened to a 2-in. gage. After drilling ahead 12 ft. a bit was welded into a 2-ft. length of 1-in. pipe and a shank into another similar length. With some extra-heavy couplings these were connected to a 10-ft. length of the same size pipe and drilling was resumed.

It was expected that the old workings would be reached at any time after drilling to this depth, but it was necessary to add successive 2-ft. lengths of pipe, resharpening the bit each time, until a 30-ft. steel was being rotated by the little 40-lb. jackhamer.

When the drill ran into the old workings at this depth the drill bit was 1⅝ in. in diameter. The extra-heavy pipe couplings were beginning to bind in the hole, but the operator predicted that he could "go a few feet more if he had to."

This hole was drilled through hard slate formation on about a 6-deg. pitch.



SHORES MADE OF BOARDS TIED BY WIRES EASILY REMOVED BY CUTTING TIES

Forms Knocked Down by Cutting Wires That Hold T-Posts

EACH of the posts under the arch form shown in the photograph is made of two 1 x 4-in. plank, one placed with its edge to the side of the other, giving a T-section, and wrapped with wire at sufficiently close intervals to make them act as one member. As the contractor states that the nearest commercial size of post that can be depended on to carry the same load is 4 x 4 in., he estimates that his lumber bill for the formwork has been reduced by the value of a good many thousand feet. Moreover, the labor cost of striking the centers is believed to be much less than with solid posts. It is only necessary to cut some of the wire ties on these posts, when the plank bend out under the load and release themselves.

These posts are being used by the National Concrete Company in building a large arch bridge on West Washington Street in Indianapolis.

Flag Indicates Location of Road Patrolman

Each patrolman on the Maryland state highway service is furnished with a cap on which is stamped in gold letters "State Patrolman," a number which he wears on his arm and a red flag. The latter he places in the ground on the section on which he is working so that if the inspector or resident engineer passes he knows that the patrolman is near the flag.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

State Accepts Cash Bid for Illinois Water Power

Sanitary District of Chicago's Bid of $15.01 per Horsepower-Year for Power at Joliet Accepted—To Develop Present Flow at Once

At a final conference on the transfer of the water-power site at Jackson Street, Joliet, Ill., formerly leased to the Public Service Company of Northern Illinois, and now transferred to the Sanitary District of Chicago, Governor Dunne accepted the cash bid of the Sanitary District. The action completes a twenty-year lease under the terms of which the state will receive $15.01 a year per horsepower. The Sanitary District is under obligation immediately to develop 7000 hp. from the present flow.

It is expected that a suit will be instituted enjoining the district from developing the power, as its state charter does not permit it to engage in such work. If the courts rule in favor of the district, work will probably be started early next year. Otherwise the development will be indefinitely postponed.

Bids Called for Site

The dam and power site at Joliet have been developing about 3000 kw. and for sixty years have been held by the Economy Light & Power Company, now subsidiary of the Public Service Company of Northern Illinois. Sixty years ago the Illinois & Michigan Canal Commission granted the Economy Light & Power Company a twenty-year lease on the power site, with provisions for two twenty-year renewals, for which rights the Economy company paid the state approximately $9,500 yearly. The last of the renewal periods expired July 17.

At that time Governor Dunne decided that the lease was not again renewable and called for bids. When they were opened on July 15 Andrew J. Cook was the sole bidder, offering $1.50 per horsepower-year for the site. At that time a movement was being discussed at Washington to restrict the flow of water to 25,000 cu. ft. per second in the channel of the drainage canal. That prevented the Sanitary District from bidding, in spite of the fact that in 1903 it had invested $500,000 in a dam at the Economy power site.

First Bids Rejected

The first lone bid of June 15 was rejected and bids were asked again for July 17. Before that date the Sanitary District succeeded in defeating the movement to limit the flow. When the second set of bids was opened it was found that Andrew J. Cook had bid $3 per horsepower-year and that the Sanitary District had presented two bids. These bids were made with the understanding that the lessor should put in machinery and develop 7000 hp. The first bid—the one that has been accepted—was a cash offer of $15.01 per horsepower-year for all power that could be developed. The second bid offered immediately to construct locks at Lockport and Joliet as a step in a Lakes-to-Gulf waterway, and do other work in the channels of the Desplaines River and the Illinois & Michigan Canal at a probable cost of $1,500,000. In addition the Sanitary District was to pay $1 per horsepower for all power developed in excess of 7000 hp. at high-water stages and at any other times. The lease was to be for twenty years, at the end of which period four-fifths of the plant and works would go to the state and the remainder to the successful bidder.

It is understood that the bid offered by Andrew J. Cook was made for the Public Service Company of Northern Illinois. The reasons why the site was not considered more valuable by that company are: That it does not fit in with the company's general plan of using large generating stations with its transmission and distribution systems; that energy can be made in its steam station with an ultimate rating of 60,000 kw. now under construction near Joliet almost as econonmically as in waterwheel units, and that the water-power plant, lying in the center of the city as it does, presents formidable difficulties in high-tension line construction.

Strike Averted—Trainmen Will Treat with Mediation Board

The danger of a nation-wide railroad strike was at least temporarily averted Wednesday of this week, when the leaders of the four brotherhoods agreed to accept the proffer of the Federal Board of Mediation and Conciliation of their friendly offices "provided it was promptly exercised." The railroad managers had refused to grant the employees' demands, and had asked the brotherhoods to join them in an appeal to the federal board for mediation. The union leaders refused to join in the appeal, but accepted the offer of services made by the board.

As the matter stands now the mediators may succeed in adjusting the controversy, they may bring about arbitration or they may be unable to accomplish anything. In the latter event it is believed that President Wilson will call the leaders of both sides of the dispute into personal conference in the effort to avoid a strike.

Erie, Pa., Celebrates Beginning of Flood-Control Work

The formal inauguration of the movement to control floods in Mill Creek was held Aug. 3 at Erie, Pa. It was just a year before that day that an unprecedented rainfall transformed Mill Creek into a raging torrent that took thirty-nine lives and destroyed $3,000,000 worth of property. Mayor Miles B. Kitts deposited a few shovelfuls of concrete into the foundation of one of the piers for the drift catcher, the initial unit of that flood-control work. An iron box containing the names of the officials of the United States, Pennsylvania, Erie County and the City of Erie and newspaper accounts of the flood was then placed in the foundation.

The main feature of the Mill Creek project is a reinforced-concrete tube 22 ft. inside width and 18 ft. high, which will be bedded into solid rock for more than 2 miles. The cost of that part of the work will be about $1,000,000. Contracts will be let this fall. Farley Gannett, consulting engineer, of Harrisburg, Pa., has charge of the work.

Plan to Develop 2,000,000 Horsepower Below Niagara Falls

A plan to dam the Niagara River below the falls and thereby develop about 2,000,000 hp. has been submitted to the government of Ontario by the Thomson-Porter Cataract Company. T. Kennard Thomson, consulting engineer, New York City, and Peter A. Porter are at the head of the project, which is said to involve an expenditure of $100,000,000.

It is planned to build a dam 100 ft. high about 6 miles below Niagara Falls. That would eliminate the whirlpool and its rapids by making a long, narrow lake. The project will be investigated by a commission of engineers of the Ontario government and then presented to the New York Legislature.

Niagara Hydroelectric Situation Discussed

New York State Legislative Committee Advocating Bill Giving State Control of Diversion for Electrical Development

Apparent neglect on the part of the government to foster the development of Niagara Falls electrochemical industries has caused members of the joint legislative committee of New York State to advocate a bill giving the state absolute control of water diversion for electrical development. The joint state committee, consisting of George C. Thompson and George W. Simpson, state senators, and Joseph D. Kelly, assemblyman, recently held a series of hearings at Niagara Falls, N. Y., at which much evidence was submitted to show the urgent necessity of greater diversion for power development. At the close of the hearing Chairman Thompson said that a bill will be introduced in Congress giving New York absolute control of water diversion for electrical purposes.

Representatives of many large Niagara Falls electrochemical industries told how they have been forced to establish Canadian and even foreign branches because of the great shortage of power on the American side. Water-power authorities expressed the opinion that the scenic beauty would not be impaired by doubling or even tripling the water diversion.

Probably the most important witness before the committee was F. A. J. FitzGerald of Niagara Falls, N. Y., president of the American Electrochemical Society. Mr. FitzGerald urged immediate legislation to extend the diversion limit for power to 20,000 sec.-ft.—the maximum fixed by treaty. That would give an additional 4400 sec.-ft., capable of generating about 80,000 hp. While the additional power would meet present needs, Mr. FitzGerald said this would not provide for future requirements.

Reviews Niagara Development

In reviewing the history of electrical development at Niagara Falls, Mr. FitzGerald said that in 1895 the only industry dependent upon electricity for its product was the Pittsburgh Reduction Company, now the Aluminum Company of America. The Niagara Falls Power Company then had only three generators in operation. Now there are twenty, most of them vastly larger than the first units. Yet, Mr. FitzGerald said, there is not sufficient power to meet the requirements of industrial establishments on the American side of the Niagara River.

The Carborundum Company and the Norton Company both have branch plants in Germany, he said, and they are of the utmost importance to the German Empire in the present war. The Norwegians are receiving the aid of the government in the establishment of electrochemical industries in that country, and no doubt the Germans have plants of that nature in Norway. It is possible to manufacture products in Norway and sell them in New York City as cheaply as those of Niagara electrochemical industries. So the great importance of not forcing the shortage of Niagara products is apparent.

Mr. FitzGerald spoke on the importance of the nitrates and of the necessity in the United States for developing the fixation of atmospheric nitrogen. Given plenty of power, he said, Niagara Falls electrochemists could by developing the fixation of atmospheric nitrogen make the United States absolutely independent in the matter of nitrates.

Investigation of the possibilities of estab-

lishing a large electrochemical industry in the State of Utah, where power is abundant, shows that it would cost more to market the product manufactured there than if it were manufactured in Norway.

Show Need for More Power

Frank J. Tone of the Carborundum Company, said that the inability of American manufacturers to obtain power was forcing American industry to Canada and European countries. He said that not only the Carborundum Company but other Niagara Falls industries have established large branches on the Canadian side of the river, and that one branch has been established in Germany. His company uses 10,000 hp. and needs that much more, but is unable to get it. Other companies also are unable to procure the desired amount of power.

"Doubling and even tripling the diversion of water at Niagara Falls for power development would not impair the scenic beauty of the cataract," said W. A. Jamieson of the William A. Rogers Company, a large silver-plating establishment. "We want to double our capacity, but owing to the great shortage of power we are operating far below our maximum. If we used steam-generated electricity rather than Niagara power our cost of production would increase 225 per cent."

Former Representative Peter A. Porter told of the junior Niagara plan of power development noted elsewhere in this issue. James S. Simmons, former representative from Niagara Falls, also told of plans of the Lower Niagara River Power Company.

W. L. Bliss of the United States Heat & Light Corporation told the committee that while his company uses only 1000 hp. the cutting off of the supply of cheap power would put one branch of the company's business out of existence. He declared that without cheap Niagara power it would be impossible to operate the storage-battery department.

Favors Joint Conference

H. G. Akers of Toronto, Ont., an electrical engineer associated with the Ontario Hydroelectric Commission, attended the hearing to learn the demands of American industries as regards future power developments. Mr. Akers expressed himself in favor of a joint conference between representatives of the United States and Canada for a new international treaty regarding water diversion for power purposes. He said the two countries could develop all the available power of the Niagara and St. Lawrence Rivers and that the Ontario commission is desirous of bringing about such a joint conference.

International Committee May Settle Niagara Power Question

Hearings begun four years ago by the House Foreign Affairs Committee on legislation to regulate diversion of water at Niagara Falls for generation of electricity were closed last week. Before Congress adjourns the committee plans to report a bill based on that introduced by Representative Cline of Indiana for co-operation with Canada in preserving the scenic beauty of the falls and at the same time developing the hydroelectric resources. Indications are that a joint international commission to limit the diversion of water will be recommended.

Final statements supporting the claim of New York State to make use of the water diverted were presented by the committee of the New York State Legislature mentioned in the preceding article. They expressed a belief that the federal government may control the amount of water which shall be diverted, but that its use should be granted to the state for development with any accruing revenue. They also suggested that the boundary waterways treaty with Canada be enlarged to develop power projects all along the border.

Form Australia Water Commission

Under the irrigation amendment act which was recently made a law, the Water Conservation and Irrigation Commission of Australia has been organized. W. C. Grahame, Minister of Agriculture, automatically becomes chairman of the commission. The other newly appointed members are H. H. Dare and W. Neville Sendall. The water department was formerly controlled by only one commissioner.

Engineers Investigate Nitrate Plant Locations in South

Citizens from practically all of the Southern states met recently at Nashville, Tenn., to formulate plans and begin the collecting of data to show that the best possible location for the proposed $1,000,000 government nitrate plant is at one of several points in the South. During the convention $15,000 was pledged to defray the committee's expenses in presenting the advantages of Muscle Shoals as the best site for a nitrate plant, and $3,500 was voted for an investigation by engineers. The relative merits of Muscle Shoals, Keokuk Falls and Priest Rapids as sites for a nitrate plant will be set forth by an engineering committee of members of the Engineering Association of the South.

Preceding the convention members of the Nashville section of the Engineering Association of the South made a trip over Muscle Shoals on the Tennessee River. As much data as possible were collected and a report made to the meeting at Nashville.

MEMBERS OF ENGINEERING ASSOCIATION OF THE SOUTH INSPECT MUSCLE SHOALS' POSSIBILITIES AS A SITE FOR NITRATE PLANT

PICTURE SHOWS AQUEDUCT WHICH CARRIES MUSCLE SHOALS CANAL OVER SHOAL CREEK

Hearing Aug. 16 on Concrete Bridge at Ocean City, Md.

Major J. C. Oakes, U. S. Army engineer in charge of the Wilmington (Del.) division, has arranged with H. G. Shirley, chief engineer of the Maryland State Road Commission, for a hearing Aug. 16 at Ocean City, Md., on the construction of a concrete bridge to connect Ocean City with the mainland. The last legislature appropriated $125,000 for the proposed structure to replace the present wooden bridge. The plans made by the Maryland Road Commission are claimed to necessitate an expenditure of only $95,000.

$100 for News of Engineer

Edwin S. Hadlock, a civil engineer in the employ of the Baltimore & Ohio Railroad, has disappeared. He was last identified in Cincinnati on June 21. Mr. Hadlock had drawn about $700 from a bank in Cincinnati and started for Portland, Me. Although the last news of him came from Cincinnati, his trunk arrived in New York City and was rechecked to Boston. Also, someone used his railway pass from Cincinnati to New York. Mr. Hadlock is thirty-nine years old, 5 ft. 7½ in. tall and weighs about 170 lb. His father, Samuel Hadlock, of Portland, Me., offers $100 for information as to the whereabouts of the son.

Proposed Dam to Raise Water Level 300 Feet

Irrigation Project on Kings River, California, Involves 1,000,000-Cubic Yard Structure—Power for Drainage Pumps Planned

All the irrigation districts supplied with water from Kings River in the central-southern section of California have joined in planning a storage reservoir which would be generally beneficial to the lands affected. The scheme consists of a storage dam across the cañon of Kings River just below Pine Flat, which will be of a height sufficient to store 600,000 acre-feet. The dam will raise the water approximately 300 ft., which is said to be 50 ft. more than the water-level raise behind any dam yet constructed.

An arched masonry structure is contemplated, the volume of which would be about two and one-half times that of the Roosevelt dam. About 1,200,000 acres are to be served, and it is believed that the cost of the development can be kept down to a much lower figure per acre than has been considered feasible in other large projects. Only about 4 miles of railroad construction will be required, and the entire work could be finished, it is thought, in about three years.

A part of the development consists of the installation of pumping units to keep the water plane over the whole area down to a desirable depth and at the same time to utilize this water for the land in need of it. A power plant located at the dam would supply power for the pumping stations. There is an area of approximately 100,000 acres on the territory involved where the water plane is only about 4 ft. from the surface, and in a large tract south and west of Fresno seepage conditions are said to have become a serious problem. The average annual flow of Kings River for the past twenty years is about 2,000,000 acre-feet. It is considered feasible to utilize only 1,700,000 acre-feet.

No borings have been made at the dam site, but bedrock shows on both side walls of the cañon. From the shape of the bedrock where it passes out of sight under the river it is believed that the distance to bedrock in midstream would not be great. A rough estimate shows that the probable volume of the dam will be about 1,000,000 cu. yd., including the masonry which will go into the spillway and other structures.

The water users of the district organized and appealed to Washington for aid in developing the Kings River reservoir site. At the request of the federal government Louis C. Hill, of Los Angeles, investigated the project and has recently submitted a report in which the foregoing information is embodied.

Form New Engineer Company

Upon the discovery that twenty-nine civil engineers were members of F Company, 4th Pennsylvania Infantry, at El Paso, Tex., orders were issued incorporating the company into the Pennsylvania battalion of engineers. The new unit will be known as Company C.

Build Dam Across the Colorado River in Seven Days

As the Imperial valley, California, has been facing a shortage of water because of the scour and rapid falling stage of the Colorado River emergent measures have been taken to maintain the supply. A canal has been rushed through for a supplementary supply direct from Volcano Lake and a rock diversion weir across the Colorado River just below the intake was built to raise the water level at the heading.

The new ditch, known as the Cerro Prieto Canal, is 20 miles long and has a capacity of 1200 sec.-ft. It was built on the west side of New River and involved the moving of more than 800,000 cu. yd. of earth. Construction was begun May 25 and on Aug. 1 the chief engineer announced it would be ready to receive water in a few days.

There was some opposition on the Yuma project to the construction of the rock weir below Handlon heading, as well as considerable delay in securing permission from the War Department. Pile driving was finally commenced on July 27, and on Aug. 1 it was stated that the structure would be finished on Aug. 3. The main channel where the pile trestle and rock weir were thrown across the river is 690 ft. wide and about 15 ft. deep.

Charles R. Rockwood, chief engineer of the Imperial Irrigation District, stated that when the weir was completed the level at the intake should rise within 48 hours so as to supply the Imperial canal with all the water needed.

Engineering Society Activities

The Engineers Club of Seattle, at its regular weekly meeting Aug. 3, was addressed by Frank T. Houlahan on brick making and clay products.

The Seattle Association of Members of the American Society of Civil Engineers held its regular monthly meeting July 31 at the Northold Inn. The relations of the national engineering societies to local sections were discussed.

The Tacoma Branch of the Naval Consulting Board of the United States was recently organized by civil, mechanical, chemical and electrical engineers. G. L. Parker, district engineer of the U. S. Geological Survey, Tacoma, was appointed chairman of the board. Capt. A. O. Powell, president of the Seattle Association of Members of the American Society of Civil Engineers, outlined the work accomplished by the Naval Consulting Board and mentioned the necessity of quickly getting the data in the hands of Washington officials.

The Engineers Society of Pennsylvania will hold an outing Aug. 26 at Pine Grove Furnace, Pa. Several hundred engineers are expected to attend.

What Engineers and Contractors Are Doing

AUSTIN B. FLETCHER, chief engineer of the California State Highway Commission, has been granted a forty-five day leave of absence to become a member of the special federal board which will handle the government's $85,000,000 good-roads appropriation. The appointment was made at the request of the Secretary of Agriculture. Mr. Fletcher has been active in good-roads work since his graduation from Lawrence Scientific School, Harvard University, in 1893. From that year until 1909 he served as secretary of the Massachusetts Highway Commission, resigning to join the highway department of California. To his efforts is attributed the success of the Massachusetts commission with which he was so long associated.

F. C. HITCHCOCK has resigned as vice-president and general manager of the MacArthur Brothers Company to join the Siems Carey Railway & Canal Company in a similar capacity. He will be engaged on extensive work in China. Mr. Hitchcock's first engineering experience was acquired in 1880, in the engineering department of the Toledo, Delphos & Burlington Railroad. The following year he went to the Delphos & Cleveland Railroad, where he was employed for a year on location and construction until his resignation in 1882 to become assistant engineer for the Toledo & Indianapolis Railroad. By studying in such periods as were available for that purpose Mr. Hitchcock fitted himself for a position in the engineering department of the Toledo & Ohio Railroad, with which company he remained from 1883 to 1887. In the latter year he was appointed resident engineer in charge of 10 miles of construction for the Duluth, South Shore & Atlantic Railroad. From 1888 Mr. Hitchcock was for several years employed by different roads on construction work, finally becoming assistant engineer on the Ohio extension of the Norfolk & Western Railway in 1890. He was later promoted to the position of resident engineer, in which capacity he had charge of the construction of 110 miles of roadway, including location and the design of heavy railway structures. He was for a time engineer and manager for George S. Wood & Company, contractors, and later locating engineer for the Choctaw Coal & Railway Company. He has been with the MacArthur Brothers Company for more than ten years.

WILLIAM G. SLOAN, formerly chief engineer for the MacArthur Brothers Company, has been made vice-president to succeed F. C. Hitchcock, whose resignation is noted elsewhere in this issue. Mr. Sloan's promotion comes after nearly fourteen years' service with the MacArthur Brothers Company. After graduation from Cornell University in 1899 he entered the employ of the Illinois Central Railroad as assistant engineer. The following year he was transferred to the Yazoo & Mississippi Valley Railroad in charge of construction of the line from Grenada to Parsons, Miss. He gave up railroad work in 1901 to become engineer in charge of masonry construction at Manchester, England, for the British Westinghouse Electric & Manufacturing Company, where he was employed until his appointment early in the following year as engineer for James Stewart & Company. He joined the MacArthur Brothers Company in December, 1902, and has been successively superintendent, Eastern manager and chief engineer.

M. M. MARSH has been promoted from assistant engineer for the Northern Railway Company of Costa Rica to superintendent maintenance of way and bridges. Mr. Marsh took up railway engineering in 1898 as rodman for the Cleveland, Lorain & Wheeling Railway. When that road was absorbed by the Baltimore & Ohio in 1901 he was made instrumentman in charge of construction of the Medina cutoff, in which capacity he served until his resignation in 1903 to enter the real-estate business. Two years later he again entered the field of railway engineering, with the St. Louis South Western Railway, where he won rapid promotion, and a year later was placed in charge of about 60 miles of grade-reduction work. February, 1908, found him chief of party in the Culebra district of the Isthmian Canal, from which position he resigned in 1913 to become assistant engineer for the Northern Railway Company of Costa Rica, C. A.

C. G. JENNINGS has resigned as rodman for the Morgan Engineering Company to become a junior engineer in the bridge department of the Illinois Highway Commission. While with the Morgan Company Mr. Jennings was engaged on a drainage survey in northeastern Kansas.

E. D. GRIFFITH, who has served as testing engineer for the California State Department of Engineering for the past nine years, was July 1 appointed testing engineer of the State Purchasing Department.

THOMAS EARLE, who has been associated with the Pennsylvania Steel Company's bridge department for more than twenty-five years, has been made vice-president of the recently organized Bethlehem Steel Bridge Corporation. He was formerly vice-president of the Pennsylvania Steel Company of Delaware.

H. B. DICK was recently made district valuation engineer for the Baltimore & Ohio Railroad with jurisdiction over the Baltimore & Ohio Southwestern and the Cincinnati, Hamilton & Dayton Railway.

C. F. BENNETT has resigned as valuation engineer for the Chicago & Western Indiana Railroad to become cost engineer for the valuation department of the Baltimore & Ohio Railroad. Mr. Bennett has had considerable railroad experience as office engineer for the Lehigh Valley Railroad, assistant office engineer and special engineer for the Canadian Pacific and as office engineer for the Mississippi River & Bonne Terre Railroad.

W. L. HAVENS, a recent graduate in civil engineering at Cornell University, is now employed by the division of sewage disposal of the city of Cleveland, Ohio.

ALBERT W. JOHNSTON, who was recently promoted from general manager of the New York, Chicago & St. Louis Railroad to become assistant to the president, obtained his early railroad experience in the engineering departments. After graduation from Massachusetts Institute of Technology he entered railway service as clerk and draftsman in the general superintendent's office of the Pittsburgh, Cincinnati & St. Louis Railway. He was made assistant engineer in 1878 and served in that capacity until his appointment to the superintendency of the St. Louis Southwestern Railway in 1880. He was appointed chief engineer for the Toledo, Delphos & Burlington Railroad early in 1882 but resigned in April of that year to go to the Leavenworth, Topeka & Southwestern Railroad as superintendent. He went to the New York, Chicago & St. Louis as division engineer in 1884. From 1884 to 1889 he was division engineer and following four years superintendent of the Eastern division. He was made general superintendent in 1893 and general manager in 1906.

R. S. WELCH, formerly assistant engineer of the Baltimore & Ohio Railroad in the office of the district engineer maintenance of way at Cincinnati, has been transferred to the Indiana division as assistant division engineer.

R. W. GABRIEL has been promoted from assistant engineer of the Ohio division of the Baltimore & Ohio Railroad to assistant engineer in the office of the district engineer maintenance of way for the Southwest district, with headquarters at Cincinnati.

W. P. ABBOTT, formerly assistant supervisor of the Ohio division of the Baltimore & Ohio Railroad, has been advanced to assistant division engineer of the Ohio division, with office at Chillicothe, Ohio.

EDGAR H. BAKER, who for the last year has been employed by the Interstate Commerce Commission, Southern District, division of valuation, has resigned. He is now in the valuation department of the Baltimore & Ohio Southwestern Railroad, with headquarters at Cincinnati.

A. H. MYERS has resigned as engineer for the William Russel Smith Company of York, Pa., to take a similar position with the B. F. Goodrich Company, Akron, Ohio.

L. N. MOELLER recently resigned as instructor in the surveying department at the Columbia University summer school to enter the technical department of the Atlas Port-

land Cement Company, Chicago. He was connected with the Atlas Portland Cement Company for nearly four years previous to joining the faculty of Columbia University, from which he has just received the degree of civil engineer.

JOHN S. RANDALL, whose duties include the supervision of the erection and repair of coast-guard buildings, jetties and wharves, is now located at Beaufort, N. C., where he is superintending construction work.

C. P. GRIFFITH, architectural engineer for Ray & Sons, building contractors, of Louisiana, Mo., is superintending the erection of a $45,000 school at Roberts, Ill., for which his company was recently awarded the contract.

S. S. CARROLL, for five years deputy state engineer of New Mexico, has been appointed resident engineer for the Las Vegas grant board. He will have charge of the construction of the Sanguijuela irrigation system. He was graduated from the University of Missouri in 1898. Mr. Carroll was at different periods employed by the Slupp Brothers Bridge & Iron Company and the Missouri Pacific & Iron Mountain Railroad. He served later as assistant engineer and superintendent of construction at Ignacio, Col., and Shiprock, N. M., for the U. S. Reclamation Service.

MELVIN C. HAZEN has been appointed to his third term as surveyor for the District of Columbia. He has been in the employ of the District since 1889, when he entered its service as transitman. He rose to the position of assistant engineer in 1896, and nine years later became assistant surveyor. His first appointment as surveyor was in 1908. The surveyorship is the oldest and the only office in the engineer department, except that of steam-boiler inspector, to which appointment is made for a definite number of years.

JAMES W. BILLINGSLEY, consulting engineer, of New Orleans, was recently engaged to plan and supervise the construction of a system of modern highways in Louisiana. The work has been divided into two districts, each of which has voted a $250,000 bond issue. Carl McHenry is chairman of the first road district; T. P. Flournoy has charge of the second.

W. N. HALL, drainage engineer for the U. S. Department of Agriculture, has been transferred from his station in Texas to the Washington office. His work in the Southwest included the investigation of the drainage of irrigated lands.

A. C. SHEPARD, formerly in the U. S. engineer's office at Cincinnati, has been placed in charge of the improvement of the mouth of the Big Sandy River, with headquarters at Catlettsburg, Ky.

G. C. CAYWOOD, in the employ of Zitterell & Sullivan, contractors, of Webster City, Iowa, is now located at Ackley, Iowa, where he is building a sewage-disposal plant for that municipality.

SAMUEL J. HOEXTER has resigned from the faculty of the University of Michigan and from the secretaryship of the Michigan Engineers' Society to become manager of the Engineers' Society of Pennsylvania. Mr. Hoexter is a graduate of Stevens Institute of Technology, class of 1909. He has been a member of the mechanical engineering faculty of the University of Michigan for the last four years.

C. H. HOWE, division engineer for the Baltimore & Ohio Southwestern Railroad, has been transferred from Flora, Ill., to Chillicothe, Ohio.

GEORGE W. SPENCER, city engineer of Huntington Beach, Cal., has been made city manager.

H. L. WILEY, contract manager of the Beers Building Company's Seattle office, has resigned. He has announced no plans for the future.

JAY H. KELLER, consulting engineer, of Portland, Ore., has been made superintendent of mechanical equipment in the new municipal auditorium now under construction. He is to serve as inspector while the structure is being erected.

WALTER H. GRAVES, consulting engineer, of Portland, Ore., has entered the employ of the Crawford Point Oregon Townsite Company. Mr. Graves has been engaged in engineering since his graduation from Illinois Wesleyan University in 1872.

FRED W. OSGOOD, assistant engineer under Frank H. Stephenson on plans and studies for the Cleveland (Ohio) filtration plant since February, 1914, is on temporary leave from the city service. He is at present engaged on work at Lima, Ohio, for R. Winthrop Pratt, of Cleveland, and William C. Clark, of Toledo, consulting engineers for Lima's new waterworks. A survey and map of the new 130-acre reservoir will be made and data collected from which to prepare plans for the filter and the enlargement of the pumping station.

F. X. BODE has been appointed deputy city engineer of Troy, N. Y., to succeed J. C. Watts, resigned.

ROBERT L. BURWELL has resigned from the Baltimore (Md.) Sewerage Commission upon the completion of that project. As assistant engineer he had charge of a large amount of storm-water and sanitary construction, in addition to being resident engineer during the erection of the sewage-pumping station. As assistant division engineer he prepared contract plans and specifications for more than $3,000,000 worth of work. He expects to devote his time in the future to work along similar lines. He was with the commission for nine years.

R. D. WAUGH, Mayor of Winnipeg, Canada, has been appointed chairman of the Commission of the Greater Winnipeg Water District to succeed the late S. H. Reynolds.

FRED A. ROBERTSON has resigned as a member of the engineering staff of the Canada Cement Company to accept a position with the Ontario Hydroelectric Power Commission.

JAMES F. TABLER has resigned as transitman on forest surveying and timber estimating for the Champion Lumber Company, of Crestmont, N. C. He is now transitman on valuation work for the Marion & Rye Valley Railway. Mr. Tabler was graduated from the Carnegie Institute of Technology in 1913.

LOUIS E. AYRES, after eight years of continuous service with Gardner S. Williams, consulting engineer, of Ann Arbor, Mich., has resigned to join the Belle Isle Bridge Commission of Detroit. The commission was recently appointed to prepare plans and estimates for the new bridge to Belle Isle.

E. G. HOPSON, of Portland, Ore., consulting engineer for the U. S. Reclamation Service, has been appointed by Secretary Lane of the Department of the Interior a member of a board that will review irrigation possibilities of the upper Colorado watershed in the state of Wyoming. The Secretary of the Interior appoints one member, the Governor of Wyoming another and the third is selected by the two appointees. Mr. Hopson has been engaged in engineering work since 1886 and has been connected with the U. S. Reclamation Service since 1906. He was for five years engaged on the building of the Hopkinton, Whitehall and Sudbury reservoirs for the city of Boston, following which he was employed on the Wachusett reservoir and aqueduct construction. During 1901-02 he was a member of the firm of Hopson Brothers, Halifax, Nova Scotia. He spent the following year as engineer in the department of aqueducts and reservoirs of New York and then became chief engineer for the National Board of Fire Underwriters. His appointment to the U. S. Reclamation Service followed.

RALPH G. KIRK has resigned as superintendent of construction at the Steelton plant of the Bethlehem Steel Company. He has announced no plans for the future.

J. M. JOHNSON, consulting engineer, of Louisville, has been engaged to examine and approves plans for a new $750,000 pump house for the Louisville Water Company.

LIEUT.-COL. WILLIAM V. JUDSON, Corps of Engineers, U. S. A., has been transferred from Chicago to Baltimore to succeed Col. C. A. F. Flagler, who was temporarily in charge of that district. Since his graduation from West Point in 1888 Lieutenant-Colonel Judson was in charge of harbor improvement at Toledo, improvement of the Mississippi River between Clarksville, Mo., and the mouth of the Missouri River and jetty construction at Galveston, Tex. Since 1914 he has been in charge of river and harbor improvements at Chicago.

Obituary Notes

A. B. STICKNEY, founder of the Chicago Great Western Railroad, died Aug. 9 at his home in St. Paul. He entered railway service in 1871 and was for several years an executive of the St. Paul, Stillwater & Taylor Falls Railway. Following his connection with the St. Paul, Minneapolis & Manitoba Railway as superintendent of construction he was general superintendent for the Canadian Pacific and later joined the Minneapolis & St. Louis in an executive capacity. He built the Minnesota Central Railway and then devoted his time to the Minnesota & Northwestern Railway, of which he was president. In 1892 he became chairman of the board of directors of the Chicago Great Western Railway and later was elected to its presidency.

PETER S. GIBSON, head of the firm of Peter S. Gibson & Sons, engineers and land surveyors, of Toronto, died Aug. 8 in that city. He was for thirty-five years engineer for York Township and a member of the board of examiners of the Ontario Land Survey. He was a graduate of the University of Michigan.

THOMAS APPLETON, founder and first president of the Society of Constructors of Federal Buildings, died Aug. 3, at Gardiner, Me.

CHARLES A. STOESS, one of the oldest civil engineers in British Columbia, died recently at his home in Vancouver. He came from England to Canada twenty-seven years ago. After serving in the civil engineering department of the Canadian Pacific Railway for many years and helping build the line through the Rocky Mountains he was employed on the Kelowna irrigation project.

ARTHUR HIDER, principal assistant engineer for the Mississippi River Commission, third district, died at Greenville, Miss., July 28. Mr. Hider has been connected with Mississippi River improvement work since 1879. For the past twenty-five years he was assistant in charge of all the bank-revetment work in the third Mississippi River district and was also in charge of the design and construction of towboats, tugs, hydraulic graders and all the various items required for river improvement. In addition to his work with the Mississippi River Commission Mr. Hider practised consulting engineering. Some of the works on which he so engaged include waterworks systems at Greenville and Hollandale, Miss., and Lake Providence, La. He was also a member of a committee to determine value of the Memphis (Tenn.) waterworks system when it was taken over by the city. Before joining the Mississippi River Commission Mr. Hider was in the city engineer's department at Louisville.

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The Health Element in Preparedness

ANOTHER indication of the co-operation which the War Department may expect from the country's technically trained men is afforded by the recently published announcement of the annual meeting of the American Public Health Association at Cincinnati, Oct. 24 to 27. As Dr. John F. Anderson points out in his presidential statement, national preparedness, to the great majority, means preparedness as to munitions, army supplies, ships and all the numerous things that the Army and Navy use. To a lesser number of people, preparedness means also the health and physical condition of the men at the front. "It is largely with us, as guardians of the health of the nation," Dr. Anderson says, "to see that this vital element is as it ought to be." It is the intention at the Cincinnati convention to devote a large part of the time to a consideration of measures affecting the vital and human element of national defense. The co-operation of such a body as the American Public Health Association, in the event of any crisis, would be of incalculable benefit.

Fine Words

IN an advertising circular being sent out by the American Society of Municipal Improvements are found these words: "The ideal of this organization—the public be served first—is sincere and powerful. . . . There has never been in this society a disposition to follow men rather than principles, and right there lies its strength. . . . The ideal of this organization that the public service be improved is the highest ideal that could possibly dominate in an association of public officials. It has the force of righteousness behind it." These are indeed fine words. If the society will back them up by reforming its present loose system of committee work, by strengthening its backbone so that it will not go counter to its own rules, and by setting itself against the adoption of patented pavement types as its standard, the engineering profession will have more faith in it. Its specifications will have a higher standing. It will become a power in the profession, instead of an object of suspicion. At its next convention it will have an opportunity to back its fine words by equally fine deeds.

Suspension Bridge Analysis

SUPPLEMENTING the articles by the same author developing graphical solutions for arches with fixed ends and for reinforced-concrete conduits (Engineering Record, Sept. 11, 1915, page 324, and Oct. 16, 1915, page 486), C. S. Whitney, on page 234 of this issue, presents a graphic analysis for stiffened suspension bridges with parabolic cables. This analysis is based upon the theory of displacements and should simplify the work of complete investigation and design of such bridges. The usual assumptions are made; that is, hanger stresses are considered to be equal under varying loadings and the deflection of the cables from the parabolic form and the deformation of the hangers and of the towers are neglected. Except for very long spans and light stiffening trusses these assumptions are sufficiently accurate for all practical purposes. It will be found that Mr. Whitney's analysis is simpler in application than the analysis usually presented in text books on the subject, where the principle of least work is applied to the problem. Influence lines by which the horizontal component of the cable tension and the stresses in the stiffening trusses can be obtained are readily drawn for either concentrated or uniform loading, and the effect of change in temperature is easily computed. This simplified analysis should tend to increase the use of the stiffened suspension bridge, especially for highway spans of the lengths for which this type is most economical.

Work Ahead for A. R. E. A.

A PERUSAL of the *Bulletin* of the American Railway Engineering Association announcing the work assigned to the various committees is sufficient to dispel any wonder that may have existed as to its late appearance. The committee on outline of work seems to have outdone itself. Instead of three, four and five subjects, one finds seven, ten and twelve lines of investigation assigned to most of the committees. Many of these, to be sure, are continued from last year, as "progress only" was reported in so many instances at the last convention. Fully half, however, are new assignments, and interesting ones. Apparently all of the good suggestions made at the last convention, either by the committees or by individuals, were absorbed by the committee on outline of work, and in addition numerous other timely subjects are brought up. If the standing and special committees do justice to all of these subjects they will have a busy year, and next year's convention should be most instructive. One subject for investigation that the Engineering Record heartily welcomes is that of grade crossings—their protection and their elimination, and the distribution of their cost between carrier and public—assigned to the committee on signs, fences and crossings. One might question the close connection between the general grade-crossing problem and "signs, fences and crossings," and wish a special committee had been created to thrash out the whole matter. The committee to which the subject has been given has, however, done some excellent work in the past, and will undoubtedly produce much food for discussion at future conventions. The Engineering Record, believing that with the growing feeling against grade crossings this is a matter that cannot be allowed to drag along over years, hopes the committee will present definite findings next March.

To Stop Reservoir Seepage

MANY remedies have been suggested for sealing the Cedar River reservoir of Seattle's municipal water and power project, which was completed late in the year 1914. The new masonry dam apparently was watertight, but great quantities of water flowed away through porous material in the north bank of the basin and emerged as springs in the valley about a mile below the structure. Among the first repairs to be suggested was a cutoff wall, which would have involved a very large expenditure. The lining of the area with concrete was another alternative. Recent developments indicate, however, that neither of these methods will be adopted. The present tendency, as indicated in a report submitted early this month by A. H. Dimock, city engineer, seems to favor a repair scheme involving the silting of the porous bottom with fine clay and, possibly, the laying of an impervious asphaltic lining over a portion, or all, of the area to be submerged. In addition to his own recommendation, Mr. Dimock includes in his report summaries of reports by Frederic P. Stearns, William Mulholland and R. H. Thomson, consulting engineers. A résumé of the findings of these experts appears on page 228. It is interesting to note that Mr. Thomson believes that sealing by silting will be sufficient and that an artificial lining will be necessary. Mr. Stearns, on the other hand, thinks it will be necessary to line the entire basin, while Mr. Mulholland occupies an intermediate position, holding that it will be necessary to line the slopes only and silt the bottom of the reservoir. Experiments by Mr. Dimock, the report states, have indicated the feasibility of the asphaltic lining, which is the novel feature of the scheme proposed. If the plan proves successful it may develop interesting adaptations on other work.

Aesthetic Bridge Design

WHILE local conditions and available funds undoubtedly modify the application of the general principles upon which the bridge designer should select the type of structure for a given crossing, there are cases in which the violation of æsthetic requirements in large cities seems inexcusable. An example in point is the Ninetieth Street bridge in Cleveland, described on page 190 of last week's issue. Conceding the difficulties of this problem of diverting Holton

Avenue and providing sufficient clearances not only for this avenue and the Pennsylvania Railroad tracks, as at present located, but to allow future change in grades in each case to eliminate the grade crossing, it still appears to this journal that the design would have been vastly improved by using concrete to mask the steel of the girders (see Engineering Record of Oct. 11, 1913, page 401, and Nov. 13, 1915, page 598) and by adopting a through arch of the same type as that at Forty-second Street in Philadelphia (see Engineering Record of May 22, 1909, page 648) for the main east span over the Pennsylvania Railroad tracks. The value of concrete as an ornamental and preservative covering for steel, making unnecessary the maintenance cost of painting, has been successfully demonstrated. In the interest of harmony of outline and appearance where concrete arch spans exist beside the steel girder spans, a relatively small added cost for concrete incasement of the steel would be amply warranted. A city of the size and civic pride of Cleveland should insist upon proper consideration of æsthetic principles in all of its important structures. The Detroit-Superior and the Brooklyn-Brighton viaducts in the same city both serve as excellent examples of the type of architectural finish in such structures which cannot fail to impress observers, and act as an intangible asset to the city itself.

Fallacy of Average Bid in Awarding Contracts

A PAVING manufacturer whose product has been injured by being used in cheap work, done by men who bid low because of inexperience, makes on page 240 of this issue an interesting suggestion for the overthrow of the low-bid fetish so commonly worshipped in American municipalities. Briefly, the method advocated is that of averaging all the bids and awarding the contract to the bid nearest the average. It is argued that this practice would, at least, absolve public officials from suspicion of favoritism, because the method is a lottery, pure and simple. Obviously, no man, bidder or official, could predict the amount of the average bid, unless, of course, dummy bids, excessively high, were put in to raise the average. Therefore, without the possibility of being charged with maladministration, public officers could award contracts at prices which would make fair work possible and leave the administration engineers free to demand it. But would this method make it any more certain that cities would get fair work? We think not. Contractors progress. They are alert to increase their efficiency, introduce new methods and do just as careful work for less money than their competitors. The proposed system would remove the premium on this progressiveness. The average contractor would be as successful in getting work as the up-to-date man. The average man would in many cases secure work at prices which would yield the enterprising contractor big profits, but which, because of his slack methods, would yield this average contractor nothing. There would be the same old temptation to "skin" work. The net result would be a defeat of the main object of engineering through increased cost of public work.

It might be argued that enterprise among contractors would still be fostered by the tempting profits awaiting the efficient. Not so. The reward of efficiency in the contracting field lies not in large profits on single operations but in a multitude of contracts. The able men, the strong organizations, must be paid if they are to be held. If they are to be paid they must be kept busy. Also, if they are to remain efficient, they must be kept busy. Unused tools rust. The enterprising firm's greatest asset is its ability to get the business because it can handle the business at the least expense. To average all bids is to wipe out this chief advantage of enterprise.

Thinking men will not agree with Mr. Carter that his remedy will prove effective. It will be hard—some deem it next to impossible—to teach the public that officials who shun irresponsible, inefficient contractors in awarding bids are not always crooked, but it must be done without resort to a system of averaging bids.

Invading the Domain of the Lawmaker

A WELL-KNOWN ATTORNEY discussing matters of broad public interest recently took the position that "the work of the engineer should be confined particularly to the collection of facts. . . . They should not attempt to invade the realm of the lawmaker or lawyer in the preparation of any form of suggested laws." At first thought the modest engineer, considering his lack of experience, expresses acquiescence, and says, "Of course, we should not go outside our technical lines." Later as he begins to think more deeply on the subject and to inquire into the fundamentals of lawmaking, it dawns on him that so far as he is concerned there can be no such thing as invasion of the realm of the lawmaker, simply because there is no such exclusive realm and no restricted body of citizens to whom pertains the privilege and duty of making laws. The efficiency of a democratic form of government rests upon the devotion of each and every citizen, especially those highly educated, to the duty of lawmaking, as far as practicable.

It is true that our legislatures and Congress are composed of 70 per cent and upward of lawyers and there is a prevailing conception that elective offices should be filled by men educated in the law. This idea is widely diffused and lawyers neglect no opportunity of showing to the world that the education of a lawyer develops qualities best suited for public service in lawmaking and in executive duties. Among others the engineers have acquiesced in this and have not presented claims which should be as valid, if not even stronger, for an engineering training is of equal or even greater importance in clearly seeing the needs of the public and in stating these in plain terms in the statutes. As the matter now stands, the laws made by bodies of citizens composed for the greater part of lawyers are not particularly well adapted to modern conditions, nor are they consistent. Neither are they wholly intelligible to the courts which must be called upon to interpret them. Undoubtedly the laws would be far better adapted to the actual conditions and far more intelligible if the engineers had a larger hand in the matter. It is to be noted that while lawyers predominate in lawmaking bodies, and while there are also bankers, merchants, doctors and nearly every other profession and trade, the most conspicuous absence is that of the engineer. There is something wrong with a profession which is practically unrepresented in this important group of citizens.

It is evident that an erroneous impression has prevailed with reference to "invading the realm of the lawmaker." The engineer cannot "invade" the realm simply because that is his proper place, but one which he has not occupied to the degree which is best for himself and for the public.

The Man from Home

FROM one of its readers the Engineering Record has received a letter objecting to the employment of nonresident consulting engineers to report on problems which could be solved satisfactorily by local members of the profession at less cost. In the opinion of this correspondent the practice is especially true of large corporations and the more important municipalities. "I have in mind," he says, "the president of a city Business Men's League who always has to have an 'expert' engineer from a distant state to look after any engineering projects his company may be interested in starting. The 'expert' usually sizes him up and charges the limit. Nine times out of ten there are local engineers who are just as capable and reliable and have had just as much practical experience as the 'expert.' I think the local engineer, everything else being equal, should be patronized."

The point raised in this communication is one which depends so greatly upon local conditions that it is not possible to dispose of it in any general terms. The report of a consulting engineer does not always serve merely as a solution to some technical problem. It has many other uses. Take the case of some sound project which needs for its development the support of financial interests. A favorable report from an engineer of national reputation will enlist this support far more readily than the findings of a more obscure local man, although in the intrinsic value of the two reports there may be nothing to choose. In another case, the failure of some engineering structure, it is common practice to call in experts from outside even though there be engineers in the immediate locality well qualified to report on the accident and the possibility of its repetition. Other factors than mere engineering enter into such situations. It may, for instance, be necessary to allay public anxiety, and reports by outside experts often prove effective remedies. It is all as much a matter of psychology as of pure engineering, and gets back to the old adage about a prophet being without honor in his own country. Many times, of course,

the local engineer, because of his intimate familiarity with conditions, may be far better qualified to express an opinion than the outsider. On the other hand, it is sometimes best to receive an opinion based upon an entirely fresh and unbiased point of view. Too close proximity may distort the vision of the local engineer, while the man from afar may be able to see the situation in its true perspective.

This journal is reliably informed that in a certain section of the country local engineers have followed one another almost blindly in the design of concrete reservoirs which are faulty in an important detail of their foundations. Most of these basins leak badly. Under such conditions the employment of an outside engineer on some new waterworks project would surely have a most beneficial effect.

From what has been said it must not be inferred that this journal advocates the universal employment of the out-of-town consulting engineer. The local man is often as well, if not better, qualified to express an opinion. Each case must be decided according to the local conditions which govern it.

That Mantle of Charity

A REFRESHING departure from the *ex post facto* policy that seems to prevail among most of those who attempt to regulate railroads is found in an opinion written recently by Walter A. Shaw of the State Public Utilities Commission of Illinois. Mr. Shaw does not believe that it is the intent of the law to correct all the evils that grew under past unregulated conditions. The case in question was one of additional capital, and Mr. Shaw thought that if the desired new securities were represented by new property that was sufficient. The principle applies, however, to other matters relative to valuation and ratemaking.

It is unfair, for instance, to deduct depreciation in evaluating a railroad on the ground that the depreciation funds of the past have been dissipated by excessive dividends. Even to this day there is no very definite provision made that the railroad may earn a depreciation reserve. Only within the last few years has the desirability of such a reserve been agitated, and in that time the uselessness of an actual fund of any considerable size for a large railroad has been demonstrated by valuation experts. On the other hand there is no blinking the fact that when many of the railroads were built both public opinion and the law as then interpreted put them in pretty much the position of the private enterprise, entitled to all the profits they could get honestly. Why then should they be permanently penalized for distributing large profits that included what a later generation says should be set aside as a depreciation fund? Even if the railroad securities had remained in the hands of those who had reaped the large profits, the public ethics of taking back what had once been given under conditions that were considered right would be questionable. But many of these securities are constantly changing hands. Their market prices are based largely, at least, on present earnings and future prospects, and the public, by keeping its hands off for so long, has in a way given its stamp of approval to the conditions.

It was right to put the public utility on a different basis and regulate its earnings, but it is not right to extend regulatory measures backward, and thereby alter the conditions under which the securities have changed hands. This is no more fair than it would be if, as may some day come to pass, we were to regulate the price of shoes, and should then oblige the dealer to sell us three-dollar shoes for one dollar on the ground that he had been getting five dollars all these years.

Of course the foregoing is not to be interpreted as an indorsement of illegal and crooked practices of the past. Presumably Mr. Shaw would, as this journal would, punish such misdeeds as fully as possible, but it should be remembered that much that is now illegal was once legal. The burden of the proof is on the public to show unlawful acts, and not assume that all utilities have been guilty of them because some have.

Laws of Chance Adapted to Engineering Studies

THE value of a numerical record of any sort depends upon the fullness and accuracy of its interpretation. Records such as are commonly met with in studies along sanitary lines, when examined as they are taken in chronological order, often fail to give the clear impression desired regarding any particular point in question, as the mind fails to grasp all the elements of the record in that form. Perhaps the commonest aid to the interpretation of such a record is the average, to which is sometimes added the maximum and minimum.

Another step in the direction of clear interpretation is in the graphical representation of the record. To those who are used to diagrammatic presentations, a chronological diagram of the record gives a clearer grasp of its meaning than does a tabular statement, but those who have to make frequent interpretation of such records realize the shortcomings of this method. A chronological draft sometimes gives a confusing mental picture, whereas clearness is the thing most desired.

The interpretation and comparison of all records of this kind is facilitated by the simple rearrangement of the terms of the record in the order of magnitude. This treatment at once converts the diagram into a smooth line of some characteristic shape, and a curve constructed in this way gives distinctly more information about the record for many purposes than does the chronological arrangement.

In studies that have recently been made, involving a large volume of records of this general character, Allen Hazen has recognized the fact that the variations of many such records follow substantially the laws of probabilities. This may be interpreted to mean not that events happen without cause, but that there are so many causes of the events that we cannot consider each alone, and these causes operate in such a way that the combined result conforms, in many cases very closely and in other cases approximately, to the laws of chance.

Observing this peculiarity about various records, Mr. Hazen conceived the idea of preparing a plotting paper on which the curve of probability would plot as a straight line. Then any series of observations which varied in accordance with this probability would also plot as a straight line. This plotting paper was prepared and used.

Along similar lines of study Prof. George C. Whipple, of Harvard University, in recent issues of the *Journal* of the Franklin Institute (July and August, 1916), describes at some length the application of this method to various problems that arise in connection with sanitation. He shows that a record of variations in death rates plots as a straight line and facilitates the easy and accurate comparison with other similar records. He points to the studies that have been made along this line with stream flows and annual rainfalls and shows that they plot as straight or nearly straight lines. He shows that the variations in the percentage of different constituents in milk analyses and in water analyses plot as straight lines and enable the frequency of a variation of given magnitude to be clearly understood. He shows that the numbers of bacteria in water, thus arranged and plotted, form a line that is direct and characteristic in shape, although not always quite straight, and points out the facility of its interpretation. And so for many other records.

The use of this method has many advantages. It indicates at a glance the average, and also the median observation, which is coming to be recognized as having an important value. It shows clearly the degree of uniformity of the terms of the record and especially shows the magnitude of the variations from the mean at any and all points of the scale. A little reflection will indicate that this latter property is a most valuable one in any record. It is a means of predicting with reasonable assurance the magnitude and frequency of variations larger or smaller than have heretofore occurred.

The substance of Professor Whipple's whole paper goes to emphasize the importance of the use of the principles of probability to engineers, chemists, health officers and biologists. As he states in conclusion: "Oftentimes direct results may be obtained by using the laws of chance, but perhaps the greatest benefit to be derived from the study of probability is the state of mind which it is likely to produce. A realization of the fact that oftentimes many different causes are involved in the productions of an event will prevent one from being too sanguine in drawing conclusions from tests, analyses, and statistical data of all sorts, and from being too drastic in the enforcement of standards.

"It is believed that in the probability paper which has been described Hazen has given to the profession a new and very useful tool. Heretofore the laws of probability have been used with difficulty; hereafter they may be used with greater facility."

WHEN COMPLETED THE CALAVERAS DAM, NEAR SAN FRANCISCO, WILL BE THE HIGHEST EARTHFILL DAM YET UNDERTAKEN

Three Million Yards Being Pumped to Build Calaveras Dam, 240 Feet High, by Hydraulic Method

Highest Earthfill Structure Yet Undertaken, to Augment San Francisco's Water Supply, One Third Complete—Unit Cost of First Million Yards, Exclusive of Overhead, 25 Cents Per Yard

By G. A. ELLIOTT
Engineer, Spring Valley Water Company, San Francisco

HYDRAULIC methods are being used in the construction of the Calaveras dam near San Francisco, the highest earth dam yet undertaken. The embankment involves more than 3,000,000 cu. yd. of fill, and practically all of the material has to be pumped. To date about a third of the embankment has been placed, and the bare cost per yard, exclusive of overhead, has been about 25 cents.

The location of San Francisco at the northern end of the San Mateo peninsula and the local climatic conditions make the water-supply problem difficult. The present supply of 44,000,000 gal. daily is derived partly from surface reservoirs located about 20 miles south of the city and partly from artesian gravel beds in Alameda County on the east side of San Francisco Bay. This water is carried to San Francisco in pipes which pass under the bay. The danger of the more or less frequent occurrence of dry seasons necessitates the maintenance of a large storage reserve. The existing storage of 90,000 acre-feet, together with the present yield of the subterranean sources, insures a supply for three years. The Spring Valley Water Company, which supplies the city with water, has in addition to the developed supply a large potential capacity in Alameda County. The development of additional water involves the use of two large underground gravel-filled basins and the construction of three dams which will form surface reservoirs with a storage of 250,000 acre-feet, having a tributary watershed of more than 300 square miles.

The Calaveras dam, the construction of which was begun in 1913, is the largest of the three. It is located about 45 miles southeast of San Francisco on one of the branches of Alameda Creek, and has a direct tributary drainage area of 100 square miles, which will be increased to 138 square miles by the construction of a tunnel 9000 ft. long. It will have a capacity of 162,700 acre-feet and will insure a daily supply of 57,000,000 gal., more than doubling the present supply.

Highest Earthfill Dam

The Calaveras dam is the highest earthfill structure yet undertaken, and in volume is second only to the Gatun dam. The height above bedrock at the center is 240 ft., the crest length 1300 ft. and the base width 1300 ft. The upstream face slope is 3:1 and the downstream $2\frac{1}{2}$:1. It will contain 3,084,700 cu. yd., of which 1,300,000 cu. yd. are now in place. To prevent seepage under or around the structure, a trench 25 ft. wide and 8 ft. deep has been cut in the bedrock under the crest line. On the west side, due to the presence of seamy rock in the abutment, this trench has been carried 50 ft. below the ground surface.

The reservoir outlet consists of a concrete culvert 1300 ft. long with an area of 234 sq. ft., following the original stream channel beneath the dam. A reinforced-concrete tower, 225 ft. high, located at the upstream end of the culvert, provides an outlet for the reservoir. The tower was designed to withstand a possible earthquake shock having an acceleration of 6 ft. per second per second. The design was made by A. V. Saph.

The type of dam was decided upon after a thorough investigation of the foundation conditions and with due respect to the possibility of earthquake effect. Materials were available for either a concrete or an earth dam. The fault line of the earthquake of 1906 passed directly through the San Adreas and Upper Crystal Springs earth dams, and although the movement was sufficient to change the position of nearby fences more than 6 ft., the structures were not affected in any way. In view of this experience, it was decided that an earth structure built on liberal lines would not offer the rigid resistance to seismological disturbance that would be met in a masonry dam.

Reason for Hydraulic Method

The hydraulic fill was selected on account of the economy of the method as compared to the ordinary dry fill, and also for the great advantage to be derived from the automatic selection of the material, which by this method is deposited in successive stages of quality ranging from the extremely coarse fill on the outer slopes to the fine clay in the core. Test pits indicated that workable material was available.

Work was started in May, 1913, and during that year the culvert was completed. Surface soil and gravel were removed to a depth of 30 ft. for a distance of 65 ft. on either side of the core trench, exposing the bedrock. The material removed in this way

was used to build dikes along the toes of the dam to retain the sluiced fill. Early in 1914 the hydraulic fill was begun and has been carried on continuously to the present time.

SLUICING METHODS

Practically all of the hydraulic fill in the dam has been pumped. The location of only one of the eight borrowpits used was at an elevation sufficient to deliver the material by gravity. The distance of transportation has varied from 1000 to 4500 ft. The equipment used in the work consists of motor-driven centrifugal pumps.

At the present time two sluicing units are used. A three-stage 8-sec.-ft. centrifugal pump, direct-connected to a 500-hp., 2200-volt induction motor running at 600 r.p.m. is mounted on a barge in the reservoir above the partly completed dam. The water is pumped through 12-in. slip-joint steel pipes, and is delivered at the pit with a nozzle pressure of 75 lb. Hendy giants, with discharge tips varying from $2\frac{1}{2}$ to 4 in. in diameter, are used on the end of the line. The size of the discharge tips varies with the material, depending upon the cutting force necessary to bring down the banks.

The second station is located in the cañon below the dam and receives its supply through a suction pipe laid through the outlet culvert. This installation consists of two units, one with a capacity of 8 sec.-ft. against a 400-ft. head and one of 4 sec.-ft. against a 550-ft. head. The water from the smaller pump is delivered with a 75-lb. head and is used to cut the banks. Water from the second unit is delivered at the pit without head and simply gives a volume sufficient to carry the material to the dam. By dividing the pumping head in this way a considerable saving was effected in the power cost.

HANDLING OF JETS

The jets are directed against the toe of the borrowpit bank, which is undermined, causing it to cave in. This results in the spoil being broken up and allows the water to carry it away. The soil-laden water flows to the lowest point in the pit, passing through a grizzly or screening device made of vertical 2-in. pipe set 4 in. apart. Rocks more than 4 in. in diameter are screened out and passed through a crusher set just below the grizzly. From this point the material is pumped by a 12-in. mud pump driven by a 300-hp. motor through a 14-in. slip-joint steel pipe to the toe of the dam.

The pipes discharge their contents on the outer edges of the toes. The flow is directed toward the center of the dam by the work of one man, who by the use of boards so controls the discharge from the pipe line as to build up small dikes along the edge of the toes. The coarser fill remains near the point of discharge, the remaining burden of the water being deposited automatically as the velocity of the stream decreases, until the pond is reached. Here the fine clay is settled in comparatively still water. The point of discharge is changed along the toes by the removal of successive pipe lengths, to maintain uniform relation between the widths of the dry banks and pond. Pipes are removed from the end of the discharge line without interruption to the pumps, so that a delivery run across the toe is always begun from the end furthest from the pit.

THERE IS LITTLE WASTE AT OUTLET BOXES

OPERATION OF MUD PUMPS

The mud pumps will operate against a head of 80 ft. When the head exceeds 80 ft. a booster of equal capacity is cut into the line. The head on the mud pumps depends largely on the character of the soil. With an excess of clay the friction is comparatively low, and the power required is a minimum. An example of this fact may be had with the present arrangement at Calaveras. In order to reduce interruptions to a minimum, duplicate units have been installed, so that should work be discontinued for any reason the crew can be immediately moved to another location. Two pits at the same elevation and the same distance from the dam are used alternately. One of these pits is composed of about 65 per cent clay and 35 per cent shale rock. In the other these percentages are reversed. When using the first pit one pump is sufficient. If the second pit is used, a booster has to be cut in and the power is doubled.

One of the problems encountered in the work was to reduce the wear on pumps and pipes. The velocity of the water and the character of material which it carries are the factors that affect the life of the carriers. Although a high velocity is desirable to secure the maximum carrying power of the water, it was found that the minimum velocity in the pipe lines which would keep the material in suspension caused the least wear on the pipes, and although the output was decreased the resulting unit cost was lower. With the installation described this critical velocity was 12 ft. per second. On an average the water carries 8 per cent of its volume of material.

WEAR AT BOTTOM OF PIPES

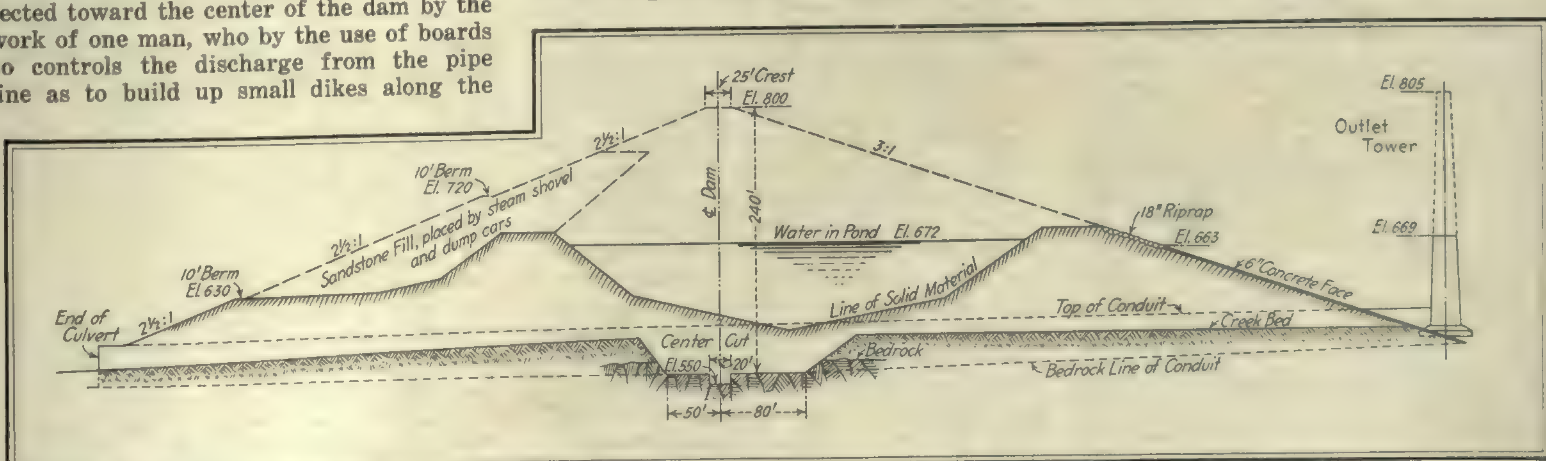
All the wear takes place on the bottom third of the pipe circumference. This feature is so pronounced that the coating on the interior of the line is not disturbed on the top two-thirds of the circumference even when the plate at the bottom is worn through. High-carbon steel pipes are now being tried, and the result has justified the slight increase in initial cost. The pipes are turned twice during their life, allowing full use to be made of the metal.

The runners or impellers in the pumps are subject to excessive wear. A worn-out runner means an idle crew for half a shift while it is being replaced. Three kinds of material have been used—cast iron, cast steel and manganese steel. Manganese-steel runners cost about six times as much as cast iron; but the cost per cubic yard was cut almost in two by the use of the former. In some cases it was found that the manganese-steel runners wore unevenly, becoming unbalanced and creating excessive vibration of the pump.

The yardage handled through the life of a runner varies with the character of the material pumped. It has varied from 30,000 with sand and gravel to 200,000 with excessive clay and soft shale rock.

REMOVAL OF WATER FROM POND

During the first year of sluicing the excess water in the pond was allowed to flow out through a vertical pipe in the center leading to the culvert. To give this pipe stability a double line was used, consisting of a 16-in. pipe set inside of an 18-in. pipe, the space between the two being filled with cement grout. It was found that as the length of this pipe increased it was susceptible to the movement of the clay core, and this scheme was abandoned and the pipe filled with concrete.



THE DAM IS BEING BUILT MAINLY BY HYDRAULIC METHODS, BUT A SMALL PART IS BEING PLACED BY STEAM SHOVEL

GIANTS DIRECTED AGAINST THE TOE OF THE BORROWPIT BANK UNDERMINE THE MATERIAL AND CAUSE IT TO CAVE IN

Two trenches 4 ft. wide were cut through opposite ends of the upstream toe and bottomless flumes constructed of 1-in. boards with 4 x 6-in. posts and 2 x 4-in. spreaders. Excess water from the pond is allowed to flow out through the box which is farthest from the point where the pipes are discharging, and runs down the slope of the dam, which is riprapped up to the outlet to prevent erosion of the slope. To raise the level of the pond, rock and gravel are dropped into the cut to the required height for the width of the dry toe. The amount of clay contained in the discharge from the pond varies from 0.1 to 2 per cent. This depends on the relative amounts of material delivered, clay sometimes being wasted in order to maintain the proper relation between the dry toes and the clay core, to insure the stability of the structure.

PARTIAL CHANGE IN CONSTRUCTION METHOD

It developed after the beginning of hydraulic operations that the available material contained an excess of clay, and that it would be necessary either to waste this excess or to add coarse material by other means. A sandstone bluff opposite the downstream toe suggested the use of steam shovels and the deposition of this material on the outer slopes of both toes. Work was started early in 1915 with two steam shovels, the material being transported with wagons. This has resulted in a substantial increase in the width of the dry toes and has allowed sluicing to be carried on at a greater rate of speed, through eliminating the necessity for wasting in the pond discharge any of the clay core.

In order to secure storage during 1916, it was decided that, to obtain the maximum height of dam with the yardage to be deposited in the time intervening before the runoff period began, the lower toe should be moved toward the center a distance of 150 ft. This was done, leaving a bench between the final slope location and the temporary toe, which will be filled by steam-shovel work in the sandstone. This is now being done by contract, using a Model 65 Marion shovel and 15-yd. air-dump cars. The contract covers the placing of 375,000 cu. yd. of sandstone, this amount contemplating a fill varying from 150 ft. in thickness at the present elevation to 60 ft. within 40 ft. of the crest of the dam. It is the intention to continue placing sandstone on the upstream toe, unless future borrowpits develop an excess of rock and coarse material.

Monthly tests are made of the clay core by taking samples of the fill at 10-ft. intervals. A 1½-in. pipe with a wooden plug in the lower end is forced down to the point at which the sample is to be taken. The plug is tapped out by means of a rod put down inside of the pipe, and the plastic clay presses into the end. It is impossible for four men to force the pipe any deeper than 60 ft. At a depth of 60 ft. below the pond surface a practically constant relation of 75 per cent of clay and 25 per cent of water by weight is found.

In addition to this quantitative test a traverse of the pond between the upper and the lower toe is also made, in order to ascertain the relative compactness of the fill. This traverse is made by forcing a pipe as far down as possible into the fill at 50-ft. intervals. The comparison between the periodical depths and distances from the edge of the pond are indicative of the consolidation of the mass.

LABOR AND COST CONDITIONS

Comparatively few men are employed on the sluicing units. Two units are working two shifts each and the total number of men per unit per shift is fifteen, making sixty altogether. When it is considered that an average of 3600 cu. yd. of material per day is transported a distance of 3000 ft. with a crew of this size, the advantage of this method of excavating and placing fills is evident. With the single exception of the relative quantity and quality of the fill, nothing is left to the judgment of the engineer.

The cost of excavating and placing fills by the hydraulic method depends as much on the character of the material as on the cost of labor, material and power. The relative coarseness of the material affects the head upon the pumps. The direct cost of sluicing the first million cubic yards of fill was about 25 cents per cubic yard. This is the bare cost of the work and includes only the expense of pipes, pumps, motors, belts, power and labor used directly on the sluicing work. No interest, overhead, superintendence, insurance or the prorated auxiliary costs of clearing the reservoir site, building and maintaining roads, trails, camp, etc., are included in this figure. In this connection it must be borne in mind that the work accomplished so far has been on the base of the dam, and that as the height is increased the unit cost of placing the sluiced fill will also increase.

It is estimated that the dam will be completed in 1918.

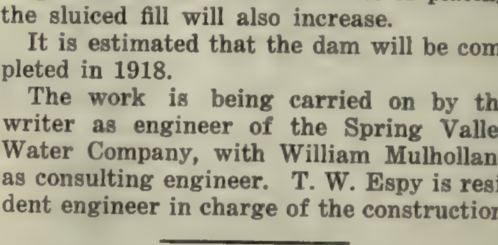
The work is being carried on by the writer as engineer of the Spring Valley Water Company, with William Mulholland as consulting engineer. T. W. Espy is resident engineer in charge of the construction.

Deflections Obtained by Means of Level Bar

H. F. Moore and W. M. Wilson Report Method of Using Micrometer Screw at End of Level Bar to Measure Beam Deflection

AMONG various forms of deflectometer used in the series of tests of I-beams and built-up girders reported by H. F. Moore and W. M. Wilson in Bulletin 86 of the Engineering Experiment Station, University of Illinois, the most convenient was found to be the level bar and micrometer apparatus illustrated herewith.

The point *A* of the instrument is set on the beam over the end bearing, and the point *B* at the end of a micrometer screw *M* is set at mid-span. With zero load on the beam the micrometer is adjusted by raising or lowering the point *B* until the level bubble *L* is centered. With any given load on the beam the same process is repeated, and the difference between the micrometer readings gives the deflection at mid-span. The point *A* is placed in a prick-punch hole and the point *B* in a cold-chisel mark on the flange of the beam.



LEVEL BAR MEASURES DEFLECTION

Since these tests were made, it is stated, a new form of level bar has been constructed according to the design of H. R. Thomas. The screw micrometer *M* is replaced by a leveling screw which actuates the plunger of a direct-reading dial gage micrometer. This later form is much quicker in operation than the earlier one.

Much New Work Outlined for American Railway Engineering Association

Board of Directors Announces Many Assignments for the Coming Year to the Nineteen Standing and Three Special Committees

ASSIGNMENTS of work for the coming year for the nineteen standing and three special committees of the American Railway Engineering Association have just been announced in Bulletin 186 of the association. There are numerous new studies proposed, and in addition the committees are instructed to continue most of the investigations already under way. The assignments, in addition to one to each committee directing it to make critical examination of the subject matter in the *Manual*, are as follows:

Roadway.—Special reference in study of *Manual* to shrinkage or expansion of material placed in embankments by ordinary methods of railway construction and to settlement thereafter; also, revisions of recommendations relating to steam-shovel work and roadbed cross-sections.

Unit pressures allowable on roadbeds of different materials, co-operating with special committee on stresses in railroad track.

Prevention and cure of water pockets in roadbed.

Advisable slopes for rock cuts 40 ft. or more high.

Advisable widths for newly constructed roadbed on embankments 50 ft. or more high.

Advantages and disadvantages of track elevation and track depression in cities where many street crossings make it necessary to change grade of railway. Advantages and disadvantages in depressing or elevating streets where few crossings are to be eliminated with but slight changes in grade of tracks.

Effect of fast trains on cost of maintenance of way and cost of equipment.

Ballast.—Ballast sections, with particular reference to use of sub- and top-ballast. Define sub- and top-ballast.

Proper depth of ballast of various kinds to insure uniform distribution of loads on roadway, conferring with special committee on stresses in railroad track and committee on roadway.

Methods and cost of applying ballast, with special reference to: (a) Organization of most economical ballast gang of railway company forces; (b) use and limitation of mechanical tools, such as the pneumatic tamper and spreader for forming shoulder and path; (c) application by contract.

Comparative merit of different stones and gravel and other materials for ballast.

Ties.—Effect of design of tieplates and track spikes on durability of crossties.

Specifications for cross and switch ties (a) when used without preservative treatment, (b) when to be used with a preservative liquid.

Trials of metal, composite and concrete crossties, and results to date.

Future timber supply for ties, both domestic and foreign.

Rail.—Special attention in study of *Manual* to rail designs recently adopted, and to specifications for carbon-steel rails and joint bars.

Annual statistics of rail failures and conclusions therefrom.

Effect on rail of defective equipment and improper maintenance.

Special investigation of rails.

Track bolts and nutlocks.

Details of manufacture and mill practice as they affect rail quality.

Joint bars from standpoint of design and material, together with laboratory tests, including strain-gage measurements, after having established uniform method for comparative testing.

Relative value of material for joint bars, quenched only versus quenched and tempered, and whether most advantageous to quench in oil or water.

Rational relation between intensity of pressure due to wheel load and resistance of rail steel to crushing and deformation.

Investigation and development of methods of inspection.

Federal and state commission rulings.

Track.—Economics of track labor.

Specifications and designs for cut and screw spikes.

Guard rails and flangeways and effect of increase of 1/8-in. thickness of wheel flanges.

Typical and detail plans of turnouts, crossovers, slip switches and double crossovers, including tieplates, rail braces, riser plates, etc., conferring with committee on signals and interlocking.

Design of and specifications for manganese frogs and crossings.

Reduction of tapered tread of wheel to 1 in 38 and on canting rail inward. Confer with committee on M. C. B. Association with view of reducing allowable limit for flat spots on freight-car wheels.

Test of tieplates subject to brine drippings.

Limit of rail-head wear on curves.

Specifications for relayer rail for various uses.

To what extent frog and switch designs recommended by association are being used by railways.

Definition of "main track."

Buildings.—Special reference to appropriate definitions in study of *Manual.*

Coaling stations.

Freight and passenger station scales.

Ash pits.

Classification of buildings on basis of "Specification-Types." Use of "cubic-foot," "square-foot," and "bill-of-particulars" method for ascertaining approximate cost of new construction.

Safety-tread devices for stations exposed to the elements.

General subject of roadway buildings.

Design and merits of high and low platforms at passenger stations.

Design of shop buildings.

Comparison of umbrella versus butterfly sheds at through stations.

Wooden Bridges and Trestles.—Design of dock and wharves, including floors; coal and ore wharves.

Comparative merits of ballast-deck and reinforced-concrete trestles, taking into consideration design of ballast floors for timber trestles.

Lagscrews in trestle construction.

Classification of wooden bridges.

Merits of galvanized-iron fastenings for timber trestles as compared with plain iron and steel fastenings, especially in relation to their use on creosoted structures.

Masonry.—Cost and method of constructing concrete piles; how and where to be used. Additional typical designs for concrete piles for different loading and rules for driving under various conditions and loading.

Cost, appearance and wearing qualities of various methods of surface finish for concrete.

Typical designs of foundations for piers, abutments, retaining walls and arches in various soils and depth of water (not including pneumatic foundations).

Principles of design of plain and reinforced retaining walls and abutments.

Results of work with joint committee on standard specifications for cement.

Results of work with joint committee on concrete and reinforced concrete.

Wisdom of use of blast-furnace slag in reinforced-concrete work, taking into special consideration its probable duration.

Signs, Fences and Crossings.—Special consideration in study of *Manual* to flangeways, both when street or highway is and is not occupied by street or interurban railway tracks.

Signs; principles of design and rules for their use.

Concrete fence posts.

Reduction of number of roadway signs and adoption of standard signs for general use as far as possible. In collaboration with committee on signals and interlocking, design of suitable day and night (if necessary) marks or signs for switch signals, derail switches, stop posts, slow posts, resume-speed posts, water station and track-pan markers, highway crossing signals, etc. Also location of signs, having in mind matter of safety of employees obliged to use roadway.

Legal requirements relative to provision of fences for right-of-way and of stockguards.

Classification of fences into types.

Comprehensive study of crossings:

(a) Grade crossings: Crossing gates, signal bells, warning signals, watch houses.

(b) Overgrade crossings: Laws of the various states which affect distribution and cost between carrier and public; economic design of overhead bridges to meet requirements of public-service commissions and other governmental bodies.

(c) Undergrade crossings: The same.

Signals and Interlocking.—Economics of labor in signal maintenance.

Problem of signaling single-track roads with reference to effect of signaling and proper location of passing sidings on capacity of line.

Specifications adopted by Railway Signal Association which warrant consideration, conferring with committee on track on any appliances affecting track.

Requisites for switch indicators, including method of conveying information as to condition of block to conductor and engineman.

Desirability of having overlap in automatic signaling; if so, is it best to have two stop indications between trains or two caution indications instead, or the latter in special cases only, such as down-grade tracks?

Various methods of giving signal indications other than by means of semaphore.

Feasibility of separating into distinct types of their own (1) signals for train operation and (2) markers or signs which indicate the location or position, or both, of information signs and switch signals for conveying information to trainmen. (1) The semaphore is now almost universally used for governing train operation, therefore (2) design suitable day and night (if necessary) markers or signs for switch signals, derail switches, stop posts, slow posts, resume-speed posts, water station and track-pan markers, highway crossing signals, etc., conferring with committee on signs, fences and crossings.

Signal schemes presented to association. State specifically for what purpose each aspect and indication shall be used and what action on part of engineman is required.

Automatic train control.

Comparative merits in various locations of alternating current and direct current for operation of automatic signals.

Applications of aspect for instructions to trains to take siding at non-interlocked switch.

Records and Accounts.—Small forms on cardboard or other suitable material for use of field men in making daily reports.

Interstate commerce classification of "Investment in Road and Equipment" and "Operating Expenses." Any desirable changes.

Various methods of reproducing maps and profiles on tracing linen for permanent record.

Recording and reporting cost of additions and betterments.

Specifications for maps and profiles, coordinating with previous work of association.

Valuation forms now in use. Recommend forms for both field and office use.

Rules and Organization.—Manual of instructions for guidance of engineering field parties.

Science of organization.

Manual of rules for guidance of employees of maintenance-of-way department.

Water Service.—Design and relative economy of track pans from an operating standpoint.

Method for rejuvenating driven wells; cost and success, as compared with driving new wells.

Various type of well strainers in use and service secured from each.

Methods for complying with federal regulations in regard to purity of drinking water supplied to public and employees on interstate trains.

Design of impounding reservoirs, and conditions under which they are economical.

Relative merits of continuous and intermittent water softeners.

Rules or examination questions for care for boilers in pumping stations.

Yards and Terminals.—Handling of freight in double-deck freight houses and cost of operation.

Typical situation plans for passenger stations and approaches; methods of their operation.

Classification yards.

Track-scale specifications.

Suitable profile for hump yards.

Iron and Steel Structures.—Methods of protection of iron and steel structures against corrosion.

Relative economy of various types of movable bridges.

Secondary stresses and impact.

Column tests.

Design, length and operation of turntables.

Construction of ballast-floor bridges and methods in use for waterproofing same.

Economics of Railway Location.—Special consideration in study of *Manual* to revision of conclusions in Vol. 16, pages 104 to 109.

Resistance of trains running between 35 and 75 miles per hour.

Effect of curvature on cost of maintenance of way, and on maintenance of equipment.

Effect of train resistance on amount of fuel consumed.

After study of effect of various physical characteristics of railroad locations upon their economy of maintenance and operation has been made, if possible to do so, state conclusions derived in a formula or series of formulas which can be used by engineers in determining efficiency of various locations.

Entire question of economics of location as affected by introduction of electric locomotives.

Extent locating engineer is justified in making additional expenditure in getting nearer to medium-size centers of population already in existence in territory where road is to be built.

Wood Preservation.—Water in creosote.

Relation of amount of preservative and depth of penetration to resistance of materials against decay, and also penetration of preservatives.

Service tests records, to include structural timbers.

Drying process in wood preservation.

Methods of accurately determining absorption of creosote, and temperature in creosoting process.

Results of exposure tests of material treated with water-gas tar.

Electricity.—Clearances of third-rail and overhead structures, conferring with other committees.

Electrolysis and insulation; effect upon reinforced-concrete structures.

Maintenance organization and relation to track structures.

Proper type of overhead catenary construction, with particular reference to consideration of providing clear vision for signals, co-operating with committee on signals and interlocking.

Water power for electrical railway operation, in collaboration with committee on conservation of natural resources.

Recommended practice for eliminating, as far as practicable, interference with telephone and telegraph circuits caused by use of 25-cycle propulsion circuit.

Interference with telegraph and telephone circuits caused by use of direct-current propulsion circuit, and methods of eliminating this effect as far as practicable.

Co-operation with national joint committee on electrolysis and national joint committee on overhead and underground line construction.

Conservation of Natural Resources.—Tree planting and general reforestation.

Developments in methods of lumbering and forestry tending to prolong timber supply.

Statistics on extent of use of treated timber and of permanent materials to replace untreated timber and bare steel.

Conservation and utilization of water power for railway purposes, conferring with committee on electricity.

Coal, fuel-oil, timber, iron and steel resources.

Relation of railways to different conservation projects; work done by each company up to present time. Policies economical for railways to follow.

Uniform General Contract Forms.—Forms of agreement for industry tracks.

Forms of agreement for interlocking and railway crossings, conferring with committee on signals and interlocking, including rights and obligations of interested companies.

Form of agreement embodying rules governing construction of undercrossings of railways with electrical conductors, conduits, pipe lines and drains, conferring with committees on roadway and electricity.

Form of leasing agreement for industrial site.

Grading of Lumber.—Classification and grading rules for all lumber and timber used in construction and maintenance-of-way department of railways.

Specifications for construction timbers and building lumber.

Stresses in Track.—No new assignments.

PERSONNEL OF COMMITTEES

A number of the committees have been enlarged. Those receiving the greatest number of new members are the committees on roadway, buildings, wooden bridges and trestles, water service, and economics of railway location. John D. Isaacs becomes chairman of the rail committee. G. J. Ray becomes chairman of the committee on track, and is succeeded as vice-chairman by H. R. Safford. F. L. Thompson is made chairman of the committee on masonry, and is succeeded as vice-chairman by J. J. Yates. Arthur Crumpton becomes vice-chairman of the committee on signs, fences and crossings. C. Dougherty is made chairman of the committee on rules and organization. D. J. Brumley becomes vice-chairman of the electricity committee. R. C. Young is made chairman of the committee on conservation of natural resources and is succeeded as vice-chairman by Prof. S. N. Williams.

Asphalt Industry, as a Whole, Prospered in 1915

The asphalt industry, as a whole, was prosperous in the year 1915, according to the U. S. Geological Survey. The natural asphalt produced and sold at mines and quarries in the United States in 1915 amounted to 75,751 short tons, valued at $526,490. Though this quantity was 5 per cent less than the output in 1914, the sales of manufactured asphalt derived from petroleum of domestic origin show a gain of 84 per cent over the quantity sold in 1914. The total sales of manufactured asphalt amounted to 664,503 short tons, valued at $4,715,583. In addition to this output, refiners in the United States made and sold 388,318 short tons of asphalt, valued at $3,730,436, that was derived from petroleum imported from Mexico. Statistics compiled under the direction of J. D. Northrop show that, of the quantity of manufactured asphalt derived from domestic petroleum in 1915, a total of 417,859 short tons, valued at $2,393,576, was marketed as road asphalt and flux, and 246,644 short tons, valued at $2,323,007, marketed as residual pitch, was used chiefly for paving.

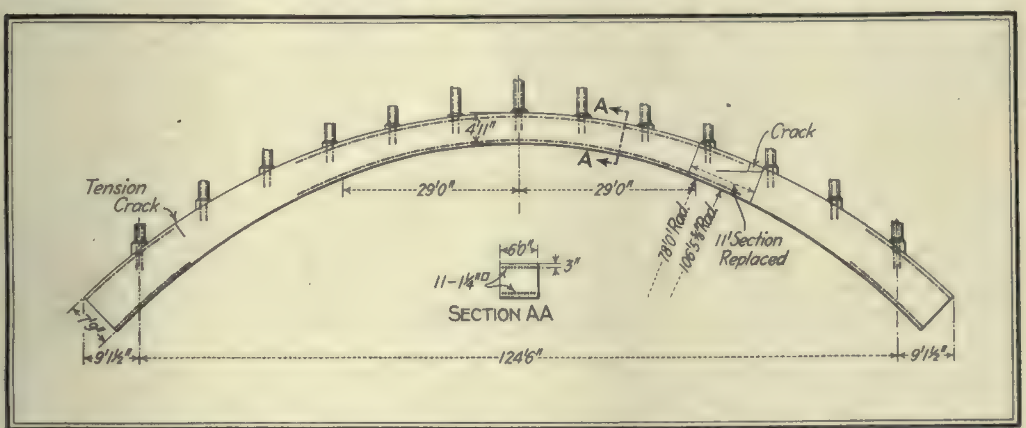
Concrete Arch Rib Supported While Section Is Cut Out

Steel Centering and Jacks, Adjusted Under 142-Foot Span in Cleveland Bridge, Prevent Relative Motion

ONE of the steel arch centers was recently re-erected to support 300 5-ton screwjacks which held up the two sections of the north rib in the sixth span of the Detroit-Superior Bridge in Cleveland while an 11-ft. block was cut out of the rib and replaced. This support was so perfect that no relative movement of the two parts of the rib was observed during the repair work.

The section replaced, shown on the accompanying drawing, contained a horizontal crack resembling a shear crack extending through the rib from side to side, which had opened to a width of less than a knife blade.

Theoretically, this section of the rib is subject only to direct compression, and on four of the ribs in the entire structure the reinforcing was omitted on each side for the distance shown in the drawing. Small vertical tension cracks developed at one or more points on each of these ribs at the upper edge in the sections where the reinforcing had been left out, but in this one rib, in addition to the tension cracks, there developed the horizontal crack referred to. This crack, which was below the end of the upper reinforcing steel, and into which the tension crack extended, increased until it was 8 ft. long after it made its first appearance this spring.



ARCH RIB OF 142-FOOT SPAN SUPPORTED WHILE SECTION 11 FEET LONG WAS REPLACED

ENTIRE SECTION REMOVED

As the crack occurred before the deck had been constructed, it was found best to take out a section 11 ft. long and replace it with new reinforced concrete. Three of the arch centers were re-erected under the rib, and 300 screwjacks of 5-ton capacity were set in 18 groups under the rib. The load on each group was carefully calculated, and only enough jacks of each group were tightened to take up the strain. This method was successful in preventing any relative displacement of the two halves of the rib. The old concrete was, in fact, cut away until only a section the size of a man's finger remained joining the two portions of the rib without any movement becoming apparent. Cutting was started on July 19. The concrete proved exceedingly hard, and eighteen consecutive shifts were required to remove the section with air hammers.

A form was then built around the rib, the old reinforcing being left in place and supplemented by reinforcing of the hooped-column type. The section was poured on July 29 and the spandrel column was poured at the same time, thus providing a sufficient head to prevent shrinkage in the arch rib section.

The repair, which, as well as the condition that necessitated it, is believed to be unique, was carried out by the Hunkin-Conkey Construction Company, of which Harold E. Ketchum is superintendent. It is building the viaduct sections of the bridge for Cuyahoga County. The work was done under the immediate supervision of A. W. Zesiger, bridge engineer, and K. D. Cowen, resident engineer for the county.

Annual Report Discusses Manhattan Pavements

Chief Engineer Stern of Highway Bureau Records Certain Changes in Specifications—Mortar Bed Adopted for Granite Block

IN outlining last year's activities of the Bureau of Highways of the Borough of Manhattan, New York City, Eugene W. Stern, chief engineer, in his annual report for 1915, just made public, discusses the merits of various types of pavement and calls attention to several changes in specifications and construction methods which are said to have improved the general quality of the work on the city's streets. Granite, Mr. Stern says, gives the best results for heavy-traffic business streets; sheet asphalt for light-traffic streets and those thoroughfares on which the traffic, although comparatively heavy, is confined largely to moderate weight vehicles on rubber-tired wheels; and wood block for streets with heavy traffic where it is essential to have quiet on account of schools, courthouses, high office buildings, etc.

CONCRETE BASE

In recent years all pavements have been laid on a 6-in. concrete base, and the question is often raised as to the desirability of increasing this depth on account of heavy traffic and to provide sufficient strength in the base to span settlements, cave-ins and shrinkage in the subgrade. Investigation of the failures in concrete foundation in New York, according to the report, shows that unless there is reason to believe that the subgrade is a recent fill, 6 in. is adequate and is able to support the pavement under normal loads.

The policy of providing all main thoroughfares and the better class of residence streets with granite curbing and less important streets with bluestone has been continued. All corner curbs and headers are of granite.

The changing of curb corners from 6-ft. to 12-ft. radii, Mr. Stern believes, has proved to be of such great advantage that the practice has been continued and is required wherever the curb is disturbed by repaving, building operations or sidewalk renewals.

The introduction of basins and inlets away from the corner at the building line has been continued with resultant improvement in drainage, dry crosswalks, shallower gutters and the abolition of the old corner receiving basin with its gaping jaws and offensive odors.

The co-operation of the taxpayers was invited by means of announcements in the newspapers and by the placing of signs along all the streets to be paved, informing the public of the fact and asking the property owners to examine their water, sewer and lighting connections in order that the necessary repairs might be made while the street was under reconstruction.

SPECIFICATIONS

On the subject of specifications Mr. Stern presents the following information:

The 6-in. concrete foundations under all types of pavement laid in 1915 consisted of 1 part Portland cement, 3 parts sand and 6 parts broken stone.

Great care has been given to the preparation of the subgrade, and very close attention has been paid to the composition and mixing of concrete for the base. Mixing must be done in a revolving batch mixer, 20 revolutions as a minimum being specified and insisted on.

Granite Block.—Until recently sand has been used exclusively as a bed under granite pavements. Experience has proved that where openings had been made, there were places where water would percolate, causing a sinking of the blocks into the sand bed. This also happened where the crown of the pavement, being flat and slightly uneven, was prevented from draining off promptly. To obviate the formation of these depressions a mortar bed, consisting of 1 part Portland cement to 3 parts sand, has been substituted for the sand cushion. This has proved entirely satisfactory, and the resulting improvement, in Mr. Stern's opinion, has fully demonstrated that the change was justified.

For some time it has become apparent, the report states, that the paving pitch for filling the joints, made of coal tar, was not giving satisfaction. At the end of even one year the joints would not remain filled. This was due to the fact that in warm weather the coal-tar filler would soften and leave the joints, and in cold weather it would chip out. When the joint does not remain filled, the paving blocks will quickly wear round on the edges and soon a noisy, rough pavement will be the result.

To improve this condition, early in the year 1915 asphaltic joint filler was adopted, for the reason that it had greater tenacity, was less brittle in cold weather and not so soft in warm weather. A comparison of those streets laid last year with asphaltic and coal-tar filler proves conclusively the superiority of the former, according to Mr. Stern.

The granite-block pavement is laid on a 6-in. concrete foundation, over which is spread a 1-in. mortar bed. The blocks measure from 6 to 10 in. in length, 3½ to

$4\frac{1}{2}$ in. in width and from $4\frac{3}{4}$ to $5\frac{1}{4}$ in. in depth. They must show no irregularities on the head of the block more than $\frac{1}{4}$ in., measured from a straight edge. The blocks are laid stone to stone, and the joints must not exceed $\frac{3}{8}$ in. in width. They are then rammed to a firm bearing. The use of pinch bars is not permitted in the backramming. A mixture of fine sand and paving pitch is poured into the joints until full.

Wood Block.—To avoid bleeding, the blocks, besides the ordinary treatment when being creosoted, have a final steaming and vacuum treatment, and the amount of oil has been reduced from 18 to 16 lb. To avoid bulging of the pavement, expansion joints have been provided along the curb. A bituminous filler is used in the joints between the block.

The blocks under the revised specification are 4 in. wide by $4\frac{1}{4}$ in. deep, and vary in length from 8 to 12 in. The foundation is 6-in. concrete, over which is spread a $\frac{1}{2}$-in. mortar bed.

Sheet Asphalt Pavement.—No substantial changes have been made in the asphalt specification. The penetration has been lowered, varying from 30 to 40, depending on the traffic conditions, etc. It is believed that this will prevent the waves and rolls which the softer asphalt developed under intense automobile traffic. The sheet asphalt pavement consists of $1\frac{1}{2}$-in. close binder course laid on a 6-in. concrete foundation. Over the binder is placed a $1\frac{1}{2}$-in. top coat or wearing surface. It is then thoroughly rolled until satisfactory compression is obtained.

Asphalt-Block Repairs

On the subject of repairs to asphalt-block pavement Mr. Stern makes this statement: "There were in the borough on Jan. 1, 1915, 40 miles of asphalt blocks out of guarantee, and early in 1915 it was decided to make repairs to these pavements with sheet asphalt, instead of with asphalt block. The result of our experience during the season has proved that it is much more satisfactory, and also cheaper, than to make repairs with asphalt blocks, as a smoother surface can be obtained owing to the fact that the asphalt blocks were uneven and with sheet asphalt the patch is rolled down to conform with the adjoining pavement."

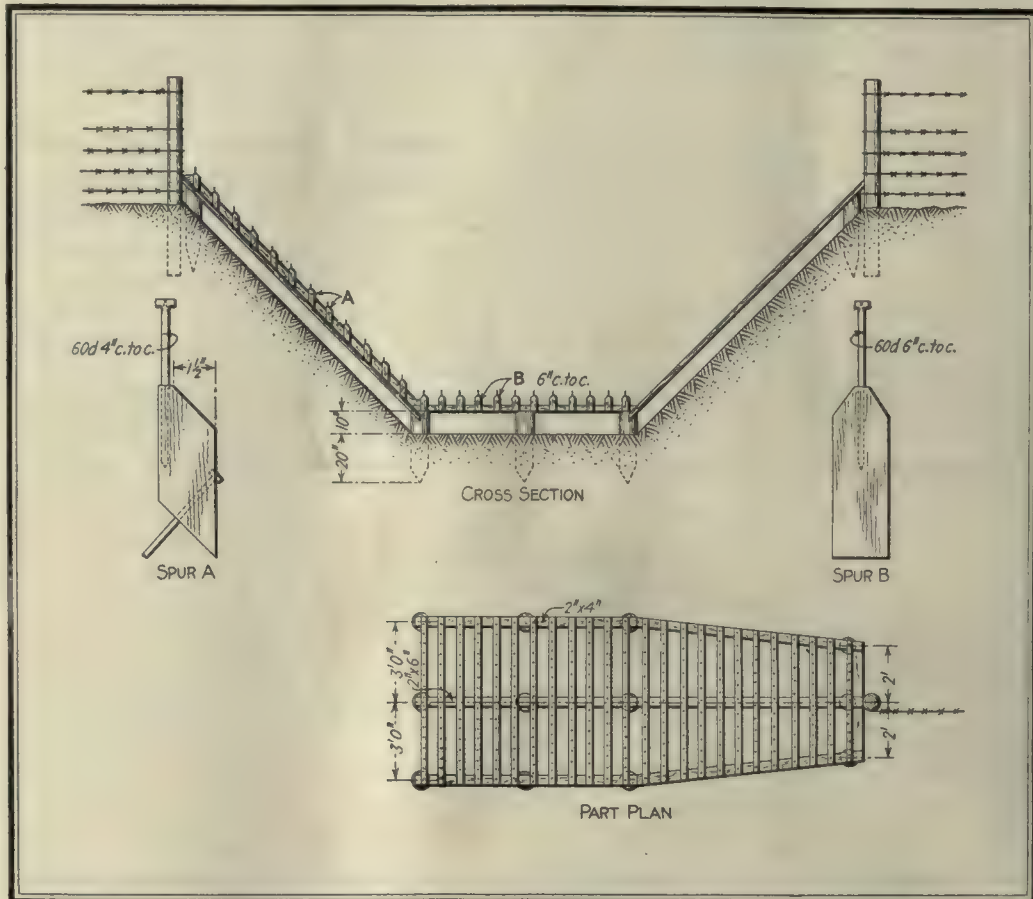
Improper Inlets Damage Drainage Ditches

Scour at End of Culvert Prevented by Head Wall—Cattle Guards in Place of Fences Permit Free Passage of Driftwood

MINIMUM maintenance cost of ditches in the Little River Drainage District of Missouri is sought by instructing the abutting property owners through a quarterly bulletin how to build bridges that will not break down the banks or fall into the ditch, and to construct proper inlets and cattle guards. The shoaling and undercutting due to an entering ditch without any special provision is illustrated in one of the photographs. The standard tile inlet of the district consists of a 16-ft. length of galvanized-iron pipe ending in a head wall about 3 ft. wide and extending at least 18 in. below the bottom of the ditch.

An obstructing fence is also shown with driftwood piled behind it, which, in time of high water, will cause excessive cutting of the section at some point and a silt deposit for many feet upstream. A cattle guard of the type illustrated is recommended.

For bridges over ditches with 4 to 10-ft. base widths the district recommends two bents of piling driven half way up the slopes and mud sills back about 8 ft. from the top edge of the slope. On these are placed four 14 x 14-in. stringers for the planking. William A. O'Brien, chief engineer of the district, supervises the work.



DRAINAGE-DITCH CATTLE GUARD ALLOWS DRIFTWOOD TO PASS THROUGH

THIS FENCE HOLDS DRIFTWOOD AND THE POOLED WATER BEHIND DEPOSITS SILT

HEAD WALL WOULD PREVENT UNDERCUTTING

Perform All Work for Double-Deck Sewer from Five Mounted Platforms

Milwaukee Interceptors for Gravity and Pressure Flows Built in Soft Material with Few Men and Maximum of Equipment

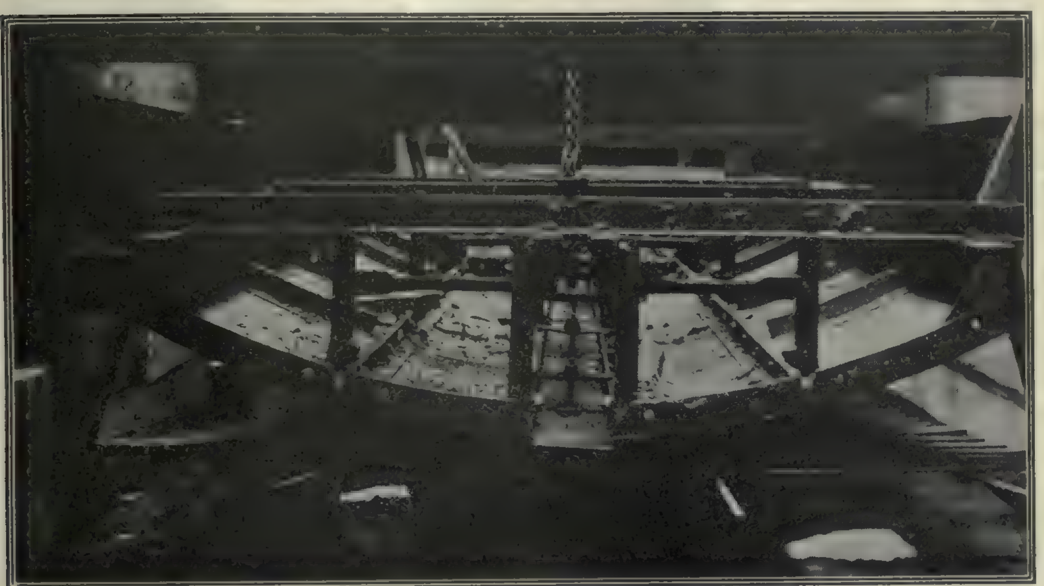
FIVE portable platforms straddling the sewer trench handle all the different operations in the construction of the intercepting sewer on the east side of the Milwaukee River. A 60-in. cast-iron pipe is laid on top of a concrete conduit supported on 30-ft. wood piles. Each platform runs on the same set of rails, 16 ft. apart, and the work is so bunched that only about 375 ft. of street from pavement to completed backfill is open at one time.

On platform 1 is a Vulcan steam hammer with which the 25-ft. Lackawanna steel sheet piling is driven on each side. This is done after the sandstone block pavement has been removed. Although the blocks were laid with cement joints, the courses were easily barred apart and the end stones broken in half with a hammer. The 6-in. concrete base was broken up with a 3000-lb. drop hammer, which seemed to punch through the concrete and not to crack it materially any distance from the area of the blow. For this reason it was possible to break the base rapidly and in a straight line close to the limit of the pavement cut.

ALL WORK IS DONE FROM FIVE PLATFORMS

Platform 2 has a derrick frame and boom and operates a ½-yd. Owens clamshell bucket. Excavated material is deposited in 5-yd. dump cars running on a narrow-gage track 5 ft. west of the platform track or onto a 10-ton Foden steam wagon. The narrow-gage track runs back to the backfill trench and beyond to the end of the street to a dock, where the material is dumped into a pit, from which a clamshell bucket, operated by an A-frame derrick, loads it on a scow, which is dumped 5 miles out in the lake.

Platform 3 has a pile driver with 1½-ton drop hammer for driving the wooden piles under the concrete conduit. These piles are driven to grade and are not cut off.



STEEL FORMS IN SECTIONS 30 FEET LONG ARE USED FOR THE INVERTS

MIXER SUSPENDED

There is no house on platform 4, for the 1/3-yd. Smith mixer is suspended and the aggregates are wheeled from the stockpile along the opposite side of the street onto the platform, which is about 3 ft. high above the ground level. Steam to operate the mixer engine is piped from platform 3 ahead.

PIPES ARE HANDLED AND PILES ARE PULLED FROM 25-FOOT GALLOWS FRAME

The last platform carries a gallows frame 25 ft. high and has a pair of 15-in. I-beams for a headblock, so that the trolley support for the block and fall can be switched from one side of the trench to the other, to pull the piles or to handle the 60-in. pipe. The piles pull quite easily, as the material is fill for 10 ft. down and marsh mud for the remainder of the distance.

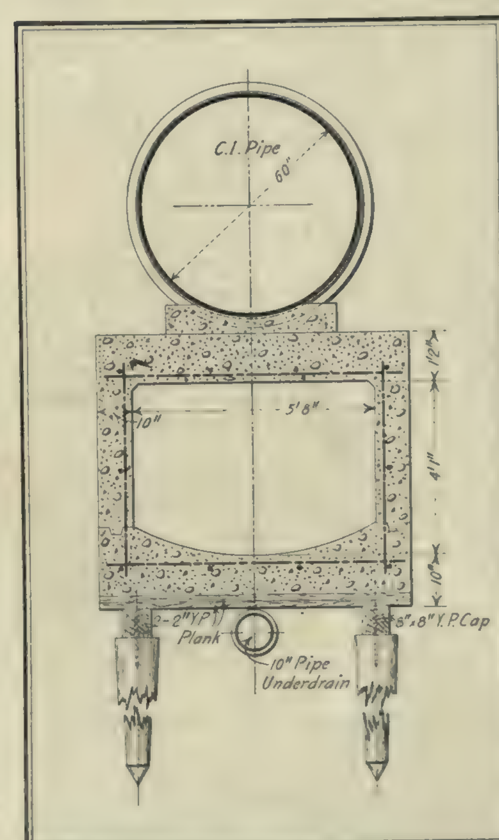
Pressures are heavy and sets of 8 x 8-in. wales and 6 x 6-in. braces are set. The wales are 18 ft. long, and a brace is placed at the ends and middle, leaving about 8 ft. in the clear for removing the excavation.

Little pumping is necessary, a 2-in. Nye steam pump in the sump fed from the tile underdrain and a pulsometer suspended from platform 3 being all that is required.

Light for the night shift is provided by two Prest-O-Lite lamps on the back of the concrete platform. Only excavation and pile pulling are attempted at night.

The reinforcing rods for the invert are made into a mat in place and left on the plank base until the 30-ft. section of Blaw forms for this invert and 6 in. of the side walls have been pulled ahead from finished work to the new position. Then the mat is picked up and wired into its true position. The form is perforated to let out excess water from the concrete, which is mixed wet and chuted to place directly from the mixer. The reinforcing bars for the side walls are stuck in after the concrete has been placed and becomes sufficiently stiff to support them in an upright position. Steel forms are also used for the upper portion.

The work is being carried out by Jennings & Ross of Montreal, for the Milwaukee Sewerage Commission, of which T. Chalkley Hatton is chief engineer. George R. Young is resident engineer on this contract.



SEWER CONSISTS OF 60-INCH CAST-IRON PIPE LAID ON CONCRETE CONDUIT

Would Silt Cedar River Reservoir with Clay and Place Asphaltic Lining

Consulting Engineers Stearns, Mulholland and Thomson and City Engineer Dimock Make Independent Recommendations for Seattle's Leaking Basin

PLANS for sealing the Cedar River reservoir at Seattle, Wash., the storage basin from which large volumes of water have been escaping through subsurface channels and reappearing at the surface of the ground in the form of springs, have been recommended in independent reports submitted recently to City Engineer A. H. Dimock by three consulting engineers, Frederic P. Stearns of Boston, William Mulholland of Los Angeles and R. H. Thomson of Seattle. The remedies suggested for making the reservoir watertight range from silting with clay to the placing of an impervious lining to consist either of concrete or of a mixture of hot sand, gravel and asphaltic oil. In a communication submitted to the City Council of Seattle, Aug. 4, Mr. Dimock summarizes the reports of the three consulting engineers and also makes recommendations of his own. He favors, as the initial step of the repair work, clearing the reservoir site, cutting down the banks and sluicing in clay. This program, it is estimated, would cost $410,000. If the basin should not be effectively sealed by this process he would place over a portion or all of it an asphaltic lining of a type developed by him in laboratory experiments. Such a lining, Mr. Dimock estimates, could be laid at a cost of $3,000 per acre. Digests of the consulting engineers' reports, as presented by Mr. Dimock, and Mr. Dimock's own findings, as submitted to the City Council, are given below.

Mr. Mulholland's and Mr. Stearns' Reports

The report of Mr. Mulholland states, substantially, that Cedar Lake was formed originally by a great deposit of morainal material closing the valley. This material consists of sands and gravels overlying a base of coarse, angular rocks and wash boulders. Cedar Lake was undoubtedly much larger than at present and filled the basin to about the height to which it is proposed to raise it by the masonry dam—that is, to El. 1590.

The basin, Mr. Mulholland believes, will not seal itself by natural means alone, but it may be made available for use by the following successive steps:

(a) Clear away the stumps and débris, sluice down the steep banks to a flat slope and fill the bottom to a depth of 15 or 20 ft. This preliminary work should effect a marked improvement.

(b) Sediment the bottom by pumping clay in suspension into the waters of the basin. This sedimentation will probably effect a permanent cure so far as the bottom of the reservoir is concerned.

(c) Protect the sides of the basin against seepage and wave action by constructing an impervious lining, preferably of some asphaltic preparation.

In view of the large area involved and problems presented, it would be wise at the present time, according to Mr. Mulholland, to limit operations to El. 1570, leaving the full elevation to be attained at a later date after experience has been acquired by the use of the above methods.

Mr. Stearns reports as follows: The lake at one time extended to El. 1580 or 1590. The bed of this ancient lake (that is to say, that portion of the new reservoir lying north of the north bank of Cedar River) may not require lining to make it reasonably tight. Further experiments are suggested to determine this point.

The basin will not ever seal itself by natural means alone. Some improvement may be effected by clearing, sluicing down the banks and filling up the bottom, but not sufficient to make the reservoir available for use. The reservoir, Mr. Stearns states, must be lined throughout with some impervious material. The experiments made by the City Engineer's Department are leading in the right direction. The work should be limited at the present time to El. 1570. The penstocks should be raised above the lining before beginning work.

Mr. Thomson's Report

Mr. Thomson's report does not discuss some of the preliminary questions gone into by Mr. Stearns and Mr. Mulholland, but enters at once upon the problem of making the reservoir available for use. He also recommends that work be limited for the present to El. 1570. He then discusses fully the plans or methods for accomplishing this result and gives detailed costs of each. These methods are as follows: (a) Sealing by the use of silt; (b) sealing by the use of some form of asphaltic application or composition; (c) sealing by the use of standard Portland cement concrete with applications of liquid asphalt; (d) a combination of some of the above methods.

Mr. Thomson strongly prefers the silting method pure and simple, which he estimates will cost $445,800. If a lining is to be placed, he prefers a two-course concrete with an application of asphalt between the courses, which he estimates will cost, including the preliminary treatment of the basin, $1,241,600.

Mr. Thomson suggests as an alternative to these two propositions the lining of the westerly half of the reservoir with two-course concrete and the silting of the easterly half, at an estimated total cost of $829,200

Mr. Dimock's Statement

It will be noted, Mr. Dimock's report states, that these three reports substantially agree that the basin may be made available for use. They agree also that the first work to be done is to clear the basin, cut down the steep north bank to a flatter slope—filling up the bottom with the material so obtained—and then to sluice in clay.

Mr. Mulholland has great faith in the virtue of clay for preventing leakage. His judgment was that a large body of clay might be obtained from the bed of Cedar Lake, and at his instance borings were made to ascertain this point. These borings have shown the correctness of his conclusion that large bodies of clay may be obtained from the easterly portion of the lake. Very recently, however, the logging operations around the lake have disclosed the existence of a large body of practically pure clay lying on the sidehill above the lake. Preliminary investigations lead to the belief that this body of clay contains about 300,000 cu. yd. There are, therefore, fortunately, two sources from which to obtain cheaply the necessary clay, the preferable source being the bed lying above the lake.

The reports vary, however, as to the amount of artificial lining to be required, Mr. Thomson believing that sealing by silting will be sufficient and that an artificial lining will be unnecessary. Mr. Stearns, on the other hand, thinks it will be necessary to line the entire basin, and Mr. Mulholland occupies an intermediate position, believing that it will be necessary to line the slopes only.

Impervious Asphaltic Mixture

Mr. Dimock's own investigations have led him to the firm opinion that the mere cutting down of the existing banks and rearranging of existing material would not accomplish any material betterment of conditions. It was necessary, therefore, before proceeding with such work to determine whether or not an impervious lining could be applied successfully and economically to the large areas necessary to be covered.

"Our laboratory experiments," Mr. Dimock reports, "have demonstrated conclusively that such a lining can be made. These experiments show that by the use of fuel oil emulsions, or preferably of the heavier asphaltic oils mixed with hot sand, gravel and dust in proper proportions, a material can be made which shows a greater degree of impermeability than ordinary concrete. Furthermore, a lining of this character will possess sufficient elasticity to adapt itself readily to slight settlements of the foundation and to changes of temperature. It also has sufficient stability to resist wave action. Preliminary estimates indicate that a lining based on the use of a heavy asphaltic oil may be laid at an expense of approximately $3,000 per acre. Even if experience shows that it may be necessary to apply this lining to the entire area of the new basin, the total cost will not be prohibitive—as Mr. Mulholland remarks, 'when the great and everlasting benefits of this reservoir are considered.'

"I concur in the suggestions of the three consulting engineers that the work for the present be limited to El. 1570. The area of the reservoir south of the north bank below El. 1570 is 190 acres.

"I would recommend that sufficient funds be provided at this time to carry on the preliminary work of clearing, cutting down the banks and sluicing in clay. The estimated cost of this work is as follows:

Clearing 200 acres, at $200	$40,000.00
Grading, 1,500,000 cu. yd., at 12c	180,000.00
Silting, 300,000 cu. yd., at 20c	60,000.00
Rebuilding penstocks	65,000.00
Raising overflow crest of dam to El. 1570	5,000.00
Engineering, superintendence and incidental expenses	60,000.00
Total	$410,000.00

"When the work included in this estimate has been completed, and perhaps prior to its completion, it will be possible to determine its efficiency and to decide just what additional measures—such as the placing of a lining over a portion or all of the basin—it may be necessary to take. It is possible that it may develop that the lining of the entire basin may not be essential, but I do not believe this can be accu-

rately foretold at this time and in presenting the estimate it should be understood that the work contemplated is not expected to effect a complete solution of the problem which confronts us, but that it is an essential preliminary and first step to any operations which may be undertaken to secure a tight and usable basin, and that when this preliminary work has been done, funds must be provided to carry on and complete the work."

Bascule Bridge Survives Blow from Steamer

Overhanging Bow of Seagoing Boat Strikes Open Span at Floorbeam 32 Feet Above Water and Displaces Lower Chords

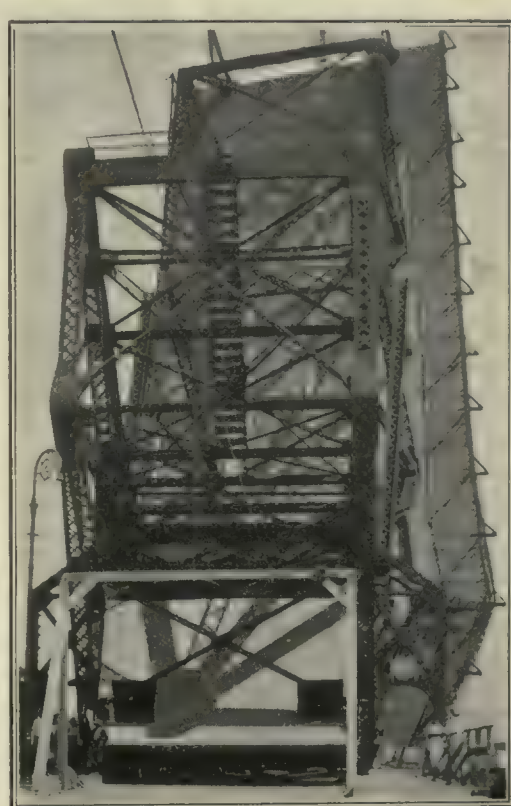
AN UNUSUAL accident occurred to the Strauss bascule bridge over the Sabine Neches Canal at Port Arthur, Tex., when it was struck by a seagoing steamer last April. That the structure remained standing, although badly warped by the severe impact of the blow, seems to be excellent evidence of the resisting power of this type of bridge against a force which no bridge is designed to withstand. The accompanying photographs indicate the extent of the damages.

The structure is a Strauss heel trunnion type of bascule bridge, taking its name from the fact that the main trunnions are located at the intersection of the bottom chords and end posts. The trunnion bearings are secured to the base of the triangular counterweight tower, footing on the piers. The main span of the bridge is 105 ft. center to center of channel piers; six-panel through riveted Warren trusses, 24 ft. apart on centers, provide a 21-ft. clear roadway and two 6-ft. clear sidewalks are carried on cantilever brackets. The roadway has 3-in. wooden planking supported on steel stringers and provides for a double-track electric street railway, although only one track is in use. The sidewalk planking is carried on wooden stringers. The counterweight tower is supported on four concrete piers, one under each corner of the tower base, built of concrete pile clusters of seven piles each, capped with a hexagonal block of concrete 6 ft. deep, tied together transversely by a reinforced-concrete beam of the same depth and 2 ft. thick. The two piers at the channel line are protected by a timber fender, with two pile clusters at each end and a single row of intermediate piles.

BENT LOWER CHORDS DAMAGED BY BOAT

DETAILS OF ACCIDENT

At the time of the accident the bridge was fully raised for the passage of the steamer "Splendor," a 6000-ton gasoline carrier. In beginning its passage through the open bridge the steamer sheared off to the side, coursing diagonally across the stream, and the overhanging bow rammed the bridge almost broadside at the second floor beam, 32 ft. above the water level, displacing this point 7 ft. south and $5\frac{1}{2}$ ft. west, the canal running north and south. The bridge at this point did not overhang the vertical clearance line projected up from the face of the waling on the fender, but the forward overhang of the bow of the boat extended over the top of the fender when the boat was diverted from its course. After the accident, bracing timbers were placed to strengthen the badly bent chords, and the upper end of the span, which overhung about 16 ft. beyond the normal position, was guyed back with cables. The timber floor was then removed to lessen the effect of wind load.



BENT CHORDS SEEN BEYOND MAIN TOWER

It is claimed by the designers that the separation of the counterweight from the leaf by means of the articulated connections largely localized the damage to the moving leaf itself, that the counterweight trusses and links suffered no damage, and the counterweight tower, aside from some derangement at the base, remained unimpaired, and that the moving leaf possessed maximum stability, having a secure connection to the piers through the trunnions and bearings located at the tops of the piers. This bridge is the earlier form of this type. Since its design improvements have been effected, one of which is the location of the operating machinery on the fixed triangular tower instead of on the moving leaf. If this had been used here the work of repair would have been facilitated.

OVERHANG INCREASE DUE TO WARPED CONDITION

The span is now being dismantled and rebuilt, new members being supplied where necessary. The contract for reconstruction was let to the original contractor, the Spence-Howe Construction Company of Port Arthur, and E. B. Van de Greyn of Houston, Tex., has been retained as consulting engineer. The bridge was originally completed by the contractor in 1913. It was fabricated by the Penn Bridge Company of Beaver Falls, Pa., according to the design and plans of the Strauss Bascule Bridge Company of Chicago. The bridge was built at a cost of $35,000 for the Port Arthur Pleasure Pier Company, but is now under the control of the city of Port Arthur.

Loose-Leaf Methods Applied to Surveyors' Notes

Detachable and Duplicate Records Highly Desirable and Easily Taken with Proper Sort of Equipment

By WILLIAM D. SELL
Civil Engineer, Charleston, W. Va.

LOOSE-LEAF SYSTEMS have proved their advantages in most lines of business and professions. Yet it would seem that some points might be well emphasized when it comes to their adaptability to surveying. Here, I think, are three very strong advantages: (1) The ease of rearranging and combining notes taken at different times and places by different corps in a logical and consistent order, which never can be foreseen and provided for when tight-back field books are used; (2) the facility with which portions of these notes can be removed for future field work without taking a burden of a whole knapsack of miscellaneous bound books; (3) the ease of indexing and referencing. In my opinion, the lack of suitable binders and holders for loose-leaf sheets has been the reason that they have not been more largely used in our profession.

What especially impresses me is the question of carbon duplication. Duplication of notes taken on engineering work should be done in order that the work of the parties

in the field may be available for the office force within the shortest possible interval for mapping, calculations and study, and in order that the notes taken may be placed at two different points to guard against the losing of the original notes or the loss of the same by fire or theft.

It must be remembered that field notes taken have a first value at the immediate time equal to the sum of the pay of the corps taking the same plus all the attendant expense. If the book is lost, the work must all be done over again. This is the basic value, and each unduplicated field book until maps and reports are made or work completed has such a value. There will always be some addition to this basic value on account of delay. What might be the maximum value is purely conjectural; if the work to be done must for any reasons, strategic or commercial, be rushed to a speedy conclusion, the result of the loss of a notebook could not be measured in dollars and cents.

The present form of duplicating field books as sold are not in my judgment a success. They have tight backs with alternate leaves perforated; the pages are about 5 x 7 in., the open two pages being used for notes. They contain about 80 leaves and cost in the neighborhood of $1 each. They are somewhat of an improvement over the loose-leaf ring books for note taking, as the slipping of the carbon sheet in the latter is a continuing source of annoyance.

A Convenient System

I use a 5 x 8 sheet, which fills all my requirements a great deal better, and with the binders and holders securable are ideal. On this sheet there is a writing surface of 5 x 7 in. which serves as the double page of the ordinary field book. In the field a sufficient number of sheets are placed in a clutch holder, using the kind with only one cover hinged. This holder is not too large for the pocket of the ordinary working jacket.

For my original notes I use a good quality of ledger linen, the best procurable, perfectly plain. Some might prefer the sheets ruled on standard forms, but this would require too large a supply to be kept on hand, and a plain sheet is adaptable in a minute or two to any arrangement necessary. The duplicate sheet may be a cheaper paper and of a decidedly different color.

In place of a lot of loose papers to be sorted over and unfolded at frequent intervals, I use what I term data sheets. These are prepared in the office (with colored duplicates), and on them is written information pertinent to the field work, such as conveyances, surveys, specifications, detailed instructions, tables frequently used in field calculations and the like. These are placed in a binder, which is carried in the field either in a large inside coat pocket or in a knapsack. In this binder at the close of the day's work are placed the original field notes.

Care of Notes

Duplicates of the field notes are sent, in some safe manner, to the office at as frequent intervals as possible. There they are placed in a binder together with the duplicate data sheets. If the field party is in camp, any duplicates on hand should be placed in a metal despatch box and left in the custody of the cook, with proper instruction as to the value of the same. If the work is done from a city office, the duplicates should be placed each night in a vault or safe. The original and duplicate notes should not be left at the same place for fear of destruction by fire.

Every sheet should be dated and lettered at the top with the title of the engagement and subtitled with the particular subject being investigated. Follow the business rule, only one subject to the sheet, then later they can be properly and consistently rearranged, and any number, few or many, removed for temporary use in field or office, with no difficulty in selecting the proper sheets. If there is any information secured in the field, enter a memo sheet giving particulars in full, and it can be inserted wherever it belongs.

For the field supplies take about twenty-five sheets of each paper, original and duplicates, and place alternately together with four carbon sheets of the same size. Securely wrap these and paste the wrapping and label the contents. Several of these packages will be an ample supply, and they can be carried anywhere without any apprehension of finding them soiled. The clutch holder will take about this amount very comfortably.

If the work is of sufficient magnitude to justify a permanent record, this can be made in the office in ink on ledger-linen sheets. Much of it can be typewritten, but care should be taken that a record ribbon is used on the machine.

As to the final disposition of the duplicates, when everything is done, reports and maps are made, construction completed and my clients have made a final settlement, I destroy them, as they have served the purpose for which they were made.

Combine Waterworks Intake and Pumping Station for Standard Oil Refinery

Erosion Difficulties and Long Suction Line Eliminated—Connection Made to Old Station Through Centrifugal Pumps Without Bypasses

A COMBINED intake and pumping station to furnish water for cooling and condensing purposes to the Sugar Creek refinery of the Standard Oil Company of Indiana, 10 miles east of Kansas City, has recently replaced a pumping station with 3000 ft. of 36-in. suction pipe extended into the Missouri River on a pile trestle.

This pile trestle, located on a section of riverfront unprotected by shore revetment for a distance of about 5000 ft., proved insecure owing to frequent erosion of the river bank. Strenuous effort alone saved the refinery from a prolonged shutdown on several occasions. To relieve the anxiety attending this hazardous situation the officers of the company determined to construct a substantial waterworks intake and to revet the riverfront to such extent as might be found desirable and necessary for protection. The refinery is operated steadily night and day and utilizes from 10,000,000 to 20,000,000 gal. daily. Pumps in the new structure are below the low-water line and space is provided for either horizontal or vertical type, the latter type being installed at present. Flexibility, provision against any shutdown from either extreme high or low water, screen arrangement and no provision for bypassing the centrifugal pumps in the new intake when the main is operated as a suction pipe are features of the installation.

Why the Combination Is Employed

A part of the undertaking originally contemplated, in addition to the building of a permanent intake, was to reconstruct or enlarge the existing pumphouse, to install additional pumping machinery and to connect the pumps in the reconstructed pumphouse with the new intake by a substantially laid suction pipe of large capacity. Past experience seemed to have demonstrated that a long line of suction pipe could be operated successfully with the assistance of an auxiliary vacuum pump to remove air, particularly on occasions of low water, under a suction lift of 15 ft. However, the fact that skill and vigilance could not entirely remove the hazard and uncertainty attending the operation of a long line of suction pipe, and that a large operating interest depended altogether upon an unfailing supply of water, led finally to the plan of making the new structure a combined pumphouse and intake. The old pump installation remains as originally built, but is connected with the new line of pipe to the intake for emergency use only in the manner originally contemplated.

As the result of borings along the river bank and several preliminary studies the site selected for the permanent intake was about 2700 ft. in a direct line up the river from the original pumping station, or about 3000 ft. by pipe line. The newly revetted shore line extends 300 ft. upstream to a junction with the old revetment, and in the near future a further extension downstream will fill in the remainder of the 5000-ft. gap previously described. The refinery is in the valley of Sugar Creek, immediately adjoining the original pumping station, which is near the mouth of the stream. The borings at the site of the intake indicated a stratum of shale at a depth of 26 to 28 ft. below low water at the river face of the intake, overlaid with strata of boulders, broken stone, gravel and sand. The shale was regarded as a suitable foundation for the structure and was at an elevation which admitted of excavation in open cut. Accordingly the specifications required a row of steel sheet piles around the site of the pier, with tops at least 7 ft. above low water on the river side and the bottoms driven to such depth as might be found necessary to admit of excavation in the open.

Excavation in Open Cut Easy

The excavation in open cut was accomplished with no great difficulty and with but little interference from inflow water. In fact, when the shale was uncovered at a depth of 27 ft. below low water the inflow of water was too slight to require the constant use of a small sinking pump. But later, after a few feet of foundation concrete had been deposited, the water poured into the pit through openings between deformed piles in such volume as to occasion a protracted delay and recourse to many expedients before it could be finally checked. Additional sheet piling was driven along the riverfront. Subaqueous blasting,

the sealing of cavities in boulders with river silt and frequent changes or rearrangement of pumping machinery, all helped to get the water under control.

The first 14 ft. of the foundation is of 1:3:6 concrete, followed by 4 ft. of 1:3:5 concrete containing steel reinforcing and bonding rods. The top of the foundation, forming the floor of the several chambers of the intake, is 9 ft. below the lowest recorded river level at the refinery. From floor level to the top of the pier the height is 41 ft., the top being 5 ft. above the highest recorded river level, that of the spring of 1903. The pier above the foundation is constructed of 1:3:5 reinforced concrete. A vertical division wall, 24 in. thick and parallel with the front face of the pier, separates the pier into two compartments, one for the pumps and the other for the screen chambers, sluice gates, screens and grates. Notwithstanding the heavy water pressure against the 24-in. main division wall during high water, the concrete is impervious and no water enters the pump chamber.

FUTURE PUMP SUPPORTS PROVIDED

Sixteen feet above the bottom there are a gallery on the land side of the pump compartment and three reinforced-concrete beams, each 18 x 36 in., for the support of steady bearings of vertical pump shafts or for the support of horizontal pumps, should they be installed. The compartment is also spanned by two sets of six steel I-beams anchored into the concrete—the lower set for the pump-shaft bearings and the upper set, within 3 ft. of the top of the pier, for the support of the pedestal of the electric motors. At the level of each of these two sets of I-beams is a reinforced-concrete gallery, 6 ft. wide, affording convenient access to the machinery and supports for and approaches to various details of intake and machinery equipment.

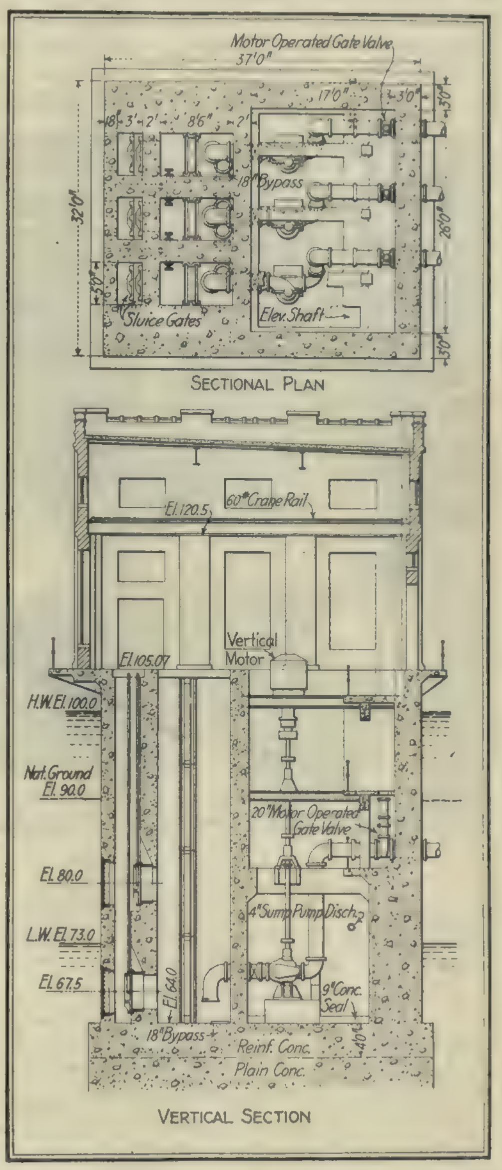
On the river side of the main division wall are two solid walls, 30 in. thick, normal to the main wall, dividing the space into three screen chambers, each 8½ ft. long by 5 ft. wide. In each of these chambers are cast-iron screen guides for a double set of screens. The screens are in sections made of perforated steel plates set in frames of structural-steel angles. The bottom section of each row of screens has a heavy bale, to which is fastened a cable attached at the opposite end to a windlass on the traveling crane. Thus the entire line of screens is raised in one operation, each section of the screen being removed as it clears the guides at the top of the pier. The front of the pier is a double wall. The face or curtain wall is 18 in. thick, with openings 5 ft. square for two sets of grates for each of the three screen chambers. One set of these openings is below low-water level; the other set, 12 ft. higher, is for use during high water. The space between the walls affords ample room for the sluice-gate rods and guide bearings. In the inner wall there is a sluice-gate opening 4 ft. square opposite each grate in the curtain wall. The sluice gates are lifted by the traveling crane, the hook of the crane cable engaging a chain passing through an eye screwed to the top of the valve rod. The sluice gates, grates, frames and guides were furnished by the Coffin Valve Company.

Each screen chamber has an independent suction pipe arranged for an independent pump, but any pump can draw water from the adjoining chamber by means of inverted siphon pipes embedded in the foundation concrete under the chamber division. To the horizontal flanged opening of each siphon pipe is bolted a companion flange in which is a conical valve seat. In this seat is fitted a leather-faced flap valve hinged to the companion flange. To an eye in the flap a cable is attached extending to the top of the pier, for the purpose of manipulation.

The finish of the top of the pier is an overhanging balcony on the front, upstream and downstream sides of the pier. The shore face is plain except for a bracketed bridge rest and landing. The screen chambers and sluice-gate walls are covered with steel plates resting on I-beams set in pockets in the concrete; but the pump pit is open except for the balcony. This balcony and supporting beams of the pump motors are constructed 3 ft. below the top of the pier in order to minimize the danger of injury to the motors while handling material with the traveling crane.

The skeleton work of the superstructure consists of four columns, the lower part of which is made of 18-in. Bethlehem beams, with brackets at the top for the support of the crane beams, the upper part of which is structural angles and plate, with a bracket near the top for the support of the two 24-in. main roof beams. The two 18-in. crane beams rest upon the column brackets and at the ends in the brick wall on steel bearing plates.

The traveling-crane bridge is designed to carry 30 tons so as to be able to handle horizontal pumping units, should an installation of machinery of this type be found desirable in the future. The Whiting crane in use at the present time is of 15 tons capacity, designed for hand manipulation, and is sufficiently powerful for handling the machinery now in use.



COMBINED INTAKE AND PUMPING STATION FURNISHES OIL REFINERY 20,000,000 GAL. DAILY

MACHINERY INSTALLED

The machinery installed consists of three motor-driven vertical single-stage centrifugal pumping units, each unit having a capacity to deliver 10,000,000 gal. of water per 24 hours under a total head of 110 ft. when operating at a speed of 1175 r.p.m. The centers of the pumps are 3 ft. below low water and 32 ft. below the bottom of the motor bases. The 3½-in. shafts are carried by a thrust bearing set in a bracket securely bolted to the bottom flanges of the motor-supporting beams. The motors are connected directly to the shaft by flexible coupling. Each motor is of 300 hp., of the three-phase 60-cycle 2200-volt, slip-ring induction type. A vertical centrifugal sump pump of 100 gal. capacity, actuated by a motor at the lower balcony level, is installed on the floor of the pump pit.

The severe wear which vertical centrifugal pumps must undergo when pumping muddy water continually was recognized at the very beginning; yet the advantage of having the pumps always positively primed and ready for work was regarded as an offset to the higher cost of repairs and maintenance over that likely to be incurred in the use of horizontal pumps set at a higher level. In any event, the intake is roomy enough to permit the use of either type of pump, and a change from one to the other type can be made in the future if experience with the vertical pumps warrants it; but the engineers state that these pumps have now been in constant operation for more than six months with gratifying results. The pumping machinery, gravity oiling system, shafting and bearings were furnished by the A. S. Cameron Steam Pump Works, and the motors, switchboard and furnishings by the Westinghouse Electric & Manufacturing Company.

CLARIFY WATER FOR HYDRAULIC VALVES

Construction flexibility is provided for by lead joints on the horizontal runs of discharge pipe between the bend at the top of the rising pipe and the flanged wall pipe embedded in the concrete of the intake pier. The hydraulic valve on each of the discharge-pipes is a standard Ludlow valve in which the hydraulic valve mechanism, rather than electrically operated mechanism, was employed, according to the engineers, because of simplicity and freedom from accident, although the use of pressure water for this purpose entailed unusual appliances. The Missouri River water is used in the refinery without previous sedimentation; consequently provisions had to be made to clarify the water utilized in the cylinder of the hydraulic valves, and after clarification to place it under the requisite pressure for valve operation. This was accomplished by installing a small open steel settling tank, 42 in. in diameter and 60 in. high, on the middle balcony, and suspending beneath the same balcony a closed pressure tank, 30 in. in diameter and 60 in. long. The settled water flows by gravity into the pressure tank and is then put under pressure by a small electrically operated air pump. The waste water from the

valve cylinder returns to the settling tank. A hand-operated air pump is also provided as a substitute in case of failure of the electric pump.

3000-Foot Suction Successfully Operated

Three lines of 20-in. cast-iron discharge pipes, one for each pumping unit, lead from the intake to a 36-in. main 2645 ft. long. This main is laid on reinforced-concrete slabs on a slightly raising gradient to a point about 300 ft. from the old pumping station, where it unites with two lines of steel pipe, one line leading to the distributing system and the other connecting with the suction of the old pumping engines. This 36-in. line serves the purpose of a force main for the pumps in the new intake and in an emergency as a suction pipe for the pumps in the old pumphouse. The operation of pumps successfully with a 3000-ft. suction pipe may seem doubtful; nevertheless, it was satisfactorily accomplished very soon after the new intake was completed, but before the new machinery was in shape to operate. At the time referred to, the old intake was undermined and threatened to collapse through the effect of river-bank erosion. Rather than incur the expense of repairs to the old intake, needed only a few weeks longer, the old pumps were coupled up to the new work, getting all the water needed through the 3000 ft. of suction when operating under a vacuum of 15 ft. at the pumps.

The novel feature of the work as planned is that no provision is made for bypassing the centrifugal pumps in the new intake when the main is operated as a suction pipe. The water, under suction lift, enters the 36-in. main simultaneously through the three 20-in. branches and through the casing and impellers of the three centrifugal pumps. In an emergency requiring more water than can be thus obtained it is designed to remove one or more impellers and cap the shaft opening in the pump casing. This expedient seems to answer every practical purpose and serves to simplify greatly the mechanical part of the installation by avoiding cumbersome bypass pipes and an unnecessary multiplicity of valves.

The intake is equipped with a two-passenger Hollister-Whitney electric elevator running from the top to the bottom of the pier, an Areo steam boiler and heating system, electric lights, sump pumps and pipes and other minor conveniences.

The entire work was carried out under the direction of G. H. Moffett, superintendent of the refinery, who had his own force of mechanics to install the machinery and mechanical equipment in and about the intake. C. C. Huhn acted as inspector during the period of construction. The Midland Bridge Company was contractor for the pier exclusive of the machinery and piping. The design of the intake, machinery layout, building, pipe line and mechanical details of the intake pier is the work of Wynkoop Kiersted, with the aid of his assistant, W. A. Bott.

Cost Data on California Roads

The expenditure since 1909 of $16,119,583 by the California Highway Commission has resulted in the survey of 2280 miles of road, 1705 miles of right-of-way secured and 1490 miles of highway constructed, according to the *California Highway Bulletin.*

Oiled Pavements Smoothed with Scarifier and Scraper

In Riverside, Cal., Material Is Taken from High Spots and Saved for Use in Filling in Slight Depressions

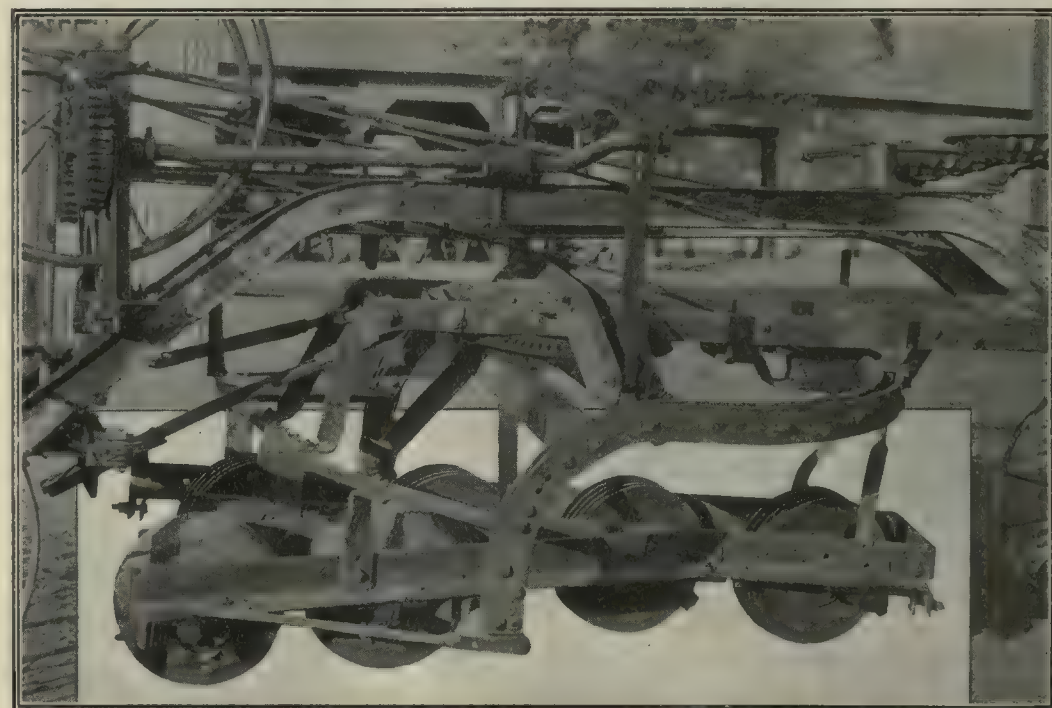
ABOUT 120 miles of oiled pavement are in use in Riverside, Cal., some of which have been down more than 20 years. Most of this pavement has been laid on a concrete base, but considerable decomposed granite base, rolled to a 4-in. thickness, has been put down and surfaced with 1¼ gal. of oil per square yard. As a whole, the oiled surfaces have given excellent satisfaction, it is stated, and are still the preferred type of construction. There is, however, with heavy traffic and hot weather, an occasional roughening of the surface, which tends to increase if not remedied early in its development.

About five years ago it was realized that some plan for smoothing down the irregularities in the oiled pavements was highly desirable, in order that such trouble might be remedied in the early stages. Experiments were made with harrows, or toothed scarifiers, but although they gave a measure of success the teeth were found to wear excessively and did not permit of a sufficiently flexible control. Further experiment applying the rotary disk idea met with greater success, and for several years now scarifiers have been in service with which roughened pavements have been effectively restored to a high degree of smoothness.

Sequence of Operations

The method is to loosen the surface of the high spots with the scarifier and follow with a road grader, which cleanly scrapes off the loosened material and leaves it in convenient shape to be gathered and hauled to the yard. These scrapings are kept free from foreign material by sweeping the pavement with a rotary brush just before scarifying it. After having cut the surface down to grade, the depressions are swept by hand, painted with heavy base crude petroleum and the requisite amount of the loose material or scrapings is filled in and tamped. Depressions so filled have given satisfactory service for five years. It is not, however, intended to use this method where actual patching of the surface is required; only depressions less than 1 in. in depth are treated in this way.

Scarifying and scraping are done only in the afternoons during warm weather. The scrapings, after being delivered in a winrow along the gutter by the road grader, are left until the following morning, when they can be handled more conveniently than when the temperature is high. The usual road crew on this work consists of two four-horse scarifiers and a road grader, each with one driver and one operator. Where the surface is rough, progress is at the rate of about ½ mile of 60-ft. street per day; but up to 1 mile per day has been made where the roughening had developed to a lesser degree.



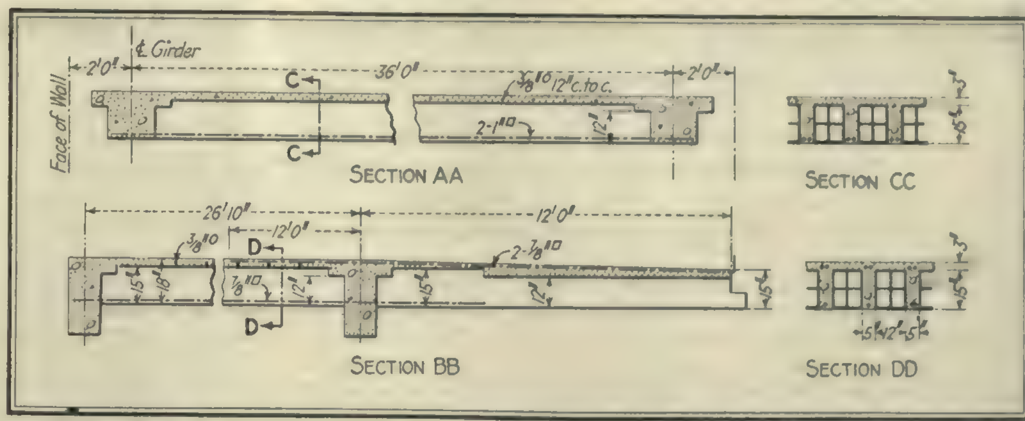
THIS MACHINE CUTS UP HIGH SPOTS IN ASPHALT SURFACE

Since scarifying is done only in summer, while the patching goes on all year, scrapings for winter use are stored during the summer. It is customary to have accumulated by fall a pile 5 or 6 ft. deep on a 20 x 30-ft. area at one end of the yard used for storing the equipment of the street department. Two patching outfits are usually employed continually. The quantity of scrapings recovered per square yard varies so much with the condition of the pavement that no average figures can be quoted. It has been observed, however, that there is usually a greater recovery from surfaces on decomposed granite bases than from concrete base pavements. It has been found that the scrapings are a convenient and inexpensive material to use for driveways, garage floors, etc., and there has therefore developed a great demand for them for private use. During the summer considerable quantities are sold in outlying districts to purchasers who desire to remove the material from the streets themselves, but the city has use for most of the material and prefers to store it for repair purposes.

The accompanying illustration shows the scarifier with the opposed sets of disks, which were added after some experiment, and which have been found effective in preventing any tendency to shift out of alignment. The disks are 18 in. in diameter

and are spaced 1 in. apart by cast iron spreaders. The sets are so adjusted that the outer disk on each set is offset 1 in. from the track of the near disk on the preceding set. The axles of the disk sets are not quite parallel to the main axles of the scarifier, as it has been found that a slight inclination aids in turning the loosened material out of the cuts. This inclination is usually such that with 30 disks all spaced 1 in. apart the actual effective cutting width is 28 in. This inclination is kept constant for all disk sets and can be changed by adjusting a pair of bolts on the frame. The entire set of disks is shifted right or left, lifted or depressed, by hand wheels on the operator's platform.

The scarifier has been developed and patented by W. V. Darling, superintendent of streets at Riverside, Cal.



FLOOR SLAB AND CANTILEVER BALCONY DETAILS AND REINFORCING

Longest Span Slab Used in Chicago Hospital

Reinforced-Concrete Building Contains 15-Inch Tile in Floor Slabs for 36-Foot Spans—Balcony Slabs Cantilever 12 Feet

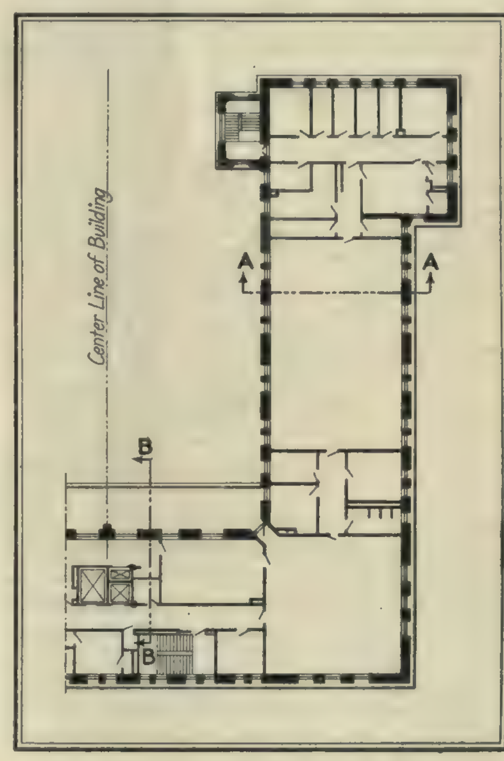
By J. NORMAN JENSEN
Architectural Engineer, Chicago

THE Cook County Psychopathic Hospital in Chicago is an unusual building in more ways than one. It is a reinforced-concrete structure, of four stories and basement, located on Polk and Wood Streets. It is primarily a hospital in which people believed to be insane can be detained for a sufficient length of time to determine whether they are rational or not. The patient under suspicion is given a trial by a judge and a jury, in a court room located on the first floor of the building.

Usually a hospital is laid out with a center corridor and a line of rooms on each side of this corridor. This necessitates either brick bearing walls for the corridors or beams and columns to carry the floors and corridor partitions. The span of the floor slabs running from the outside wall to the corridor partition, in the ordinary arrangement, is comparatively short.

It was stated that the patients in this building are peculiar, at least as judged by ordinary standards. Because of the advisability of having large, open wards so that the number of attendants could be kept down to a minimum, and because of the necessity of having a clear, unobstructed view of every patient, day and night, it was decided to eliminate all walls and columns by spanning the slab from outside wall to outside wall.

It is believed that this long-span slab is an innovation in hospital construction. Aside from the especial advantages mentioned, the partitions can at any time be shifted to whatever position any new arrangement of rooms may dictate.



HALF PLAN OF BUILDING

Referring to the plan and typical sections, it will be seen that the slab is 36 ft. center to center of girders, and that temperature rods are provided in the concrete top. The upper inch of the slab was troweled to a smooth finish. The two 1-in. square bars were placed in the 5-in. rib, extending well into the concrete girders at both ends. Some difficulty was experienced in obtaining the 15 tile, but a kiln outside the state was in a position to furnish them, after making some necessary changes in equipment.

Section BB, through the slab alongside the stairway, shows a typical porch cantilever, with two ⅞-in. square top bars bent at one end so as to extend into a brick parapet wall, and anchored well into the adjoining slab at the other end. A slope of 3 in. for drainage is provided by using 15-in. tile for a portion of the way and 12-in. for the remainder of the distance.

Although severe construction loads had been placed on these slabs, it was deemed advisable to make a load test. This was done under the direction of the writer, who represented the Building Department of Chicago. After the 1:2:4 concrete was about 4 months old, an area of 10 ft. in width and the full span in length was loaded with bags of cement so that the superimposed load was 250 lb. per square foot. The Chicago ordinances require hospital floors to be designed for 50 lb. live load, plus the dead load. The test load, including the weight of the construction, is required to be double the sum of the dead and live loads.

After the load had been on for 50 hours the deflections were carefully measured. The maximum deflection in the center of the span of the rib immediately under the center of the load was 3/16 in. The test was approved, as it was well within the allowable limit fixed by the city ordinances.

Views of the under side of the long span slab and the cantilever porch slab are shown herewith. The Blome-Sinek Company was the contractor, and Richard E. Schmidt, Garden & Martin were the architects, all of Chicago.

FLOOR SLAB SPANS 36 FEET BETWEEN WALL GIRDERS

VIEW OF CANTILEVER BALCONY CONNECTING THE WINGS

Theory of Displacements Applied to Analysis of Suspension Bridges

Influence Lines Drawn for Horizontal Component of Cable Tension and for Shear and Moment in Stiffening Truss

By C. S. WHITNEY
Assistant Engineer for John Parkinson, Architect, Los Angeles, Cal.

THE STIFFENED suspension bridge with parabolic cables and parallel-chord stiffening trusses forms an economical type which deserves wider use, particularly for highway spans. While the exact analysis of stiffened suspension bridges is quite difficult, the simple method outlined here can easily be applied. The simplification is accomplished by using the theory of virtual displacements instead of the theory of least work, and leads to equations and influence lines for the horizontal component of the cable tension, and to influence lines for shear and moment in the stiffening truss.

The great advantage of the theory of displacements over the theory of least work is the fact that the effects of several forces on the displacements of the structure are treated independently of each other. To analyze the suspension bridge by the theory of displacements it is only necessary to consider the effect of the cable tension alone. It is possible to determine the effect of live load on the bridge by simply considering the effect of a cable tension of unit intensity when there is neither dead nor live load on the structure, while the least-work method involves the simultaneous effects of the cable tension and live and dead loads.

The true theory of suspension bridges as developed by Melan is too involved for general use. The approximate theory, based on the following usual assumptions, is accurate enough for all practical purposes, except for cases in which the stiffening trusses are light and the spans very long.

Assumptions Made

The axis of the cable is assumed to be parabolic, and the effect of the deflection of the cable on the shape of its axis as a force polygon is neglected; that is, the effect of elongation of the cable is considered as it increases the load on the stiffening truss, but the cable is always assumed to maintain its original parabolic form. The stresses in all the hangers of such span are considered equal, and the effect of the deformation of the hangers may be entirely neglected without appreciable error.

In the usual process of erection, the practically uniformly distributed dead load is taken by the cable until the stiffening truss is completed and made continuous in each span. If the floor system is placed after the stiffening truss is complete, it will stress the stiffening truss in the same way as a similar live load, but this effect can be obviated by leaving the stiffening truss discontinuous or hinged at the ends and center of each span until the dead load is all applied. The tower reactions are assumed to be vertical and the effect of the tower deformations is neglected.

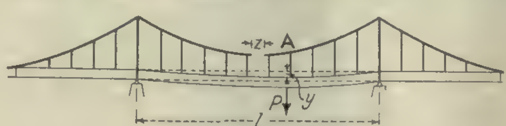
Effect of Single Concentrated Load

When a single concentrated load is placed on the bridge shown in Fig. 1 the effect on the stiffening truss is the combined effect of the load and the uniformly distributed upward pull of the hangers. After the hanger tension has been determined, the stiffening truss becomes a simple or continuous truss, according to its type, and the stresses may be found by ordinary means.

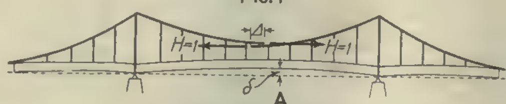
The moment of inertia of the stiffening truss can usually be considered constant without much error. The effect of variation of moment of inertia could be considered, if desired, by the graphical method of treating such beams. It is usually sufficiently accurate on the safe side, except for very long-span bridges, to assume that the truss is a solid-web beam of the same moment of inertia as the actual truss.

Fundamental Relations

Consider the case of the three-span suspension bridge in Fig. 1 with a concentrated load P applied at any point A. As-



Deflection Due to Cut Cable
FIG. 1



Deflection Due to Unit H
FIG. 2

FIGS. 1 AND 2—FUNDAMENTAL RELATIONS

sume that the cable is cut at the center point. It will then be under no stress, and the two ends of the cable where cut will be pulled apart a distance z by the deflection of the truss when P is applied. It is assumed for the present that the structure has no dead weight. Since the cable is actually not cut, the cable tension at the center must be just great enough to pull the ends together again and close the gap z.

Maxwell's theorem may now be applied. This theorem may be stated as follows: If on any elastic structure two equal forces P_1 and P_2 act at any two points 1 and 2 respectively, the displacement of point 2 along the line of action of P_2 produced by P_1 is equal to the displacement of point 1 along the line of action of P_1 produced by P_2. Thus in Fig. 1 the value of z produced by P is equal to the value of y which would be produced by a tension $H = P$ at the center of the cable.

Determination of Cable Tension H

To find H, the tension at the center of the cable produced by a concentrated load P at any point A, we may proceed as follows: Cut the cable at the center as before and apply a unit horizontal tension at each end where cut, Fig. 2. The ends of the cable will then pass each other by an amount Δ. The cable tension will produce a uniform upward load on the truss, which will cause a vertical displacement of δ at any point A. By Maxwell's theorem, δ is equal to the length of gap z, which would be produced by a unit vertical load at A. The length of gap due to a load P would therefore be $P\delta$.

Since a unit cable tension will close the gap an amount Δ, the true cable tension H (produced by P) will close it an amount $H\Delta$, and $H\Delta$ must, of course, be equal to $P\delta$, since there is actually no gap. Equating and solving for H, there is obtained

$$H = P\delta/\Delta$$

Computation of δ and Δ

The values of δ and Δ are easily computed for any arrangement of spans. To find δ, the uniform load on the truss produced by a unit value of H is first computed from a formula given below, and the value of δ is then the deflection of the point A of the truss under that uniform load.

The easiest method of computing Δ is to find the total work W done in the structure when the unit value of H is applied. This is equal to the external work done by the force H, assuming the cable cut at the center. As H is a gradually applied load, this external work will be

$$W = \tfrac{1}{2}\Delta H$$

or solving for Δ,

$$\Delta = 2W/H$$

Simple formulas are given below for the work in the cable and in the trusses, and the work in the suspenders may be neglected.

Effect of Change of Temperature

Since the ends of the cables are anchored at a fixed distance apart, changes of length due to changes in temperature will produce stresses in the structure. The effect of any range in temperature may easily be computed. Again consider the cable cut at the center and compute the gap Δ_t produced by the change in temperature, which would be

$$\Delta_t = Lte$$

in which L is the total length of cable, t is the change in temperature, and e is the coefficient of expansion.

As before Δ_t must equal $H_t\Delta$, or

$$H_t = \frac{\Delta_t}{\Delta} = \frac{Lte}{\Delta}$$

When H_t has been found, the temperature stresses are, of course, all statically determined.

Application of Method to Single-Span Bridge

In order to explain the method of analysis, it will be applied to the case of a one-span bridge of average proportions, Fig. 3. The stiffening truss is 600 ft. long, continuous from one pier to the other, and its depth is one-sixtieth of the span, or 10 ft. The sag of the parabolic cable is one-tenth of the span, or 60 ft. The cable has a constant cross-section, and the inclination of the anchor cable is made the same as that of the parabolic cable at the tower, for greatest economy. The sag of the cable and the depth of the stiffening truss depend on the ratio of live to dead load and upon the allowable deflection of the bridge. They vary for different spans and classes of bridges, and the economic ratios should be determined for each case.

As in the case of other statically indeterminate structures, the stresses cannot be obtained until the size of the members is known, and hence an approximate preliminary design is necessary. The cable should be proportioned to carry the full live and dead load. For this loading the horizontal component of the cable stress is given by the formula

$$H = pl^2/8s$$

in which p is the total load per linear foot of truss, l the span length and s the sag of

the cable in feet. The maximum cable tension is equal to $H\sec\alpha$, if α is the angle of inclination of the cable at the tower.

The suspenders in this example are spaced 15 ft. apart. The truss will be assumed to have a constant moment of inertia, and the maximum moment may be assumed for preliminary design to be $wl^2/50$, in which w is the live load per foot of truss plus that part of the dead load placed after the truss is riveted up. The maximum and minimum moments in the truss occur very near the quarter points instead of at the center. The average maximum live-load moment will be about $wl^2/72$.

DETERMINATION OF W AND Δ

The total work done by the unit tension, $H = 1000$ lb., at the center of the cable will now be determined by finding the work done in the parabolic and anchor cables and in the truss separately.

The work done in the parabolic cable is given closely enough for practical purposes by the approximate formula:

$$W = \frac{H^2(l^2 + 8s^2)}{2A_cE_cl}$$

in which l is the span in inches, s the sag in inches, A_c the cross-sectional area of the cable, and E_c the modulus of elasticity of the cable. For the given example this value of W was found to be 3.853 in.-lb.

The work in the anchor cables is given by the following formula:

$$W = \frac{H^2l_1 \sec^3\alpha}{A_cE_c}$$

in which l_1 is the total length of both anchor cables in inches and α is the angle of inclination of the anchor cables. This value was found to be 2.757 in.-lb.

The work in a prismatic beam under uniform load w is:

$$W = w^2l^5/240EI$$

Applying this to the stiffening truss in the given example, the work was found to be 128.2 in.-lb.

The sum of the three quantities just found gives for the total work W the value 134.81 in.-lb. and from the foregoing formula:

$$\Delta = 2W/H = 2W/1000 = 0.2696 \text{ in.}$$

The work of the suspenders in this example was found to be 0.0547 in.-lb., which is obviously negligible.

DETERMINATION OF δ AND H

The value of δ is the deflection of the truss at the point under consideration when a cable tension of 1000 lb. exists at the center. The uniform upward load per foot p produced on the stiffening truss by this cable tension can be computed by solving the general formula for H given above. Thus

$$p = 8H_s/l^2 = 8 \times 1000 \times 60/600^2 = 1.33$$

or 1.33 lb. per linear foot is produced by the suspender tensions. The equation of the elastic curve of a simple beam under uniform load is

$$\delta = \frac{1}{EI}\left(\frac{wlx^3}{12} - \frac{wx^4}{24} - \frac{wl^3x}{24}\right)$$

in which w is the load per linear foot and x distance from the left end to the section.

The deflection at the center is

$$\delta_c = \frac{5}{384} \times \frac{wl^4}{EI}$$

which was found to be 0.501 in. The cable tension produced by a concentrated load P at the center of the span will then be

$$H_c = P\delta/\Delta = \frac{0.501}{0.2696}\,P = 1.857P$$

The elastic curve of the truss under uniform load is the influence line for the tension H, and the H-line may be plotted as in Fig. 3 (see article in the Engineering Record of Dec. 18, 1915, page 762). The coefficients given below the curve are proportional ordinates obtained from the formula for δ given above, and when multiplied by the ordinate H_c at the center will give the ordinates of the H-curve. The influence line for H for concentrated loads can thus be plotted from these ordinates.

VALUES OF H FOR UNIFORM LOADS

The value of H for uniform loads (called H_u) is obviously equal to the area of the H-curve under the load multiplied by the load per unit length of truss. The H_u curve is therefore the integral of the H-curve as shown in Fig. 3. Its equation is

$$\frac{1}{\Delta}\int_0^x \delta dx = \frac{1}{EI\Delta}\left(\frac{wlx^4}{48} - \frac{wx^5}{120} - \frac{wl^3x^2}{48}\right)$$

The value of H for full uniform load (called H_f) is equal to the full area of the H-curve multiplied by the uniform load per unit length and for the given type of bridge is:

$$H_f = 0.64H_cl$$

Under the H_u curve are given proportional ordinates which when multiplied by H_f will give the ordinates of the H_u curve at the twentieth points to be used in plotting the curve. In this way it is only necessary to compute the component of the cable tension H_c under a single concentrated load at the center to get the H influence line for both concentrated and uniform loads.

Typical influence lines for moments and shears at one of the panel points (8) of the truss, for a concentrated load in any position, are shown in Fig. 3. These influence lines show the position of uniform load for maximum and minimum stresses and their areas give the magnitude of the stresses. The construction and use of such influence lines are explained in "Modern Framed Structures" by Johnson, Bryan and Turneaure, Vol. 2, page 221.

In this brief treatment it has been possible to give only the method of determining the cable tension, which reduces the structure to a statically determinate condition. The deflections of the truss under any particular loading can best be determined by drawing the elastic curve of the trusses for that loading by the graphical method, after the cable tension has been determined as explained in the foregoing.

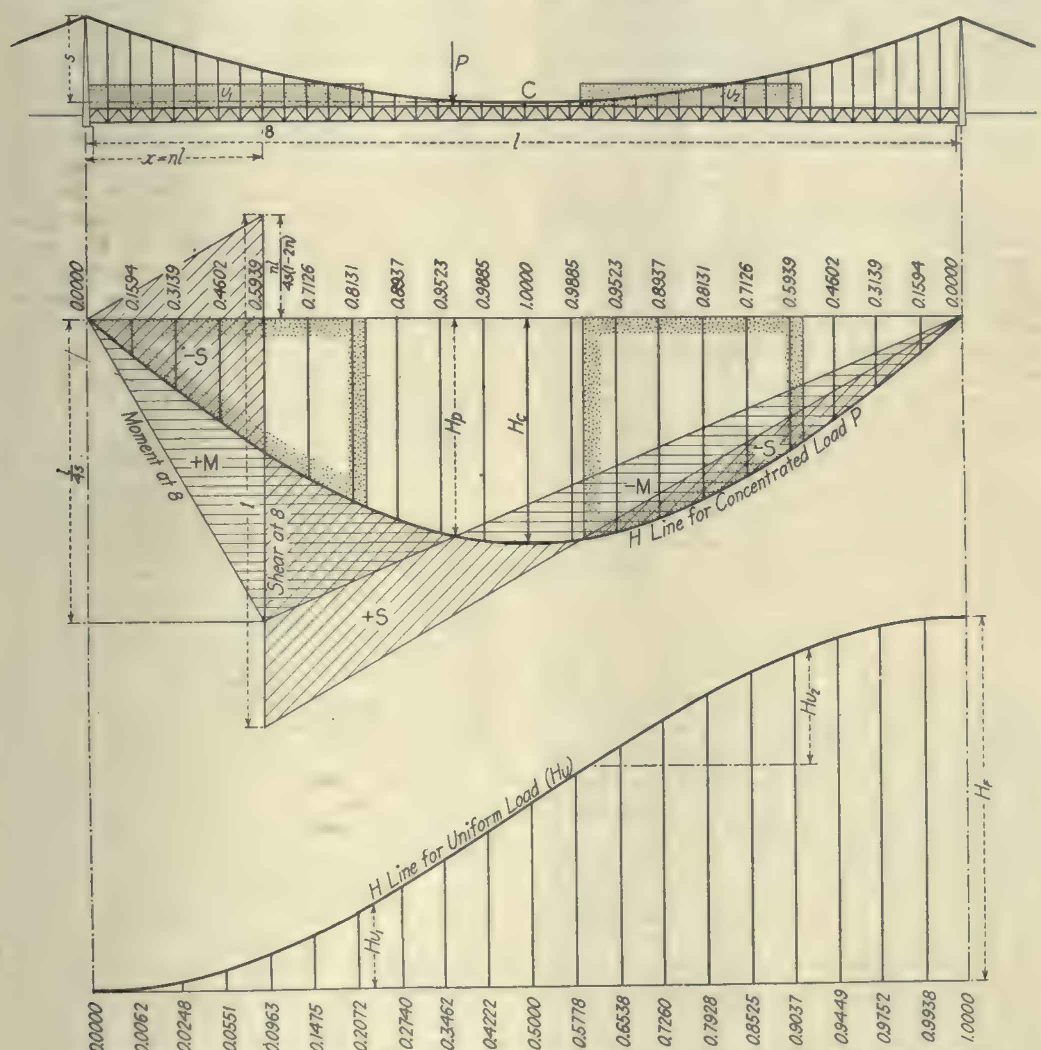


FIG. 3—INFLUENCE LINES FOR "H" AND FOR SHEAR "S" OR MOMENT "M" AT POINT 8

May Railroad Income 52.6 Per Cent Higher Than in May, 1915

Gross operating revenues for May on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were \$1,307 per mile, showing an increase of \$263, or 25.2 per cent as compared with May, 1915. Operating expenses were \$857, an increase of \$122, or 16.6 per cent. Net operating revenue, therefore, was \$450—an increase of \$141, or 45.6 per cent; and operating income was \$395—an increase of \$136, or 52.6 per cent. The operating ratio was 65.6 per cent, as compared with 70.4 per cent in May, 1915, and 76.4 per cent in May, 1914. Considering the three main districts, the respective ratios for May, 1916, and May, 1915, were as follows: Eastern, 66.0 and 70.0; Southern, 64.9 and 71.3; Western, 65.3 and 70.5.

Million-Dollar Project, Just Started, Will Remove Flood Menace at Erie, Pa.

Flow of Mill Creek Will Be Carried by Huge Concrete Conduit, Two Miles Long—Strategy Shown in Financing the Works

By FARLEY GANNETT
Consulting Engineer, Harrisburg, Pa.

THE problem of preventing damage in the city of Erie from floods in Mill Creek is being solved by controlling the flood water as it passes through the city, instead of by attempting to reduce the volume of flood flow coming down the creek to the city. Within one year after the flood of Aug. 3, 1915, construction work has been started on a comprehensive and costly flood-damage prevention project, with all the money necessary to finish it made available.

Last year's disastrous flood was described by Theodore E. Seelye, a member of the writer's firm, in the Engineering Record of Aug. 14, 1915, page 186, and in the issue of Oct. 9, 1915, page 440, the report to the city commission by this firm was briefly described. The flood inundated about 150 acres in the heart of the city, killed 34 people and caused $2,000,000 damage to property. Since that date the plans recommended in that report have been accepted by the city commission, a bond issue of $950,000 for construction of the works has been approved by vote of the citizens, surveys and designs are under way, contract has been let for a small piece of the work and ground has been broken thereunder.

A Two-Mile Conduit

The adopted plan involves more than 2 miles of a horseshoe-shaped reinforced-concrete conduit, 22 x 18 ft. inside dimensions, passing for most of this distance through the heart of the city. Fortunately for the cost of the work, but unfortunately for the owners of the property, it was possible to lay out the line so that it follows a course which traverses properties practically all of which had buildings removed from them by the flood. The city solicitor advised that for this reason, and because only an easement is required, no damages will have to be paid for this right-of-way, even when the new alignment departs entirely from the original creek channel. Placing the creek entirely underground will add 12 acres of valuable city property, formerly occupied by the creek bed and channel, to the taxable property of the city of Erie.

One of the interesting features of this project has been the promptness with which certain stages of the work were undertaken and prosecuted and the fact that within less than a year after the flood occurred actual construction has begun.

Alternative Plans Studied

The flood, which occurred on the evening of Aug. 3, 1915, resulted from a heavy and continuous rain over the entire watershed of 13 square miles, lasting from 3 to 11 p. m. On Aug. 23 consulting engineers were engaged to survey and report upon the best method of affording adequate and permanent protection. Two days later work was begun, and soon thirty men were engaged on a comprehensive survey, which included propositions to deflect the water to Lake Erie above the city; to store the flood runoff in a permanent reservoir or reservoirs; to build a detention reservoir and to construct a large conduit through the city to carry the unregulated flood flow. These surveys and the accompanying plans were completed and the report with recommendations and estimated cost of various plans was presented Sept. 25, 1915. The city commission adopted Plan 2, involving a large conduit to carry the unregulated flow, in November of last year.

The municipal election came at this time and changed the members of the city commission, but the new commission readopted the plan approved by the former one and ordered a bond issue election for the regular primary election day, May 16, 1916. This was the only delay and was considered a necessary one. An active campaign, led by the mayor, carried the bond issue through by a five to one vote.

The consulting engineers were almost immediately directed to begin work on the designs and specifications, and on June 3, 1916, this work was under way. Plans and specifications for a small part of the work —some necessary excavation for temporary stream deflection—are now completed, contract let and work has begun; while plans for a reinforced-concrete drift catcher, to be located above the city, are completed and bids are being asked for.

Progress Rapid

It is believed that, considering all the steps which had to be taken to bring this project to the point of construction, it is probably a record for so large a flood control project and bears testimony to the energy and wisdom of the city commission and of the citizens of Erie.

The tremendous majority in favor of the bond issue was a surprise to everyone familiar with the circumstances. There was a certain amount of opposition, objection which applies to all bond issues; other plans, involving partial protection at less cost, were proposed, and there were people who thought the owners of property in the valley of Mill Creek were obtaining the improvement of their property at the expense of the property owners in other parts of the city. No concerted opposition, however, developed.

The two most feasible plans for the elimination of the flood hazard were as follows: A detention reservoir, formed by a concrete dam 50 ft. high, 1 mile above the city limits. This reservoir would have a capacity of 50,000,000 cu. ft. The dam would have an opening through its base 7 ft. in diameter, capable of discharging no more water than could be cared for by the channel below. Within the city the creek would be confined within a horseshoe-shaped reinforced-concrete conduit 18 ft. wide by 14 ft. deep. The cost, according to this plan, was approximately $800,000.

The other feasible plan was to construct no reservoir and to carry the unregulated maximum flood flow of 12,000 sec.-ft. through a similar conduit 22 ft. wide by 18 ft. high in inside dimensions. A drift catcher was recommended to be constructed above the upper end of the conduit. The cost of this plan was $920,000, and this one was adopted.

The reasons for its adoption are interesting. All the members of the city commission which was in office at the time the report was submitted were in favor of the detention-reservoir plan, as were quite a number of the citizens who were familiar with the work; but all agreed that it would be impossible to convince the average voter that the dam would not be a menace. They all hesitated to put the plan involving a dam up to the voters for a bond issue, fearing it would fail to receive the necessary approval.

Detention Reservoir Preferred

Most, if not all, of the members of the new city commission favored the detention-reservoir plan on account of its lesser cost and because it would afford a better means of stopping débris from entering the conduit; but they also feared the result of putting a proposition involving a dam before the voters. It was therefore decided by both commissions that, although they favored Plan 1 recommended by the engineers, involving a detention reservoir, on account of the prevailing feeling against dams and the necessity of putting the question to the vote of the people for a bond issue, the plan without a dam was to be preferred, even though it would cost considerably more.

The consulting engineers recognized this situation, and in submitting their report recommended either one of the two plans, indicating, however, their preference for the detention-reservoir scheme.

It was estimated by numerous methods, described in Mr. Seelye's article, that the maximum discharge during the flood was approximately 11,000 sec.-ft., over 800 sec.-ft. per square mile, for the 12.9 square miles of watershed. The conduit is designed to carry 12,000 sec.-ft., with a value of $n = 0.012$. The alignment of the conduit will omit sharp bends and grade changes and will preserve a constant cross-section throughout. Great pains will be taken to obtain an exceedingly smooth surface on the inside of the conduit in order to maintain a high efficiency. Borings are in progress through the 2½ miles of line to determine the rock elevation. The rock is shale, soft above and harder the deeper one goes under the surface. The final design of the section has not yet been determined upon.

Financing the Project

When survey work was started at Erie last fall the general impression prevailed that it would not be possible to handle the construction with money voted by a popular bond issue, as Erie people would not vote for bond issues. Erie had a small debt, except for schools and waterworks, and it was the general belief that a bond issue for anything else, being almost unheard of, would surely fail. Gradually this impression became less and less fixed, and when in November, 1915, a bond issue of $1,000,000 for a new high school passed there was much satisfaction felt by the city commission, as it was believed that event augured well for a flood-control bond issue. In order to obviate the necessity of a popular bond-issue vote it was proposed at one time to build the Mill Creek flood work a little

at a time as money could be made available by vote of bonds by the city commission.

The question of the elimination of some dangerous railroad grade crossings came up for final decision about this time and a contract was finally signed between the city and railroads, by which the city agreed to pay $450,000 toward that work. At the time of the Mill Creek flood, similar but far smaller damage was done by Garrison Run near by and to the east of Mill Creek. Surveys and plans indicated that $200,000 would be required properly to protect property from damage by this stream. Numerous storm-water sewers were also needed badly, and several old ones required extensive repairs.

QUESTION SUBMITTED TO VOTE

It was finally decided to put all these questions up to the people at once. Some wanted the Mill Creek work done, some thought the elimination of grade crossings important; the residents of the Garrison Run valley thought the control of that stream the most necessary, while others in the western part of the city, who had been damaged by the lack of storm-water sewers or by the breaking of old ones, wanted those conditions remedied before any new work was undertaken.

By putting all the issues before the voters simultaneously it was believed the adherents of these various projects would vote for them all, while if only one or two were put up for vote those who were not to be directly benefited by the measures proposed would not back them and all might eventually fail.

The decision proved to be a wise one, as indicated by the five to one vote by which the whole $1,450,000 of bonds, covering Mill Creek, Garrison Run, grade-crossing elimination and storm sewers, passed. The first allotment of 4¼ per cent bonds sold was taken at over 105.

The first construction work to be undertaken, except for some temporary creek channel changes now in progress, will be the building of a row of concrete piers across the creek valley about ½ mile above the upper end of the conduit. The valley is 220 ft. wide at this point, with steep hill sides rising sharply. The piers are to be constructed to stop and hold drift coming down from the upper watershed, to prevent its entering the conduit. Ground was broken for this work with appropriate ceremonies on Aug. 3, 1916, the anniversary of the flood.

BELT CONVEYORS HANDLE CEMENT FROM BARGE TO TRUCKS AT LILY BAY

Thirty-Mile Macadam Automobile Road Built Through Maine Woods to Construct Dam

Well-Maintained Gravel Road and Motor Trucks Prove Cheaper Than Teams or Railroad for Hauling Cement to Inaccessible Work at Ripogenus

A THIRTY-MILE macadam automobile freight road has been built through the Maine woods from Lily Bay to Ripogenus, and is being used to transport cement for dam construction for its second season, at costs stated to be much lower than for teaming or for a light railroad. Over this road throughout the open season of 1915 nine 5-ton White trucks hauled from 90 to 120 tons of cement and miscellaneous freight per day.

Many dams have been built on the upper waters of the Kennebec and Penobscot basins around Moosehead Lake, but always heretofore of timber. Water transportation for pulp logs—the chief product of this territory—and for campers—its chief visitors—has combined with the mountainous and heavily forested country to check railroad extension and bar highway building. Timber of the best, cut on the spot, has always been available for dam construction. Until the building of a dam 86 ft. high to impound 28 billion cubic feet of water was decided on by the Great Northern Paper Company, timber had no competitor for this purpose. This dam, however, is to be a permanent part of the company's system for transporting annually 100,000,000 ft. of pulp logs and manufacturing them into paper. It is therefore being constructed as such dams are built where every requirement for modern construction is ready to hand.

CEMENT THE PROBLEM

The mountain sides at Ripogenus gorge furnished stone, sand, lumber for forms, and wood for fuel in abundance. Cement, however—600 carloads of it—had to be brought in. The Maine Central Railroad was available as far as Kineo on Moosehead Lake, and the cement could be readily transferred from this point to Lily Bay across the lake by barge, using a steamer of the company's log-driving fleet for towing.

A railroad to the dam would have cost entirely too much in proportion to the project, in view of the fact that it would have been useless after the dam was finished. It was estimated that the cheapest sort of con-

TAKING METERED GASOLINE AT GRANT FARM, HALF WAY TO THE DAM, OPPOSITE THE MAIN GARAGE AND REPAIR SHOP

AFTER A HEAVY RAIN

struction would have cost $15,000 a mile, as against less than a third of this sum for construction and maintaining a first-class gravel macadam highway. The road, moreover, could at a later date be connected at reasonable expense with an existing highway passing less than 20 miles east of Ripogenus, which would furnish direct communication between the company's mills and the territory in which most of its pulp logs are cut.

It was thus a question of using teams or motor vehicles for transportation. Although the company employs 1000 horses in this territory in logging, motor trucks were decided on. While each of the nine trucks cost more than twice as much as a four-horse team and wagon, each could make from eight to fourteen round trips a week, as against two for the team, and transport from 50 to 85 tons in that time, as against about 7 tons a week for the team. The far greater number of units required for team transportation would have made both first and operating costs more than twice that for the motor trucks.

Road Well Drained

In building the road, drainage was a first consideration because of heavy winter snowfalls and the liability of rainy months occurring during the working season. In fact, just this condition has been realized this spring at the opening of the road's second season. How well the gravel surface stands up under traffic after continuous rain is shown in the accompanying photographs, taken early in the morning following a sixteen-hour downpour which wound up a week of bad weather.

Gravel from numerous pits opened along the road and in a few places broken stone from shale cuts were spread on the road to a depth of 8 in. or more as it was graded, and consolidated by the traffic. The gravel used contains both clay and sand. The center of the roadway, which varied from 16 ft. to 20 ft. in width with construction conditions, is crowned 18 in. to 2 ft. above the side ditches, and this crown is carefully maintained. In a few soft places crossed the total gravel fill amounted to several feet, the gravel packing into the material below till a solid bed was obtained. The maximum cuts and fills required did not exceed 8 ft. and for about one-third of its length the road was built with very little grading.

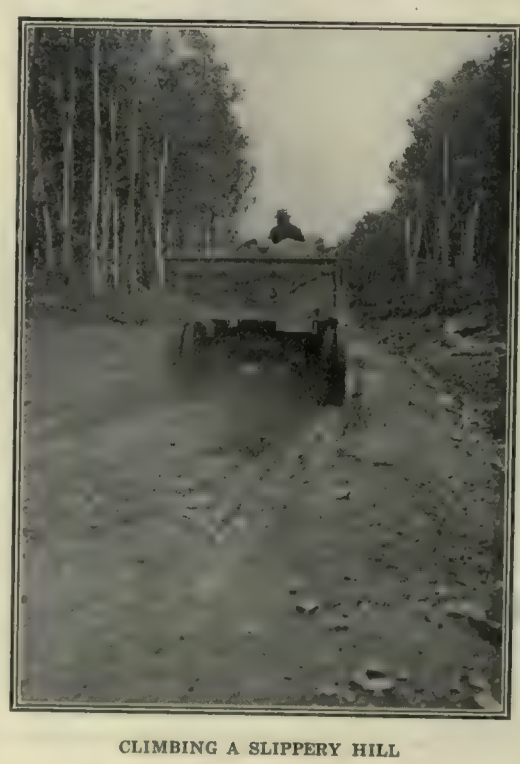
Every foot of the road is dragged after each rain. In bad weather as many as sixty men and fourteen teams have been employed in dragging, and in unloading and distributing gravel. Work on the surface is continuous, and no holes or ruts are allowed to form.

Ruling Grades 5 Per Cent

The road follows in the main an old logging road, for widening and straightening which considerable additional clearing was required. The road rises about 235 ft. to the crest of the divide between the Kennebec and Penobscot basins 8 miles from Lily Bay. From here the road drops 295 ft. to the dam. Descending from the crest the trucks are snubbed down a 10-per cent grade 1200 ft. long—the only steep hill on the entire road. An ordinary snubbing machine is used, consisting of separate sheaves mounted on four vertical shafts to which a hand brake is applied. A wire rope of double length is rove through the machine, one end being pulled back up the hill as the other descends with a truck. The machine is used to save wear on the truck brakes, and the trucks easily climb the hill light on the return trip. The ruling grades on the road are about 5 per cent. These must be climbed in low gear when the road is wet, and the trucks take them at 5 miles per hour in ordinary weather. For the rest of the way the trucks make speeds of 10 to 15 miles per hour, both loaded and light.

Trucks Well Cared For

Even during the season of 1915, when the road was first put in service and the trucks were operated for a time with two shifts, two hours a day was allowed for overhauling. Spare parts were obtained promptly, the machines were kept in adjustment and heavy repairs were made at a well-equipped machine shop at Grant Farm. When operating with one driver to a truck and a mileage bonus for distances exceeding 77 miles a day, as at present, the trucks are dispatched so that the drivers spend the night either at Lily Bay or at Grant Farm, 13 miles from Ripogenus. At both places complete garages accommodating seven trucks have been built, while at Ripogenus space for two trucks is provided.



CLIMBING A SLIPPERY HILL

OPEN COUNTRY IS RARE

Cement, the large item of freight, is unloaded from the specially built barge by a conveyor run by a gasoline engine. This conveyor dumps the sacks onto a bridge, which is an extension of a conveyor passing through the top of the cement shed and operated by a 40-hp. gasoline engine plant on shore. From the second conveyor the cement is discharged by chute into the trucks, having only to be stacked by hand. The house contains four cross-driveways for this purpose, and 100 sacks can be loaded in 10 minutes or less. Cement is unloaded from trucks at Ripogenus to gravity rollers at three doors in the cement shed, which is set below the road on a steep hillside. When the trucks are running together, the entire fleet can be discharged and the last truck started back to Lily Bay 50 minutes after the first one has arrived at the dam. When hauling oil, food and supplies, loading and unloading take longer. Reinforcing and heavy construction equipment are handled by team because of the time required to load and unload and the fact that such loads cannot be hauled at high speed with safety.

Accommodations Along Road for Men

Two hotels for tourists, one at Lily Bay and one 9 miles above, in addition to Grant Farm, maintained for stock raising by the company, and the camp at Ripogenus furnish unusually good accommodations for the truck drivers and road crews. Horses and men of the latter force are also boarded at several logging camps along the road.

To each truck is charged the cost of gasoline, oil and repairs. Accurate costs have been kept on the entire system since the beginning of the work, and the company considers that the estimate on which the selection of motor-truck transportation was based has been fully justified by the actual experience.

The road has been built and operated by forces of the Great Northern Paper Company, of which Garret Schenck is president. H. S. Ferguson, of New York, is consulting engineer for the company. J. T. Mullen is in charge of both the road and the dam construction. E. W. Prouty represents Mr. Ferguson as resident engineer on the dam.

Diagram Useful for Bending Up Steel Reinforcement

Shows What Percentage of Area of Rods for Maximum Bending Moment in Uniformly Loaded Beams May Be Bent Up

By KARL D. SCHWENDENER
Los Angeles, California

FREQUENTLY in the design of reinforced-concrete beams it is desirable to know what percentage of the steel required for maximum moment is needed at any given section, and what area of the steel may be bent up. For the case of beams uniformly loaded the accompanying diagram has been prepared to indicate the points at which rods may be bent up, or otherwise dispensed with, for three types of beams with the maximum bending moments specified.

To illustrate the use of the diagram, assume that a beam designed for $M = WL/10$ requires 3.5 sq. in. of steel at the center. To

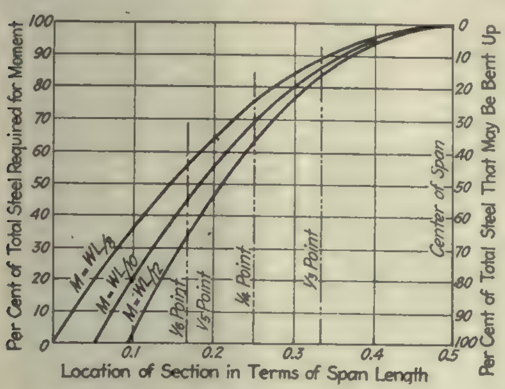


DIAGRAM FOR PERCENTAGES OF TOTAL STEEL REQUIRED AT SECTIONS OF BEAMS

find the area of steel required for moment at the quarter point, trace vertically from the quarter-point line on the diagram to the curve $M = WL/10$ and then to the left margin, where 68 per cent is read. The area of steel required for moment at the quarter point is then $0.68 \times 3.5 = 2.38$ sq. in.

It must be kept in mind that this diagram considers only the steel area required for tensile reinforcement of a uniformly loaded beam and that bond stress and diagonal tension reinforcement will need investigation before an intelligent selection and distribution of bent-up bars may be made.

Erie Filter Plant Has Low Operating Cost

An average of only 0.203 gr. per gallon of aluminum sulphate was applied to the water entering the Erie filters during 1915. An average of 3.6 lb. of bleach was used per 1,000,000 gal. Wash water amounted to 2.32 per cent, states J. S. Dunwoody, superintendent of filtration, in his annual report. The cost was $1.67 per 1,000,000 gal., but this does not include pressure water, steam and electricity used or low duty pumping cost.

Air drawn, supposedly, through a spongy place in the concrete into the underdrain of one filter caused a loss during washing of 6 cu. yd. of sand through the wash-water trough. This is the only noticeable loss in 1½ years' operation. In May and June asterionella caused considerable trouble by clogging. The filters removed the growth without the aid of a chemical. Bacteria by months ranged from 1 to 84 in the effluent, and no coli were found in 573 samples.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Instructions to Pilot Engineers on Federal Valuation

SIR: The following instructions to pilot engineers with roadway parties on government valuation of the carriers have been prepared for use on the Duluth, South Shore & Atlantic Railway:

The pilot engineer will represent the carrier in the field and will accompany the roadway and track field party of the Interstate Commerce Commission, Division of Valuation. The pilot will co-operate with the members of this party in securing information for valuation purposes.

Prior to the commencement of inventory the pilot should make a thorough inspection of the property. Maps and profiles should be compared with conditions on the ground and any changes noted. Obtain history of construction, noting any unusual features thereof and dates of tracklaying.

Ascertain sources of different kinds of ballast material and any grading material which may have been hauled from a distance.

Pilots should be informed of the ownership of all tracks belonging to the carrier, whether on the right-of-way or not. Particular attention should be given to ownership of crossing frogs and switches connecting with foreign lines. Obtain copies of contracts covering agreements on crossings, joint ownership of tracks and structures and ascertain the present status of same. A study of these items in advance of the valuation will prove invaluable.

Secure a list of special assessments made against the carrier for public improvements, such as paving, laying sidewalks and construction of drainage systems.

Consult with division engineers, roadmasters, section foremen and others in position to know about average service life of ties, switches, rails and fastenings, culverts, fences, crossing planks, stock guards, etc. A knowledge of the carrier's experience on renewals of ties and track material will be helpful to a pilot on field work, and he should be prepared to confer with the assistant field engineer on these topics. Consideration should be given to the fact that the service life of certain parts of a property is sometimes affected by the amount and class of traffic to which those parts are subjected.

The matter of "subsidence" or settlement of roadbed into the underlying ground will generally be given the attention of the head of the valuation department, who will issue special instructions to the pilot concerning same. In cases where evidence exists of a settlement of roadbed into the subsoil soundings or test borings will often reveal the nature and extent of extra grading done. Pilots should endeavor to have complete data in these cases, as the government engineers will require satisfactory evidence of hidden quantities before they will be returned in the inventory.

In addition to right-of-way maps and profiles, lists of sidings and industry tracks, regularly required by the Interstate Commerce Commission, the pilot should provide a condensed profile of the line and drawings of the carrier's standards and ballast sections.

The road and track party will take an inventory of roadway tools in charge of section men. To this end it will often be preferable for carrier to furnish a list of tools for the entire line at the commencement of the valuation.

When cross-section parties require the service of a section laborer to dig ballast test pits, the pilot will arrange for such man to report when needed, equipped with the proper tools. Where water-supply pipes cannot otherwise be located and inspected, it may be necessary to dig holes to uncover them.

It shall be the duty of the pilot to arrange for movement of camp cars.

Pilots will check the work of field parties where practicable to do so. They should be provided with an inventory the carrier may have, including reports of section foremen. Also engineers' estimates on construction quantities, force account bills, etc.

In cases of difference of opinion on topics of inventory the pilot should endeavor to have a statement of the matter incorporated in the field notes. The pilot should approach all questions relating to inventory from the most impartial standpoint. An unbiased report is desired by all concerned. Over estimates or under estimates are alike undesirable.

F. T. HOWES,
Pilot Engineer, Duluth, South Shore & Atlantic Railway.
Duluth, Minn.

Planimeter and Plane-Table for Railway-Valuation Work

SIR: Some recent experiences in connection with field work and computations for determining volumes on railway-valuation work have prompted the following remarks:

In the first place, it was somewhat surprising that the use of the planimeter was not allowed except for checking areas that had been worked out by "main strength." An ordinary polar planimeter in good order will give results easily within a discrepancy of 2 per cent; and the error contained in the mean of two results will, on the average, not be much over 1 per cent. The field measurements, both the rod reading and distances out, are subject to probable errors of at least 1 per cent, and the product or computed area will therefore have a probable error of 2 per cent. In fact it would be improper to measure the end areas any more accurately, for additional precision would be dissipated in the volumes by irregularities in the surface between end sections. The scale chosen for plotting the sections (vertical, 1 in. = 5 ft.; horizontal, 1 in. = 10 ft.) allows the points to be plotted as accurately as they are measured in the field; hence the use of the planimeter is perfectly consistent with the results desired.

Where computations are used, much labor is wasted by many computers in carrying results to five and even six places when there are never more than three signifi-

cant figures in either factor, and therefore the result cannot possibly be accurate to more than three figures. A slide rule will do for most cases.

Again, the use of the very simple and universal co-ordinate method of computing irregular sections seems not to be generally understood. It has been given in different ways, but the best form I have found is in Pickles and Wiley's text on "Railroad Surveying."

It seems possible, too, that there is a place for a wider use of the plane-table (approximate cost $75), whereby sections and station maps may be plotted directly in the field. This method has many advantages as regards both time and expense and would relieve the tedium and opportunities for error in office plotting. In many places on extensive work special instruments are in use, but it seems that on many smaller units of work the simple table could be used in the field to very good advantage.

W. H. RAYNER,
Instructor in Civil Engineering, University of Illinois.
Urbana, Ill.

Accept the Bids Nearest the Average and Not the Lowest

SIR: Recently the Engineering Record and some other engineering publications have commented on the question of the policy of awarding contracts to the lowest bidder. In my opinion, most city engineers and city officials recognize that this is a pernicious practice, and that many times a city spends more money for its work through this method and gets the poorest job than if the contract were awarded at a higher price.

It may be that the difficulty of changing the practice is entirely due to the attitude of the average citizen, who so frequently comes to the conclusion that city officials are dishonest unless contracts are awarded to the lowest bidder. At the same time it is certain that the citizen in his private life and the manufacturers do not place their orders solely on the basis of the lowest bid.

It seems to me that some method by which cities would award contracts to the bidder whose price was nearest the average would tend to improve the class of contractors, raise the standard of work and make city work more attractive to efficient, responsible parties.

Some such method of awarding contracts to the bidder nearest the average would prevent a contractor from receiving excessive prices and at the same time would prevent the city from accepting bids from irresponsible men, who bid so low that they must either fail before the work is completed or skin the job.

This suggestion has occurred to me because in so many cases the contractor who gets big jobs for granite-block paving by reason of offering the lowest bid requires constant watching. It is impossible to get a properly laid granite pavement of the modern type unless the contractor receives a price that is profitable.

The result of the present practice is that granite-block paving, as well as other types, suffer the ignominy of having the material criticised when it has nothing to do with the case—when most of the burden can be laid to the present practice of awarding contracts to the lowest bidder.

By making the average bid the standard, the aim of the contractor in every case would be to make the price absolutely correct and just for the work. It would give the engineer an opportunity to demand that the specifications be lived up to and relieve him of the feeling that it would be unjust to insist upon rigid adherence to the specification when the contractor had taken the job at a losing price.

ZENAS W. CARTER,
Field Secretary, Granite Paving Block Manufacturers' Association.
Boston.

Small Bridge "Repaired" by Local Officials Fails

SIR: I am inclosing a photograph of a recent bridge failure in this county that I trust will be of interest to your readers.

The structure was a 33-ft. span, light truss highway bridge. During the summer of 1915 it was "repaired" by the township trustee by placing a 12-in. concrete floor on 6-in. I-beams. During the fall and winter the 20-ton engine shown crossed it safely, but during the recent hot wave, with the thermometer at 105 deg., the failure occurred. The truss buckled and the rivets were all sheared or pulled out. Although the truss was badly bent and twisted, no members were broken. By the trusses failing on both sides at once the engine dropped squarely into the creek, a distance of 9 ft., a broken axle being the only damage to the machine.

There are large numbers of similar type trusses being repaired (?) by local officials through the Middle West, and accidents of this kind should impress on the minds of all public officials the necessity of competent engineering supervision for this work.

R. L. LONGSHORE,
Deputy County Surveyor.
Decatur, Ind.

THIS BRIDGE COLLAPSED UNDER THIS LOAD DURING THE RECENT HOT WAVE

Our Trade in British Eyes

SIR: Referring to an editorial in your Aug. 5 number, page 157, entitled "Our Trade in British Eyes," I would, without denying the importance of the statements made, venture to correct and amplify one of them by saying that the fundamental basis of a foreign trade under any circumstances is a merchant marine controlled by the people of this country. There is no use in our meeting foreign prices or making goods suitable for foreign requirements so long as we have no ships in which to deliver them, or control of banking facilities by which settlements are made in payment for them. It is absolutely impossible for us to develop and hold foreign markets in the case of a large proportion of our manufactured goods as long as we attempt to hire foreigners who have the same line of goods to sell, in the same markets, to carry our goods in their ships.

It is all right when we ask the foreigner to deliver things that he needs in his own country, or things that do not enter into competition with those that he wants to sell —he is only too glad to take our money for carrying them; but the minute we ask him to carry something that hurts his own manufacturing business it is a different story. He will take our freight money just the same and carry the goods to destination, but after they arrive he will use all manner of devious ways to prevent their being sold. To prove that his devious ways have been successful, note that the percentage of our manufactured goods sold abroad up to the outbreak of the present war was about 5, while that of England and Germany was about 50.

The people of this country must be brought to a realization of the fact that the foreign shipping business is a basic industry on which rests the entire financial and commercial prosperity of the nation, and that a merchant marine owned by Americans and flying the American flag is the only door to a world trade.

EDWARD A. EDWARDS,
Standard Supply & Equipment Company.
Philadelphia.

Progress on Sacramento River Levees

Of the 519 miles of river levees contemplated by the Sacramento River flood-prevention scheme there have been constructed up to approved grade, as fixed by the California Reclamation Board, 80 miles; constructed but not up to standard, 285; in course of construction, 19; projected, 6; unprovided for, 56; data lacking, 73. Of the 194 miles of bypass levees there have been constructed up to approved grade 9 miles; constructed but not up to standard, 21; in course of construction, 40; projected, 25; unprovided for, 75; not yet located, 24.

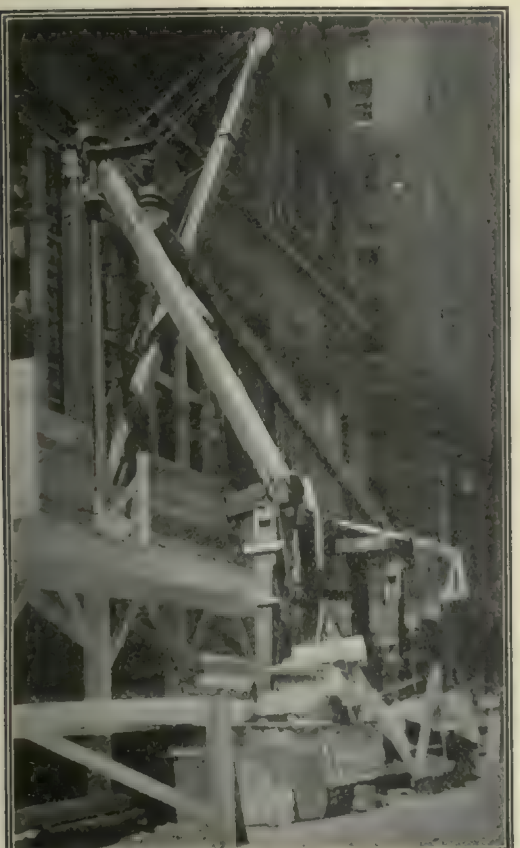
HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Elevated Derrick Removes Cracked Columns

THE DERRICK used for removing the eight granite columns from the front of the twenty-one story Continental and Commercial National Bank building in Chicago was set above the street level on a bridge



DERRICK FACES BUILDING TO SECURE GREATER WORKING RANGE

over the sidewalk. The outer ends of the stifflegs extended beyond the curb line and rested on timber frames secured to the base platform weighted down with brick, as shown in the photograph. The bridge is constructed of heavy timbers to support the boom of the derrick and the materials.

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

The columns are 60 ft. high, and the rings of granite cracked soon after the building was completed, nearly two years ago. The space between the steel columns and the ring was filled with concrete. Apparently the difference in the coefficient of expansion of the granite and the core caused the trouble.

Brick Walls Under Mill Building Replaced in Sections

By H. L. DRAKE
Seneca Falls, N. Y.

BRICK BASEMENT walls of the buildings of the Seneca Falls Woolen Mills Company, which will be below water level when the State Barge Canal is in service, have been strengthened by partly replacing them with concrete piers, built alternately, without any settlement or damage to the buildings. The main building was of stone, with wooden interior columns. The brick walls of the basements of the other buildings, in which were located the boiler and power plants, rested entirely on stone foundations. When it was found that the buildings could not be protected by constructing a levee around them except at prohibitive expense, it was decided to underpin them with concrete, remove the machinery from the basements and fill in the entire property, including the basements, to an elevation 1 ft. above the future water level. Sections 18 in. wide were cut through the brick wall from the stone foundations to a point 2 ft. above water level. These cuts were on about 6-ft. centers, leaving piers of brick 4½ ft. wide to support the load while the cut sections were filled with concrete. This concrete was placed within 2 in. of the top and allowed to harden and shrink. The 2-in. space was then grouted and thoroughly rammed. As soon as this grout had set, a section was cut out of the center of each remaining 4½-ft. brick pier and concreted in the same way. These piers are strong enough to take any water pressure that may develop from the outside, and it is expected that the brick piers left in place will arch between them. No falsework was required by this method, and there was no danger of settlement to the buildings at any stage of the work.

The interior wood columns, which rested on stone piers or on rock, were shored and removed. Reinforced-concrete columns were built in their places, capped with steel plates and wedged tight. All the basements were then filled with earth to a point above water level.

The methods used were developed by the state engineering department. The contractor for the work was the firm of Larkin & Sangster.

Transfer Company's Truck Rigged to Handle Long Loads

THE Krause Transfer Company of Milwaukee has for some time kept the truck shown in the photograph busy in the service of Milwaukee contractors, making a specialty of handling long pieces similar to the pile driver with which the truck is shown loaded. The truck has just hauled this 75-ft. pair of leads with its own power from the basement excavation of the Plankington Hotel. The excavation was about 20 ft. deep and the runway from it was on a steep grade.

For handling derrick timbers, steel girders and other long loads the regular body of the truck is taken off and a home-made fifth wheel, which can be quickly attached to the frame of the car, is put on. This wheel consists of a couple of timbers bolted to the frame, two steel plates for a bearing surface, a bolster and a king bolt.

TRUCK HAULS LONG LOADS FOR MILWAUKEE CONTRACTORS. IT HAS JUST CLIMBED OUT OF AN EXCAVATION 20 FT. DEEP WITH THIS ONE

Field-Office Accounting: Agent's Account, Freight Records

By BENJAMIN L. LATHROP
Of Lathrop, Shea & Henwood Company, Scranton, Pa.

THE LOCAL agent, timekeeper or superintendent on a job is usually provided with sufficient funds to enable him to meet petty-cash expenditures and such payroll disbursements as may be absolutely necessary between the regular paydays. In reporting such disbursements for the month considerable work can be saved the general bookkeeper by having the agent keep payroll disbursements in a separate column and classify the expense items in a summary at the end of the statement, using some such form as that shown herewith.

1916		Station	To	From	Account	Car No.	W. B. No.	Weight	Rate	Amount	Material	Checked by	Loaded	Unloaded	Car Released	Date Paid
Jan.	5	Leeds		Monroe	Concrete	37721 P.R.R.	191	64,600	1.90	61.37	Cement	D.J.A.		Jan. 6	Jan. 6	Jan. 5
	20	Leeds	Monroe		Concrete			196		.58	Sacks	D.J.A.	Jan. 19			Jan. 20
	22	Leeds		Rocton	Concrete	9043 Y	224	86,600	.42	18.19	Stone	D.J.A.		Jan. 23	Jan. 24	Jan. 24
	23	Leeds		Minor's	Excavation	1497 M.C.	254	99,400	2.00	88.80	Coal	D.J.A.		Jan. 30	Jan. 30	Jan. 24
	30	Leeds		Demurrage						5.00						Jan. 30
Feb.	3	Leeds	Millville		Excavation			150	.30	.45	Casting		Feb. 2			Feb. 3
	10	Leeds		Millville	Excavation		270	150	.30	.45	Casting	D.J.A.		Feb. 10		Feb. 10

Leeds, Ore., April 1st, 1916.

R. Sanders, Agt.,
In a c with Arnold Brown & Co.

Mar. 1	To Balance	$25.00		
5	Advanced laborer No. 301		$5.00	
	Paid off laborer No. 305		10.50	
6	Carfare to Corfu and return			.20
8	Express on rollers			3.24
10	Tom Burns, blacksmith bill			1.15
12	Postage stamps			.50
	Received from General Office	100.00		
15	Paid off laborer No. 308		9.00	
17	Express on stationery			.25
25	Damage claim of Chas. Devon, paid on authority of Mr. Brown			25.00
		$125.00	$24.50	$30.34
				24.50
		54.84		$54.84
Mar. 31	Balance on hand	$70.16		

SUMMARY

Charge Leeds March payroll		$24.50	
Corfu		.20	
Leeds:—Excavation	28.24		
Repairs	1.15		
Office	.75	30.14	
		$54.84	

Extra copies of freight bills and bills of lading are hard to get. Sometimes the owners of the work being done require the original, and the duplicate has to be sent to the main office of the contractor. In any case it is advisable to keep a record of incoming and outgoing freight on a large ruled sheet. Such a record has been found indispensable on many large contracts in connection with tracing shipments and adjusting demurrage. Records kept in the accompanying form are also valuable at times in proving whether the job has been kept properly supplied with materials.

Traveler Moving in Two Directions Builds Channel Improvement

By J. H. WEATHERFORD
City Engineer, Memphis, Tenn.

AN A-FRAME excavator which moves forward or backward on double-flanged wheels and sidewise on rollers has figured largely in the construction of the Gayoso storm sewer and of a large concrete-lined open channel, which form a part of the flood-protection system of the city of Memphis, described on page 775 of the Engineering Record for June 10, 1916. This traveler not only makes the excavation, but is also driving with swinging leads the piles for the support of the channel lining.

The machine has a rectangular base 15 x 23 ft., which is made up of 15-in. cross I-beams, connected on each side by two 12-in. channels. The A-frame is made of 8-in. channels latticed back to back, and 6-in. channels are employed in the same way to form the stifflegs. The derrick has a 50-ft. wood boom with an 8½-ft. bullwheel. It is equipped with a three-drum hoisting engine and boiler and a separate swinger, and handles a ⅝-yd. bucket. When a section of excavation has been finished the bucket is taken off and the closing line attached to a pair of 35-ft. leads. The 2500-lb. hammer is handled on the hoisting line, and a runner line from one of the winch heads is used for a pile line. In driving short piles, and in driving longer piles after they have reached sufficient penetration, the foot of the leads rests on the ground. Aside from handling both the excavation and the pile driving with one tool, the use of swinging leads on this work was practically a necessity, as piles had to be driven where it was impossible to use the ordinary form of driver with economy.

The machine is the property of the contractor for the work, the Koehler Brothers-Fowler Construction Company, which has found it an almost indispensable adjunct.

Asks How Variety of Sheet-Pile Structures Can Be Made Tight

SIR: We are using, on a job where 75 per cent of the ground is covered with water at high tide, both Carnegie and Lackawanna steel sheet piling to form pier cylinders and also to make a large cofferdam. The pier cylinders, 14 ft. in diameter, are in water 24 ft. deep at high tide, and the large cofferdam is in water about 20 ft. deep.

With these conditions in mind, we would like to ask your readers who have had experience with similar construction the following questions, answers to which will be appreciated:

1. Is there any difference between the watertightness of new and re-used sheeting?

2. Should the sheeting be stretched tight from the inside of the cylinders by wedging against the bracing, or should they be tightened from the outside by putting a cable with a turnbuckle around them at the top, and by the outside water pressure when the cylinders have been pumped out?

3. Is it necessary to calk the joints? If so, is there any better method than the use of sand or sand and flour?

4. What is the best way to make a long straight line of sheeting watertight?

5. What type of pump has proved best for unwatering such cylinders?

Brooklyn, N. Y. READER.

[With regard to the second question, the contractor for the Hanover Street Bridge in Baltimore, which was described on page 632 of the Engineering Record for May 13 last, had considerable success with constructing the bracing, for single-wall steel sheet pile cofferdams in deep water, a little smaller than the steel, and allowing the water-pressure to clamp the piles against it. It was stated in the article referred to that the sheeting was jammed together and practically all of the leakage shut off by the time a 2-ft. head had been established outside the dam. The success met with at the Forty-sixth Street pier cofferdam in New York City in making large cylinders watertight by stretching the interlocks, through placing a heavy stone fill on the inside, suggests that a long line of steel sheeting might be made watertight by anchoring it to master piles at the proper intervals and allowing the water pressure to stretch the intermediate sheeting tight. Every contractor has his own preference in the matter of pumps. Many like for this sort of work small, direct-acting steam pumps that can be hung from a set of falls.—EDITOR.]

COMPACT TRAVELER DRIVES PILES AND DOES EXCAVATING ON FLOOD-PROTECTION WORK

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Main Lock Lake Washington Canal Opened to Traffic

Lieut.-Col. J. B. Cavanaugh Conducts Ceremonies Celebrating Completion of Main Lock of Big Government Harbor

The huge concrete main lock built by the United States government at the entrance to Salmon Bay as one link in the project to provide a fresh-water harbor for oceangoing vessels plying from Seattle to other ports was opened to traffic this month. The snagboat "Swinomish," belonging to the U. S. Corps of Engineers, was the first vessel to enter the basin from Salmon Bay. Aboard the vessel were Lieut.-Col. J. B. Cavanaugh, Corps of Engineers, U. S. A., builder of the canal; A. W. Sargent, assistant engineer in charge of canal construction work, and representatives of several Seattle organizations. The ceremonies were planned and conducted by Lieutenant-Colonel Cavanaugh, with Mr. Sargent as chief assistant. C. A. D. Young, assistant engineer in charge of construction and installation of lock gates and equipment, operated the machinery.

Basin Filled and Emptied During Ceremonies

The ceremonies at the opening of the locks were of the simplest nature and took less than half an hour. Several thousand persons gathered to witness the event, and for their entertainment the great basin was filled and emptied several times. Promptly at the hour set by Colonel Cavanaugh the basin was filled to the level of Salmon Bay, in which the "Swinomish" was waiting with steam up. The moment the vessel steamed her way into the basin the ponderous gates swung closed and the lock's culverts were opened. When the water in the lock had reached the level of the outside channel into the sound the "Swinomish" headed for the open sea. By 10.30 the vessel was again moored in the lock, after descending into the lower channel, making a turn beyond the Great Northern's cantilever bridge, and then retracing her course into the basin.

With the opening of the main lock the first unit in the government canal was completed. The lock is 825 ft. long, 80 ft. wide, and at the Salmon Bay end opens into a channel 36 ft. deep. The concrete walls of the lock are 55 ft. thick at the bottom, 8 ft. thick at the top and 55 ft. high. When the lock is emptied and the water brought down to the mean level of Puget Sound the water inclosed by its walls has a depth of 36 ft.; when it is full, or raised to the level of Salmon Bay, the water has a depth of nearly 50 ft. Only eight minutes are required to empty or fill the big basin. At high tide there is only 8 or 9 ft. difference between the level of the salt water in the outer channel and that of the fresh-water basin at Salmon Bay. The small lock built alongside the large basin is 150 ft. long and 30 ft. wide and receives vessels of 16-ft. draft. Its gates are much lighter than those of the large basin.

Work on the two locks, begun in September, 1911, represents an expenditure of more than $2,250,000.

RECENTLY OPENED LAKE WASHINGTON CANAL LOCKS AND LIEUT.-COL. J. B. CAVANAUGH, WHO HAD CHARGE OF THE WORK

Lake Toxaway Dam Fails as a Result of Recent Heavy Floods

The dam at Lake Toxaway, North Carolina, weakened by recent floods, broke Aug. 13. So far no loss of lives has been reported, as warnings enabled many inhabitants to escape before the flood reached them. According to reports from Asheville, a small part of the dam failed early in the evening, followed by the collapse of the whole structure within a few hours. A $10,000 electric-power plant was wrecked by the flood. A spring which had weakened the foundation is also said to have been a contributing cause of the accident. The dam, built at a cost of $50,000, is reported to be an entire loss. The artificial lake formed by the dam covered about 550 acres to an average depth of 30 ft.

Georgia House and Senate Pass Highway Bill

No Provision for Highway Engineer—Operating Fund Not Appropriated—Fail to Define Duties of Highway Department

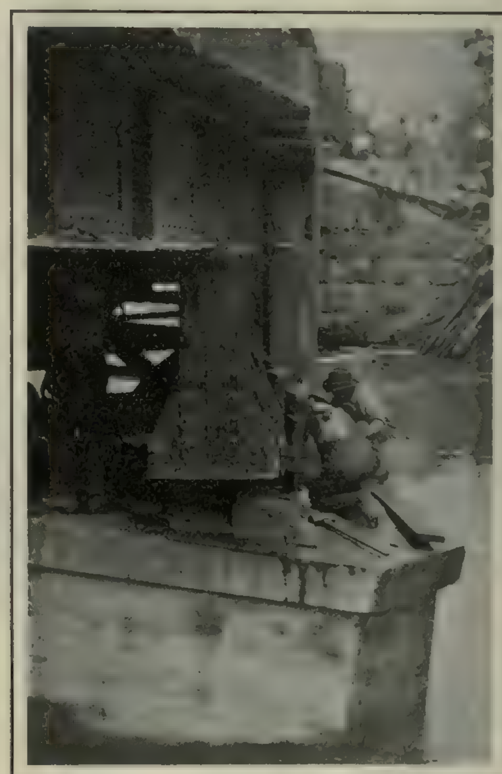
The Georgia Senate Aug. 11 passed the state highway bill recently created in the House of Representatives, making the prison commission the state highway department. Under an amendment the membership of the highway commission will also include the state geologist, the dean of the college of engineering at the University of Georgia and the professor of highway engineering at the Georgia School of Technology. While the measure creates a "highway department," no funds are provided for its operation, nor is any provision made for a highway engineer. Several highway bills have recently been presented in the Georgia House of Representatives, but none was voted on. When the $85,000,000 federal good-roads bill became a law the creation of a Georgia highway department was necessary if the state were to receive the $2,000,000 provided for its road construction.

The Heath-Adams bill was accordingly introduced into the House July 26 and passed in preference to other measures considered more meritorious. No provision for the employment of a highway engineer, no funds on which to operate a highway department and no definitions of the duties of such a body were included in the measure. That the Senate would not accept the act was freely predicted. It was thought that an appropriation for operating expenses and a definite provision for a highway engineer would be included before the bill became a law.

The Senate, however, on Aug. 11 passed the highway bill in the form in which it came from the House. It contains no provisions other than those mentioned. According to legal advice, the bill is so inadequate that Georgia's share of the federal good-roads appropriation may be withheld.

400 Square Miles Devastated by Cabin Creek Flood

MORE THAN SIXTY PERSONS were killed, houses were torn from their foundations, 18 miles of track on the Chesapeake & Ohio Railway demolished and nearly every bridge was swept away Aug. 9 when the waters of Cabin Creek flooded part of West Virginia. The area affected by the flood extends over about 400 square miles, and the loss, not yet estimated, is expected to run into millions. The damage to an electric railway bridge near Cabin Creek Junction is shown in the top picture. The effect of the water and débris on the pier of a highway bridge near the junction is shown at the left. The pier of a steel structure just below Ronda is pictured at the right. The left lower picture shows the damage caused by the torrent to the Chesapeake & Ohio Railway bridge near Cabin Creek Junction. Only one bridge—a concrete structure upstream from the ones that failed—is said to have withstood the violence of the flood. Damage to the railroad yards at Cane Fork is shown in the lower right photograph. Dr. S. L. Jepson, commissioner of health of West Virginia, has sent a force of engineers into the flooded district to see that suitable sanitary measures are enforced.



To Abandon Part of Cleveland Tunnel in Which Men Were Killed

That part of the West Side 10-ft. water tunnel at Cleveland in which twenty-one men lost their lives July 24 will be abandoned. Examinations have shown that the lining of the tunnel within 200 ft. of the scene of the explosion has been ruined beyond repair. The shore end will be projected so as to come into the outer end of the tunnel at an angle near the intake 5 miles from shore. Though the work of recovering bodies has been going on for ten days, only two have been taken out, leaving seven more buried. The explosion is said to have forced concrete blocks weighing 1250 lb. up into the bed of the lake.

Architect to Assist Engineers in Designing $1,250,000 Bridge

The Secretary of War has appointed Nathan C. Wyeth, architect, of Washington, to cooperate with U. S. Army engineers in the design of the $1,250,000 bridge to be built over the Potomac River at Georgetown. The appointment was indorsed by General Black, chief of engineers, U. S. Army. The new structure, which will replace the old aqueduct bridge, will be built of reinforced concrete. It is generally understood that five long arches will be built high enough to allow unobstructed passage of ships.

What Engineers and Contractors Are Doing

A. T. AND R. M. THOMPSON have opened consulting engineering offices in the Keystone Block, Chippewa Falls, Wis. A. T. Thompson was for several years city engineer for Stevens Point, Wis., resigning early this year to engage in consulting practice in that city. R. M. Thompson is a graduate of the University of Wisconsin and was formerly employed as instructor in the high school at Chisholm, Minn.

T. KEITH LEGARE has been promoted from assistant city engineer of Columbia, S. C., to become city engineer. He has been in the employ of that city, with the exception of a little more than a year, since 1906. Mr. Legare spent several years as architectural draftsman before joining the Columbia engineering department as surveyor and draftsman. He was made assistant engineer in 1908 and was promoted to superintendent of streets soon afterward. In 1910 he resigned to become associated with Weston & Brooker, engineers and contractors, which was followed by his appointment with J. B. Urquhart, architect and engineer. In 1911 he returned to the city engineering department of Columbia as paving inspector and later in that year was made assistant city engineer. Since 1913 Mr. Legare has performed the duties of supervisor of public playgrounds in addition to those of assistant city engineer.

FREDERICK C. WYSE, formerly superintendent of waterworks of the city of Columbia, S. C., has been made assistant city engineer to succeed T. K. Legare, whose promotion is noted elswhere in these columns. After graduation from Clemson College in 1905 Mr. Wyse entered the engineering department of the Southern Railway. He resigned the following year to become assistant to the chief engineer on construction of the Richmond & Chesapeake Bay Railroad, in which capacity he designed and constructed concrete arches, bridge abutments and piers. He joined the engineering department of Columbia in 1908 as paving engineer and was made superintendent of the sewerage and water departments three years later.

W. C. DODGE, formerly assistant in the engineering office of the Pennsylvania Lines West of Pittsburgh at Indianapolis, is now with the New York State Highway Department as rodman. He is located at Salamanca.

CHARLES D. SNEAD has resigned as bridge engineer of the Virginia Highway Commission to take a similar position with the highway department of Kentucky. After graduation from the Virginia Polytechnic Institute in 1906 he entered the employ of the engineering department of the Norfolk & Western Railway. Two years later he joined the Virginia Highway Commission as draftsman, from which position he was promoted to assistant bridge engineer. He has been chief bridge engineer of the commission since 1914.

CHARLES J. GADD, formerly engineer in charge of construction of the American Iron & Steel Manufacturing Company, at Lebanon, Pa., has been made chief engineer.

L. G. WALLIS has been promoted from resident engineer to engineer of construction of the Jacksonville (Fla.) Terminal Company. Mr. Wallis will have charge of building the new union station in that city.

WALTER COWELL, who was masonry inspector on the Elephant Butte dam, is now masonry superintendent of the Ryan Construction Company of Hartford, Conn. Mr. Cowell has been employed on various dam constructions, including the Wigwam and Morris dams at Waterbury, Conn.; the Weston Aqueduct in Massachusetts and the Pathfinder dam in Wyoming.

R. H. TUMY has resigned as assistant county engineer of Jasper County, Iowa, to become county engineer of Mahaska County, with office at Oskaloosa. Mr. Tumy was graduated from the civil-engineering department of Purdue University in 1909 and for a year thereafter was inspector on government construction work at lock 13 on the Kentucky River. He resigned to take up railroad work with the Chicago, Rock Island and Pacific Railway as instrumentman at Des Moines, Iowa. For three years he was stationed at Des Moines, resigning in 1913 to become assistant engineer of Jasper County.

ROY M. GREEN has been appointed assistant professor of highway engineering in the Agricultural and Mechanical College of Texas. Mr. Green is a graduate of the University of Nebraska and has recently completed the graduate course in highway engineering at Columbia University. Since graduation he has been employed as testing engineer and superintendent of pavement construction with Clarke E. Mickey, consulting engineer, of Lincoln, Neb. Mr. Green's appointment increases the highway engineering staff of the college to three members. He will be in charge of the road laboratories.

EDWARD C. ALBRECHT, formerly designer and estimator for the Trussed Concrete Steel Company, has joined the Republic Structural Iron Works Company, Cleveland. In his new position Mr. Albrecht will design and estimate reinforced-concrete and steel work. He is a graduate of Marquette University and has been engaged in concrete and steel design for about three years.

THOMAS A. STROUP has resigned from the engineering staff of the Tennessee Copper Company to become engineering assistant during the construction of the new copper-leaching and flotation plants of the Utah Copper Company at Garfield, Utah. The projects contemplated by the Utah company involve the expenditure of about $2,500,000, most of which will be spent on steel buildings and machinery.

T. E. BENNETT, a recent graduate of the engineering department of the University of Wisconsin, is now employed in the engineering department of the Dayton Power & Light Company as chief draftsman.

JACOB L. CRANE, JR., having completed the building of the $180,000 sewer system and disposal plant at Cleburne, Tex., has moved to Menominee, Mich., to take charge of the construction of a filtration plant there. Mr. Crane has been employed by Burns & McDonnell, consulting engineers, of Kansas City, Mo., since his graduation from the University of Michigan in 1913.

CAPT. J. B. HODGSON, formerly in charge of underground operations in the Copper Queen mines, has been appointed to the consulting staff of Phelps Dodge & Company, with headquarters at Bisbee, Ariz.

L. J. CHARLES, formerly construction engineer on the Elephant Butte dam, has been appointed assistant to James A. French, state engineer of New Mexico, succeeding S. S. Carroll, resigned. Mr. Charles will have charge of hydrographic and stream gaging work.

EDWARD WEGMANN, consulting engineer, of New York City, has been asked to report on the present condition of the dam across the Colorado River at Austin, Tex., and to suggest necessary changes and improvements, especially in regards to the automatically operating gates.

CHARLES M. EDWARDS has been promoted from resident engineer to division engineer of the New York highway department. Mr. Edwards was born in 1872 at Plattsburg, N. Y., and was graduated from Yale University in 1894. After a short experience in mining engineering he returned to New York to enter the state engineer's office. In 1899 he opened consulting offices at Plattsburg and designed and superintended the building of a masonry dam near that city. He was also engaged on road construction and designed a gravity water-supply system for Dannemora, N. Y. A short experience with the Lackawanna Steel Company in 1901-02 was followed by his appointment with the New York state engineer's department. When the highway department was organized he was made first assistant engineer and later resident engineer.

C. BOONE SADLER, who has been employed by the engineering department of the city of Baltimore since 1907, has been made pitometer engineer. After about eight years' experience as draftsman for different engineering companies Mr. Sadler joined the Baltimore Sewerage Commission as draftsman. He was for several years inspector, following which he was made assistant engineer in charge of the drafting room of the storm-water division.

J. C. WATTS has resigned as deputy city engineer of Troy, N. Y., to become engineer of the harbor and dock commission of that city.

Civil-Service Examinations

United States—Examinations will be held Aug. 28 at the usual places for subinspector of radio towers at a salary of $5.52 a day. Another, for assistant material engineer, at salary of $5 to $6 per day, will be held Sept. 5. Applicants for positions as architectural and structural-steel draftsman at $1,500 a year will be held Sept. 6 and 7. Form 1312 should be filled in by applicants. An examination for junior civil engineer will be held Oct. 11. Further information may be obtained at the usual places.

New York—Examinations Sept. 2 for chainman, $2.50 to $3 a day; sanitary engineering draftsman, $900 to $1,200 yearly, and superintendent of landscape construction, Bronx Parkway Commission, salary $2,000 to $2,200. Particulars may be obtained from the secretary of the New York Civil Service Commission at Albany.

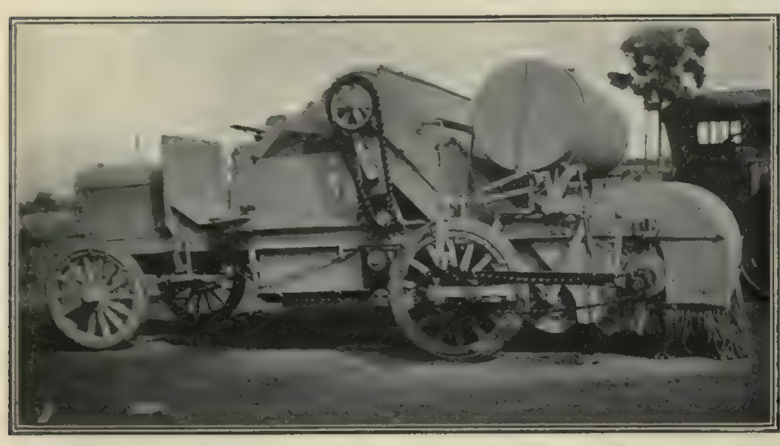
Examinations Previously Announced

Date		See Eng. Record
Aug. 21-25.	Second lieutenant, civilian candidates	April 1
Aug. 22.	Mechanical draftsman	Aug. 5
Aug. 23 and 24.	Laboratory assistant	Aug. 5
Sept. 18.	Aid in Coast and Geodetic Survey and for draftsman	Aug. 5

Broom Drive on New Motor Sweeper Has Two Speeds

The new motor sweeper manufactured by the Baker Manufacturing Company, Springfield, Ill., is equipped with a broom drive that has two speeds. The sweepings are elevated by means of a series of built-up brushes, which empty into a dust receptacle of 2⅓ cu. yd. capacity. The actual sweeping width is 7 ft.

A 30-hp. 4-cylinder motor drives the machine at speeds of from 3 to 6 miles per hour. The wheel base is 10 ft. 4 in. and the treads 56½ in. and 98 in. at front and back respectively. The usual automobile accessories are included in the equipment.



NEW MOTOR SWEEPER HAS 7-FT. SWEEPING WIDTH

Centrifugal Pump Uses Smaller Impeller to Increase Efficiency

The development of the steam turbine and the high-efficiency multi-stage centrifugal pump have gone hand in hand. Up to the present it has not been found entirely practicable to reconcile the speeds of the two machines so that each would work at its best efficiency. Heretofore it was necessary to reduce the speed of the turbine and sacrifice much of its efficiency, or else speed up the pump with similar results. To overcome this difficulty the A. S. Cameron Steam Pump Works, New York City, has designed and built a multi-stage centrifugal pump, known as the "BT" type. The construction of one of the three-stage pumps is illustrated herewith.

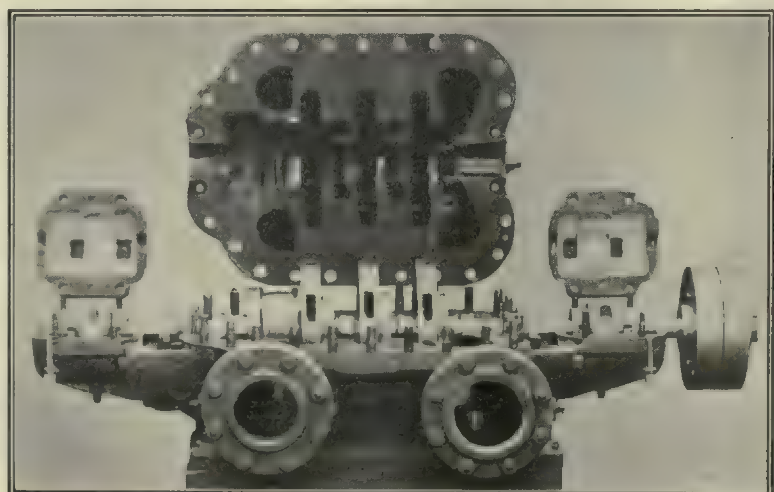
It is pointed out that with the ordinary impeller the diameter cannot be reduced sufficiently to get high speed without sacrificing vane length. Consequently efficiency for a certain vane length is necessary in order that the impeller may perform its function without excessive loss. Small external diameter and adequate vane length are obtained by bringing the vanes well down into the impeller hub. At the same time the vanes are so turned that the incoming water is guided smoothly into the outer portion of the vanes, where the velocity is generated that is finally converted into useful pressure by the external diffusion vane. Additional advantages in the small impeller are light weight and low fiber stresses.

The casing is divided along the horizontal center line. Both the suction and discharge connections are in the lower half of the casing. The upper half is readily removable, giving full access to the revolving element. There are suitable openings for draining the pump and for displacing the air when starting. Inlet and outlet nozzles can be arranged either on the same or opposite sides—held to be an important advantage where pumps are installed in limited space.

Each impeller is cast in one piece and is of the inclosed type. Each impeller hub is surrounded by a pair of rings—one attached to the casing and the other to the impeller. By using double rings the initial tightness of the joint between the low and high pressure sides of each stage can be restored without any fitting.

To take care of thrust a simple internal hydraulic balancing device is provided. This consists of a revolving disk attached to the shaft at the high-pressure end. Opposite the disk is a stationary drum of the same diameter. Water at high pressure causes the disk to react against the opposing thrust, neutralizing it and holding the rotor in proper relation to the casing. The slight leakage involved is piped back to the suction.

THE USE OF SMALL IMPELLER IS CLAIMED TO INCREASE EFFICIENCY AND REDUCE FIBER STRESSES. CASING IS DIVIDED ALONG HORIZONTAL CENTER LINE AS SHOWN



Fire Cripples Crane Plant

Owing to a fire which destroyed the Ohio Locomotive Crane Company's machine shop that company has temporarily reduced its output. The normal production will be resumed in four or five months.

Modern Equipment Used in Hawaii

In spite of the low cost of labor and the high cost of shipping the Chain Belt Company has sold three of its concrete paving mixers to cities in Hawaii. Two of the machines are operated by gasoline engines and one by steam.

Lumbermen Meet at Seattle

The West Coast Lumbermen's Association recently held its semi-annual meeting at Seattle. One hundred and fifty members assembled at the New Washington Hotel and participated in discussions pertaining to the lumber business. A guessing contest as to the breaking load of an 8 x 16-in. timber 16 ft. long gave opportunity to those who thought they knew the strength of lumber to prove it. A load of 88,200 lb. broke the stick, and the winner's guess was within 200 lb. of the actual breaking load. Tests were also made of different kinds of fire-resisting roofing.

Open New Cement Plant

The new $650,000 plant of the Choctaw Portland Cement Company at Hartshorne, Okla., was put into operation Aug. 15. Its capacity is 2000 bbl. a day, and it will offer employment to 200 men. Most of the output will be sold in Oklahoma, Texas, Arkansas and Louisiana.

Business Notes

The Clydesdale Brick & Clay Company, of Pittsburgh, with a new plant at Elwood, Pa., has become a licensee of the Dunn Wire-Cut-Lug Brick Company of Conneaut, Ohio. H. J. Orth is president of the Clydesdale company and W. W. Cunningham, vice-president and general manager. The present daily capacity of the Clydesdale plant of 100,000 paving brick will soon be doubled.

The Corrugated Bar Company, Buffalo, has been reorganized and the new officers will assume their duties Sept. 1. A. C. Garrison is president; A. L. Johnson, vice-president and general manager; W. H. Kennedy, vice-president and secretary; A. E. Lindau, sales manager.

The Link-Belt Company, Chicago, is enlarging its Indianapolis malleable foundry. The extension will be a one-story building 70 x 275 ft., with a 106 x 140-ft. wing. The company has just issued a revised price-list, effective July 15.

Wallace & Tiernan Company, manufacturer of chlorine control apparatus for water and sewage purification, has moved to its new factory at 137 Centre Street, New York City.

Arthur T. Nelson, for the past six years representative of the Trussed Concrete Steel Company in Seattle, Wash., has left that city for Boston, where he will engage in the general contracting business. A. G. Muessel, representative of the Trussed Concrete Steel Company in St. Paul, will succeed Mr. Nelson at Seattle.

Trade Publications

The following companies have recently issued trade literature:

Spray Engineering Company, Boston. Bulletin 201, 6 x 9 in., 16 pages, illustrated. Describes "Spraco" system for cooling condensing water. Illustrations of several installations.

Allis-Chalmers Manufacturing Company, Milwaukee. Bulletin 1536. Devoted to air-compressor equipment.

Lidgerwood Manufacturing Company, New York City. Folder, 9 x 12 in., 16 pages. Describes Lidgerwood cableways for hoisting and conveying purposes. Pictures of different cableway equipment and of jobs on which Lidgerwood equipment was used.

Brown Hoisting Machinery Company, Cleveland, Ohio. Catalog, 6 x 9 in., 64 pages. Describes Brownhoist locomotive cranes. Shows machines in operation on practically every kind of work to which they are adapted. Almost every page is filled with pictures.

George Haiss Manufacturing Company, New York City. Folders describing "Haiss" wagon loaders.

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Toxaway Dam Failure

ANALYSES of dam failures generally reveal faulty foundations as the primary cause of trouble. Such appears to be the case with the Lake Toxaway dam in North Carolina, which went out Aug. 13. Mr. Willis, in his article in the news section of this issue, attributes the failure to a stream of water flowing through fissured rock at the base of the structure. He also states specifically that a small stream or seepage spring at the foot of the dam had been running ever since the reservoir was created, and that this spring began to increase in volume and, what is most significant, in turbidity, more than a week before the failure occurred. With this subsurface channel operating under a head higher than normal, due to remarkably heavy precipitation, which raised the reservoir level, it was only a question of time when enough of the earthfill would be carried away to cause a cave-in and a subsequent breach through the main body of the structure. Mr. Willis does not give many details regarding the foundation except to say that a transverse channel had been blasted across the dam site in solid rock. Was this rock "solid"? Were borings made to reveal its true character? These are the questions which immediately suggest themselves to the engineer. If fissures in the foundation rock had been disclosed by subsurface exploration with drills before the dam was built they might have been sealed effectively by high-pressure grouting, a method frequently resorted to in current practice.

Making Grade Crossings Safer

NOBODY is going about these days urging the perpetuation of the railroad grade crossing. All agree that it is dangerous and a thing to be eliminated as rapidly as possible, but reasonable people realize that this cannot be accomplished in a twinkling. The next best thing to do is to minimize the dangers of the level crossing, and in this respect some of the railroads are going beyond the legal requirements. Considerable publicity has been given to the campaign of the Long Island Railroad, where automobilists have been wont to race with trains for the crossings. Now the Baltimore & Ohio announces that it has instructed its local officials to approach each grade crossing on foot from the public highways, as well as from the right-of-way, and note whether or not pedestrians, drivers of vehicles and locomotive enginemen have an unobstructed vision. The railroad promises to follow up these visits by doing all it can to correct bad conditions—trimming trees, removing fences and small buildings and, possibly, altering the location of side tracks. If this is done carefully over the entire system it will mean much, but at the same time the public should remember its own responsibility in the matter. Probably 90 per cent of all grade-crossing accidents are due to failure to heed warning signs, bells, gates or flagmen. While it is not fitting that the penalty for heedlessness on the part of a chauffeur should be the death of all the occupants of an auto, neither is it fair to denounce the railroad as the sole cause of the disaster.

New England Waterworks Convention

AFTER several years of journeying beyond the limits suggested by its name, the annual convention of the New England Waterworks Association this year will have a real "Down East" setting. In the last half dozen years four of the meetings have been in alien territory—New York, Philadelphia, Washington and Rochester. Next month's session (Sept. 13, 14 and 15) at Portland, Me., therefore, will carry with it the spirit of "old home week"—a welcoming of New England's sons back to their native heath. To this welcome there should be a hearty response. Past meetings of the society have been well worth attending, for they have blended happily opportunities for work and play. Portland, as a host to the convention, is not to be outdone by other municipalities, for she has placed her new City Hall at the disposal of the delegates for both meetings and exhibits of waterworks equipment and appliances. Five sessions of the convention will be devoted to papers and discussions, and the committee is working hard to make the program attractive to superintendents. In former years this journal has endeavored to convince city officials that they will be well repaid by sending their waterworks superintendents and engineers to meetings of this sort and paying their expenses. It repeats this plea now, for the New England convention offers a unique opportunity, each year, for learning of the newer and better things in waterworks practice.

Motor Traffic Increase

A PERUSAL of highway construction literature for the last few years discloses the oft-recurring phrase, "increase in the use of motor vehicles." No road-builder needs to be reminded that this increase is an actual fact, and one which has a very decided bearing upon his own work. Stated in general terms, however, the real significance of the motor vehicle's growth in popularity is lost. What it actually amounts to is set forth specifically in a recent bulletin issued by the Division of Road Economics of the U. S. Office of Public Roads and Rural Engineering. The figures are truly startling. During the last ten years the state registration of motor cars, including commercial vehicles, has increased 5000 per cent, or from about 48,000 in 1906 to 2,445,664 in 1915. Highway engineers will be impressed by these figures, not merely because they indicate an astonishing development of the motor vehicle as a factor in transportation, but because they represent a rapidly growing source of revenue, in registration fees, for road-building and maintenance purposes. In 1906 less than three-tenths of 1 per cent of the total rural road and bridge expenditures in the United States was derived from motor vehicle revenues, while in 1915 nearly 7 per cent was secured from this source. The total amount collected by the various states in 1905 amounted to only $62,500. In 1915, however, the total gross revenue from registration of motor vehicles and the licensing of operators was swelled to the sum of $18,245,713. The chief interest of highway engineers in these statistics is in this fact—that of the total revenue collected during 1915 practically 90 per cent was applicable to road work, and of this amount slightly more than 70 per cent was placed more or less directly under the control and supervision of state highway departments.

Highway Engineers Must Write

THREE BENEFITS are bound to result from a general order which Austin B. Fletcher, state highway engineer of California, issued early this year to all of his division engineers. The order called upon each of them for a weekly story of about 1000 words on some phase of his work. And by "story" is meant not a cut-and-dried statement of progress, but rather material, in the form of description or narrative, bringing out the real significance of the work each engineer is doing—particularly how it will benefit the public which is paying the bills. The articles are wanted, primarily, for the California commission's highway bulletin and for distribution to the press. When the scheme was first put into effect it was found that the division engineers dealt too largely in technicalities. They either did not appraise their audience correctly or were unable to address this audience in words which would convey any real message. To correct this tendency a number of useful suggestions for stories were sent out from the main office. Here are a few samples: Mileage saved by completing new highway section; elimination of a steep, well-known grade, dangerous curve or railroad crossing; description of a local celebration in honor of a finished highway; the finding of Indian relics or anything carrying a story of the early history of California; the making accessible of strange or picturesque new country or points of historic interest; voluntary praise of the state

highway system by distinguished visitors. The first and obvious effect of the weekly-story order is that it will teach the division engineers to write. In the second place, the very practice of interpreting their activities will prevent them from falling into a rut of mere technical routine. The third and most important result will be the education of California's public to the work that its highway commission is doing.

A Hint for Timid Speakers

AN assistant engineer in one of the bureaus of a large public-works department was invited recently to deliver an address before the members of a college engineering society. The young engineer had taken a prominent part in the general planning and design of a great municipal project, but he had no experience in public speaking and was thoroughly frightened at the prospect of standing up before an audience and describing work with which he was thoroughly familiar. He was on the point of declining the invitation to speak, but decided to seek the advice of the chief engineer of his department. "There is no option about this matter at all," said the latter; "you must deliver this address. Before I made my first speech I was as uncertain of myself as you are now, but this is the system I adopted: I selected a number of lantern slides showing various features of the work I had to talk about. I arranged them in logical order, turned them over to the stereopticon operator and then requested that all lights be put out. In the darkness I immediately felt at ease, and when the first view was shown upon the screen I found no difficulty in talking. I then signaled for the next view and continued in this way to the end, making a fairly creditable showing. I decided at the outset not to depend upon any written paper." The assistant engineer followed these tactics in his initial address and came through with flying colors. The mere darkening of the lecture room before he began talking seemed to give him confidence in himself. To-day he finds no need of resorting to these methods and looks upon the delivery of an address about his work as an ordinary event. Engineers who are handicapped by diffidence in speaking in public may find this experience of value to them.

Splitting Hairs

MENTION was made by W. H. Rayner in his letter in last week's issue, page 239, of the wasting of labor in computing results to five and six figures when there are no more than three significant figures in either factor. Experienced engineers are not likely to be guilty of this, but the practice is surprisingly common among the younger generation. A rather hard-headed mathematics instructor in the engineering department of one prominent university used to insist that the entrance requirements for a technical course should include a stiff examination in arithmetic. Certainly there is something wrong in the mathematical grounding and balance of the young man who, in making a survey of buildings by the intersecting-arc method, reads his distances to hundredths of a foot, but gets his arc intersections so flat that they will not plot; or who, in taking cross-sections of soft ground, uses a target on his level rod, and then computes his volumes to tenths by the average-end method from stations 100 ft. apart, but fails to divide by 27 to get cubic yards instead of cubic feet; or who accepts obviously absurd results of any sort because the figures seem to show such results. Hasty inspection will usually tell whether a figure is reasonable or not, and that should always be made, whether the figure was obtained mentally, by slide rule or with seven-place logarithms. Beyond that, however, the young engineer should have constantly in mind the purpose of his work, the degree of accuracy desired and the degree obtainable with the methods employed. He should know, for instance, as Mr. Rayner has suggested, that you cannot multiply three significant figures by three significant figures and get six correct figures. Then he should be thoroughly conversant with some of the simple shorthand methods of arithmetic—synthetic multiplication and division, the use of reciprocal factors, cancellation, approximations. At the same time he must know where to draw the line in approximations, so that he will not throw out all of the significant figures and miss his mark entirely. It is bad to be unable to make a precise calculation when precision is demanded. It is almost equally bad to be unable to produce any sort of reliable result when there is no time for hair-splitting accuracy.

Is State Insurance Accident Prevention?

A LARGE contractor, referring to some of his work in a state which has advanced liability laws and state insurance, recently remarked that the state system was perfect. He no longer worried about accidents, damage suits and troubles with insurance rates. The very next day the chief engineer of construction of a railroad operating in an adjoining state having similar compensation laws added this significant statement: "The contractors don't seem to care any more whether their men get hurt or not. They pay so much to the state, and if a man gets careless and falls off a trestle, the state takes care of him. Why should the contractor worry?"

Why, indeed? With private insurance an inspector is on the job after every serious accident and at regular intervals when there are no accidents. If accidents increase unwarrantably the contractor's rate goes up. As a result a heavy premium is put on unsafe construction. Foremen and men are instructed and cautioned. The careless and unfit are discharged. Safeguards are maintained and extended. Dangerous practices are curbed.

State insurance administrators should look to these matters if the whole experiment of public liability, met through taxation of the protected industries, is not to prove a colossal failure. Further neglect of them cannot but raise the cost of compensation and the tax rate charged for state protection. The advantages of state insurance over the old system of common law suits are in a fair way to be lost through shipwreck on this one obstruction.

The remedy is at hand—the safe channel has already been marked out by the private companies. Accident prevention through inspection and differential rates based on the accident records of the insured mark the way to the goal of reduction in public cost of accident compensation and better protection for the working man.

War's Light on Technical Education

TO NEUTRALS the European War has been far more than a succession of campaigns or a gigantic interplay of upset economic forces. It has been a panorama of nations stripped of artificiality. Under the stress of conflict characteristics have stood forth as never before. National virtues and weaknesses have been emphasized. Hidden motives have been revealed.

It is not surprising that educational systems, necessarily responsible for national traits, have been searched by the war's light. That, if anything, could show up their excellences and their weaknesses.

In April of this year, Dr. John Dewey, professor of philosophy in Columbia University, discussed in the *New Republic* the German and British educational ideals as revealed by the war. More recently Earl Cromer in a debate in the British House of Lords expressed views identical with those of Dr. Dewey. Their analyses should prove especially interesting to engineers, for their conclusions involve the very problems of technical education which are most debated with reference to technical education.

Dr. Dewey and Earl Cromer conclude that both English and German education have been at fault, though in exactly opposite directions. Germany has overemphasized scientific education. England has given too little attention to science and has laid too great stress on liberal and humanistic subjects. Both observers plead for a serious consideration of the lessons which the war has taught, to the end that there may be a proper balancing of liberal and scientific studies.

So much has been written upon the military organization of both Germany and England in this war that it seems unnecessary to discuss them at length in order to point out the justification for the views expressed by Dr. Dewey and Earl Cromer. The machinelike precision of the whole German military organization, backed by an industrial plan that meshed perfectly with the strictly military movements, has been the marvel of the world. On the other hand, there is no need to point out the miserable failure of Germany to judge correctly other peoples, whether belligerent or neutral. Her diplomacy has been anything but diplomatic.

England, on the other hand, while not miscalculating the psychological and diplomatic phases of the conflict and of the is-

sues it has raised, was unprepared industrially. Its unpreparedness, too, was not merely in the failure of the military authorities to appraise, and prepare to use, the industrial resources of the empire, but in the entire lack of a scientific industrial organization able to cope quickly with the great problems which the war imposed. In the debate above referred to, for example, Viscount Haldane, one of the participants, pointed out that at the outbreak of the war there were only 1500 trained chemists in England. He intimated that the same lack of experts existed through the whole gamut of British industries.

The application of these observations to engineering education is obvious. Our courses should be so shaped that humanizing studies will go hand in hand with the technical. We want not merely scientific machines, but engineers with broad human sympathies, who will bear their part well as citizens. At the same time their technical attainments must be above question. In other words, a combination of the scientific spirit of Germany with the cultural qualities that distinguish the graduates of the English universities is what we seek. Not easy of accomplishment, it is true, but necessary if we are to avoid the defects which the critics here cited have found in the educational systems of the two leading warring powers.

Standardize Structural Details

ONE of the most prolific sources of disagreement among structural engineers is found in the field of those ever-recurring details of connections for which each experienced detailer is apt to develop strong personal preferences. While proper details and adequate attention to the many small but vital matters, such as lacing, tie plates, jaw plates, etc., are highly essential, it is doubtful whether the small changes about which strenuous arguments often occur are sufficiently important to occupy so much of the engineers' time. Cannot the stormy sessions or many long letters in which the relative advantages and disadvantages of a given detail are argued at length be avoided in the future, and at the same time the true importance of these details recognized, by a serious attempt at standardization which will harmonize the practice of all big fabricating companies and designing engineers throughout the country?

Take for example the number and distribution of rivets used in connecting angles to gusset plates. Should not the general principle be adopted that the connection should be made good enough to carry the full working stress in the main section, and in that way, based upon standard specifications and thickness of plates, fix once for all the number and distribution of the rivets? It is assumed that the question whether clip or lug angles should be used would be one of the first to be settled —based upon results of tests such as those made by Professor Batho (see the Engineering Record of Oct. 23, 1915, page 512).

Only a committee of broad-gage men with national reputations would be competent to settle such details and insure their general adoption, and it is proposed that a committee of members of the American Society of Civil Engineers, such as suggested by this journal in the issue of June 24, 1916, page 821, should, after drawing up standard specifications for steel buildings, proceed to consider the standardization of structural details. Ample field for the ingenuity of the detailer would still remain in the multitude of special problems which arise so often in structural work, yet essential principles and, so far as practicable, universally standard details should be definitely fixed. It is believed that a vast amount of useless and wearying minutiæ might thus be avoided.

Range-Finding as an Engineering Problem

THE war correspondents speak so glibly of range-finding at the front that the uninitiated might suppose that it involved no particular difficulties. Engineers who are familiar with problems of triangulation, however, know better, and from experience are in a position to sympathize with their military and naval brethren.

Fundamentally, range-finding is nothing more than a problem in triangulation, where, from a measured base line, the distance of a given object is sought. Ordinarily the engineer reaches his results by the use of an exact base with accurate transit observations made at each end, thus giving two angles and the included side of the unknown triangle. Sometimes, for simplicity, he may make one of these angles a right angle in laying out his base. If the distance to be measured is long, he may have to allow for the curvature of the earth, and if his base line and the object are not on the same level he may have to figure the difference of elevation.

Consider now the difficulties which the artillery officer, military or naval, has to face. With leisure and a front not exposed to fire he may proceed comfortably, like his confrère in civil life, using the same instruments and methods; but this is altogether an abnormal situation. On land the object of which the distance is sought is usually out of sight from the gun. Its distance and elevation must therefore be found from a point which may be anywhere from a few hundred yards to a mile or more from the battery, and the range, azimuth of laying the guns and elevation must be computed for the battery from readings taken at the post of observation. In field artillery work the data must be obtained and reduced for the gun pointer inside of a very few minutes. There is generally neither time nor opportunity to triangulate by ordinary methods, even if the apparatus were at hand.

The military engineer, therefore, is driven to range-finding with a base of such length as he can carry with him in an instrument capable of being carried by a mounted man, with all the contingencies of accident, while yet remaining in working order and giving a good degree of precision. Ranges must be found up to five miles from an instrument, constituting the base line, no more than three or four feet long. This is practically a tube with a pentagonal prism at each end, bending the rays from the object at right angles. The rays are then united by two objectives into the field of a common eyepiece. One of the prisms is always fixed and the other either capable of a slight and exactly measurable rotation or, more usually, supplied with equivalent means of shifting its line of sight, so that the images as observed from each end of the base line may be brought into coincidence. In most instances this adjustment is made by sliding a prism of small angle along one side of the tube, thereby deflecting the rays from the corresponding end of the base line by a measurable amount, and, the base line being fixed, the device can, by a suitably graduated scale, be made direct-reading, so that the distance of the object, once the images are in coincidence, can immediately be read off.

The difficulties of the artillery range-finding on land, however, are as nothing to those encountered on the sea. Here the actual fighting ranges extend to 10 or 12 miles, at which distance ships may easily be sunk by gun fire. The range-finder used for the purpose is ordinarily similar to that just described, but with a tube 10 or 15 feet in length, giving a correspondingly longer base. At 10 miles, however, even the longer distance subtends scarcely one minute of arc, so that the precision of measurement necessary is not easy to obtain, particularly as the instrument is often mounted on the top of a turret or in other positions where the tremendous concussion of the big guns subjects it to shocks which require the most robust construction.

The most serious difficulty is found in changes of atmospheric refraction, the phenomenon which, in its commonest form, is known as mirage. Even at the distance of a very few miles mirage may falsify elevations of objects seen. Likewise lateral deviations may appear, and the images writhe and wobble in the field to an extent that must be seen to be appreciated. Under these conditions even the best range-finder may give misleading information.

The great desideratum in naval range-finding is in some way to obtain stability with a longer base, thus minimizing the various difficulties of the situation. For a long time our Navy used a depression range-finder. This used the height of the crows-nest from the water as a base and measured the depression of the enemy's water line. This gave the increase in base, but magnified all the difficulties that arose from mirage and is now practically abandoned.

All kinds of ingenious schemes have been planned for using the length of the ship or even the distance between ship and ship in a squadron as a working base, but none of them has yet worked out in a satisfactory manner. The problem of improvement is one to stagger the ingenuity of the engineer, and if the notes can induce anyone to whet his wits successfully on practical improvements it will do good service to the military art.

HYDRAULIC SAND BOAT DISCHARGING ITS CARGO WITH ONE PUMP WHILE SECOND PUMP FEEDS IN LAKE WATER. EACH BIN HAS SEPARATE SUCTION PIPE, WATER BEING FED FROM OVERHEAD TROUGH

Sand Sluiced Around Field Museum Columns, Chicago, Holds Them for More Fill by Conveyors

Combined Tripper and Shuttle Conveyor on Transfer Belt Carries Dry Sand from One Boat 1350 Feet While Other Boat Is Successfully Unloaded by Pumping

FILL around the Field Museum foundation columns in Grant Park, Chicago's front yard, amounts to 180,000 cu. yd., and with the attendant fill outside will reach a total of more than 600,000 cu. yd., a quantity warranting a large initial expenditure for plant. The salient features consist of an elaborate belt-conveyor system for transporting the sand from a boat a maximum of 1350 ft. to the 400 x 750-ft. building, a special shuttle tripper in a transverse conveyor and a second hydraulic system which is operated by pumps located on one of the sand boats.

The Field Museum is said to be the largest marble building in the world, and is built on made ground opposite the Twelfth Street station of the Illinois Central Railroad. Concrete columns with their tops at El. 33 above city datum, resting on nests of piles cut off at El. — 1, will support the building proper. Filling at the site by the Illinois Tunnel Company has been going on for several years, and there has been miscellaneous dumping from the nearby loop district, so that when the contractor began operations two years ago the elevation was at + 9, whereas the basement-floor level is to be at + 33 and the main floor at El. + 50. Suggestions have been made that this valuable sub-basement space be utilized for an aquarium or for a public garage, of which Chicago is now so much in need. The enormous expense of completing this work and designing a floor slab and girder system having bays 42 ft. by 9 to 20 ft. on a side over the area precluded any serious consideration of these plans.

Track Impossible

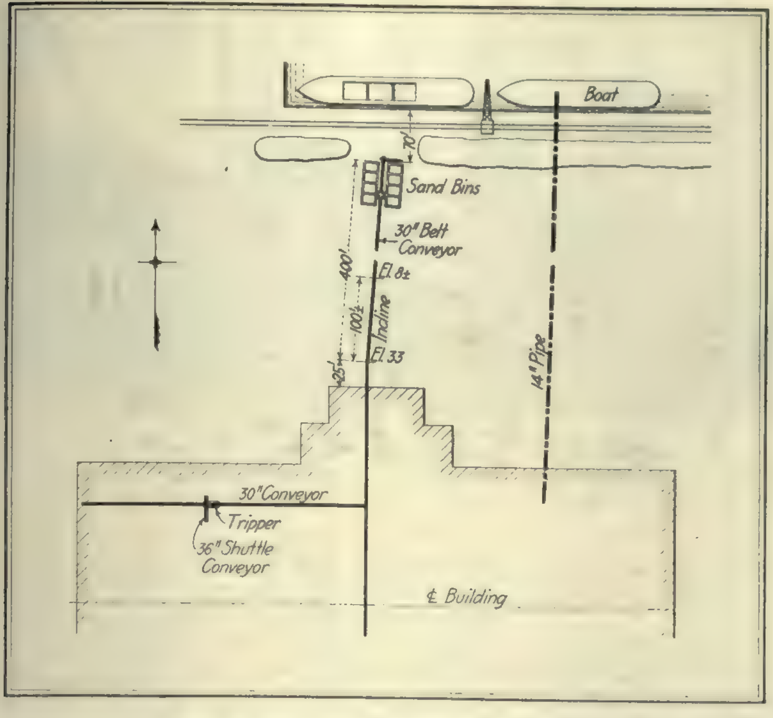
The space is now being filled with sand from boats and the basement floor will be laid directly on the fill, all other work being practically suspended until this work has been completed late this fall. In the choice of method of filling, tracks were out of the question, as no room was available to make turns, and as there was danger of shifting columns. The material already in place is soft fill and easily shifted.

To the north of the site about 700 ft. is an east-and-west dock to which the sand boats have access. A harbor only 8 to 12 ft. deep had to be dredged to give 19-ft. channels 90 ft. wide. Near the shore two bins of 900-yd. capacity each, with four compartments, were erected. The sand is pumped from the Barth, a boat specially rebuilt for this job with three bins, 28 x 21 x 13½ ft. deep, into the bins and the water drained off through vertical sluices on the side of each compartment. The other boat unloads upon a stock pile over a 100-ft. tunnel conveyor leading to the 30-in. main belt conveyor passing between the above bins. This conveyor runs south to the building, rising in the last 100 ft. as shown in one of the photographs to the level of the finished fill at the top of the present concrete work. Here it is discharged upon a 30-in. conveyor, 425 ft. long, continuing south across the full width of the building.

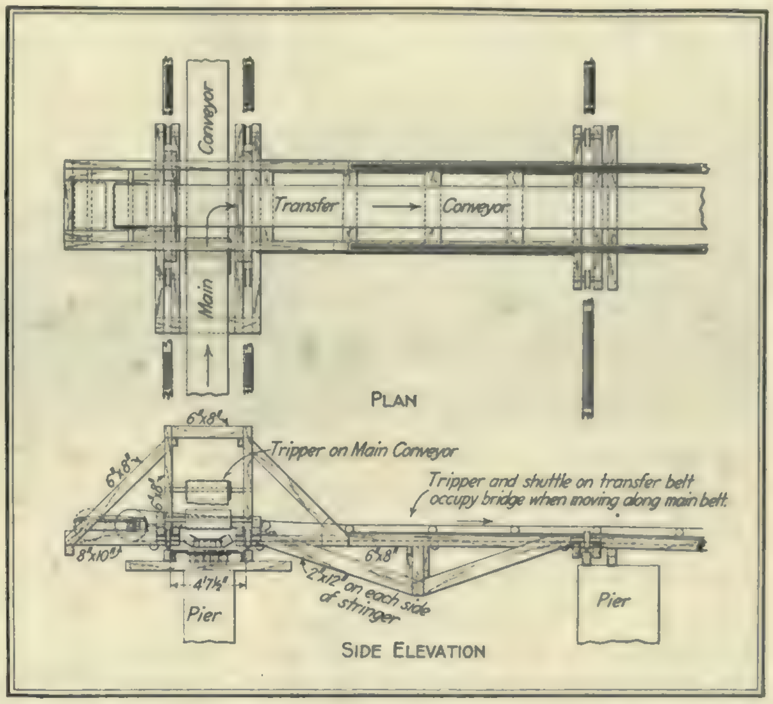
A tripper on this belt discharges upon a transfer conveyor running to the west wall. Both of these belts are mounted on the con-

MOTOR RUNNING TRANSFER BELT DRIVES CRAB AND WINDING SPOOL

SHUTTLE CONVEYOR HAS 18-FOOT OVERHANG ON EITHER SIDE



RELATIVE UNLOADING POSITIONS OF THE TWO BOATS AND ARRANGEMENT OF THE BINS AND CONVEYOR SYSTEM



TRUSSED BRIDGE FOR THE SHUTTLE AND THE TWO TRIPPERS CARRIES THEM TO THEIR NEW POSITION ON THE PIERS

crete columns, but the transfer line starts at the north wall and is moved over its own fill toward the south. The successive stations will be 21 ft. apart, or in the center of the light bays and on the tops of the seven lines of columns and on the north and south walls.

SHUTTLE NEW FOR SAND

The tripper on the transfer belt has a 36-in. shuttle conveyor belt overhanging a maximum of 18 ft. on either side. It and other new machinery were made by the Weller Manufacturing Company. This is probably the first time this shuttle arrangement, which is used in making wide stock piles of coal or ore, has been used in making a sand fill. The 40-hp. motor for driving the transfer belt is located at the west end and is connected by a clutch and reducing gears to a winch for winding up the belt before moving the track on which the shuttle and tripper run. The winch is also for use in pulling over the sand the 14-ft. sections of track, which are mounted on plank sleds.

The shuttle mechanism and the tripper moving along the transfer belt are driven by the transfer belt itself.

In moving the transfer conveyor to the next station the shuttle tripper is driven up close to the receiving end near the tripper on the main belt onto a trussed bridge with a span reaching to a track laid on the first line of piers to the west. Both trippers can then be moved south the required distance to the new position of the transfer belt.

Two boats bring the sand used for filling from the Michigan or Indiana shore, as little sand dredging is available in shallow water on the Illinois shore. The limit in depth for the suction is about 25 ft. The Hydro has two 500-yd. bins, and unloads by means of two derricks with 2-yd. clamshell buckets delivering into a small central hopper feeding a belt conveyor on a 72-ft. boom, which discharges the 1000-yd. load onto the stock pile in three to five hours. The stock pile provides leeway for both the boat and the conveyor system, the latter operating at about 250-yd. capacity per hour. This boat makes one trip to the Michigan shore daily, and requires from three to four hours to load. The aim is to do the loading in daylight if possible.

The Barth carries about 600 yd., and is equipped with two 12-in. special Erie centrifugal pumps, both of which are used to load. In unloading water must be pumped in by one of the pumps, as the 1000-ft. line of 14-in. spiral riveted pipe to the building carries about 80 per cent water and 20 per cent sand. This boat usually loads near Gary, Ind., and makes the round trip in

SAND FILLING BELT IS MOUNTED ON SLED SECTIONS FOR QUICK MOVEMENT

SAND FROM BELT CONVEYORS IS RUN IN ON TOP OF THAT PUMPED IN AROUND COLUMNS, WHICH SPREADS OUT EVENLY ON ABOUT A 15-DEGREE SLOPE

80-FOOT CONVEYOR DISCHARGES SAND FROM BOAT ONTO STOCK PILE, WHENCE FEEDER BELT FOR MAIN CONVEYOR LEADS TO BUILDING SITE

Revolving cranes (A) on each side of boat take sand from 500-yard bins (B) and deliver to conveyor hopper (C). Conveyor boom (D) reaches over stock pile (E), under which is tunnel (G). Short belt in this tunnel feeds on main conveyor (F), which runs between two sand bins to building site. Sand bins are filled hydraulically from other boat and feed onto same main conveyor.

about twelve hours—two to three hours for loading and coaling, two to three hours for unloading and six hours going and coming. The sand spreads out evenly on a 15-deg. slope from the discharge end of the pipe. At first the hydraulic fill was separated from the west portion by sand discharged under the main conveyor. It is intended to fill back under the depressed existing floor of the lecture hall hydraulically, as the sand will have to be carried horizontally about 150 ft. After running for a short time with the conveyors the spiral pipe was laid in a cut running under the main conveyor to the west side to fill in hydraulically around the bases of the columns so as to prevent their moving and thus let the work progress more rapidly. Marble for the structure has been on hand for two years, and it is imperative that the fill be done on a portion of the site at as early a date as possible.

Water from the sand drains off quickly through the cinder fill. An old breakwater runs from the north dock to the center of the building and then turns west. This was not removed, and is now found to make an excellent main underdrain for collecting the water from the cinders and carrying it back to the lake.

The filling is being done by J. R. Sensibar, sub-contractor to the Thompson-Starrett Company, general contractor. The conveyor system was designed by the Raymond W. Dull Company. Graham, Burnham & Company are the architects and have supervision over the construction for the trustees of the Field Museum fund.

Much Work for Railroad-Valuation Engineer Precedes Advent of Government Forces

Jenks B. Jenkins, of Baltimore & Ohio, Has Evolved Comprehensive System for Showing Valuation Sections and for Lining Up Available Map Data

By C. W. STARK
Associate Editor, Engineering Record

IN THREE previous issues of the Engineering Record the writer has attempted to take from various vantage plants snapshots—the work is far too big for anything else—of what is being done and how much work is involved in the actual prosecution of the government evaluation of the carriers, irrespective of the much-discussed fundamental principles of valuation. The last of this series of pictures suggested the magnitude of the railroad's task in locating, assembling and classifying its available data concerning its plant. Perhaps a better conception of this preliminary work can be obtained from a railroad not yet in the thick of the inventory. The Baltimore & Ohio is one of the large roads that have not yet received notice from the government as to the date as of which they will be valued, and is not likely to be put under valuation for a year or more to come. Yet its valuation engineer, Jenks B. Jenkins, has been at work nearly three years getting acquainted with his road, indexing his records and clearing the decks for action. Following are a few of his activities along two lines only—the historical and geographical subdividing of the road for inventory purposes and the sizing up of available map data.

The first thing Mr. Jenkins did was to list his corporations and make a tentative list of valuation sections. The Baltimore & Ohio operated lines, including the Baltimore & Ohio Southwestern, together with affiliated lines under the jurisdiction of the valuation committee, have a route mileage of 5366 miles, and comprise sixty-five transportation corporations. In addition there are numerous subsidiary land-holding corporations and others owning personal property only. No mere "paper" corporations were listed. In compiling the list the status of 169 corporations was investigated and the total number to be finally listed was greatly reduced by the transfer of property from a number of corporations to others and the dissolution of the grantor corporations.

A part of the numerical list of corporations is shown. Where not preceded by any letter the corporation is a transportation corporation. The prefix B indicates a real estate company, while P preceding denotes a company owning personal property only, such as an equipment company. Effort has been made to have the subsidiary companies correspond in number to the transportation company in the same territory. Thus, 1 denotes the Baltimore & Ohio Railroad Company proper, R1 denotes the Real Estate & Improvement Company of Baltimore City, the general holding company for land all along the line, while P1 is the main equipment company. Similarly, R2 is the land company of 2, the Staten Island Rapid Transit Railway Company. The various symbols used in the column "Character of Control" are explained in the legend.

The corporations were grouped geographically, with gaps in the numbering to separate the groups. Thus, while the numbers 1–60 were assigned to the corporations east of the Ohio River, the numbers 53–60 are left open, thus separating the main group from the lines west of the Ohio, while other gaps divide the line into smaller groups. No. 21 begins the West Virginia series, No. 31 the Pennsylvania series, No. 81 the Chicago district and No. 91 the Baltimore & Ohio Southwestern.

VALUATION SECTIONS

With the corporations established, Mr. Jenkins began a tentative division of the whole road into valuation sections, which was the basis for a second, or "final," division. All corporation limits are, of course, section limits. So also are state lines. In addition the sections have been broken up for expediency at other points—junctions, division points, changes in operating, historical or construction conditions and the like—although such breaks were avoided unless deemed essential. While the government is empowered to fix the valuation sections, it is expected that those proposed by the railroad will be accepted.

As finally set off by the railroad the system has 146 valuation sections. They are numbered consecutively from 1, in geographical order, modified by the limits of operating divisions, with occasional gaps to allow revision of the sections. They are given a three-part designation—the corporation number, followed by an abbreviation of the state, followed in turn by the section number. Thus 91–OH–146 means valuation section 146, located in the state of Ohio, on the Baltimore & Ohio Southwestern.

Subnumerals and suffixes are used to distinguish the main line of a valuation section from its branches and owned or leased lines from trackage rights. The decimal .1 after the section number denotes the main or principal line and .2, .3, etc., denote branch or secondary lines—all exclusive of trackage rights over foreign lines. The suffixes a, b, c, etc., denote trackage rights over foreign lines. Corporations and sections in parenthesis are not under the jurisdiction of the valuation committee, but are included for indexing purposes.

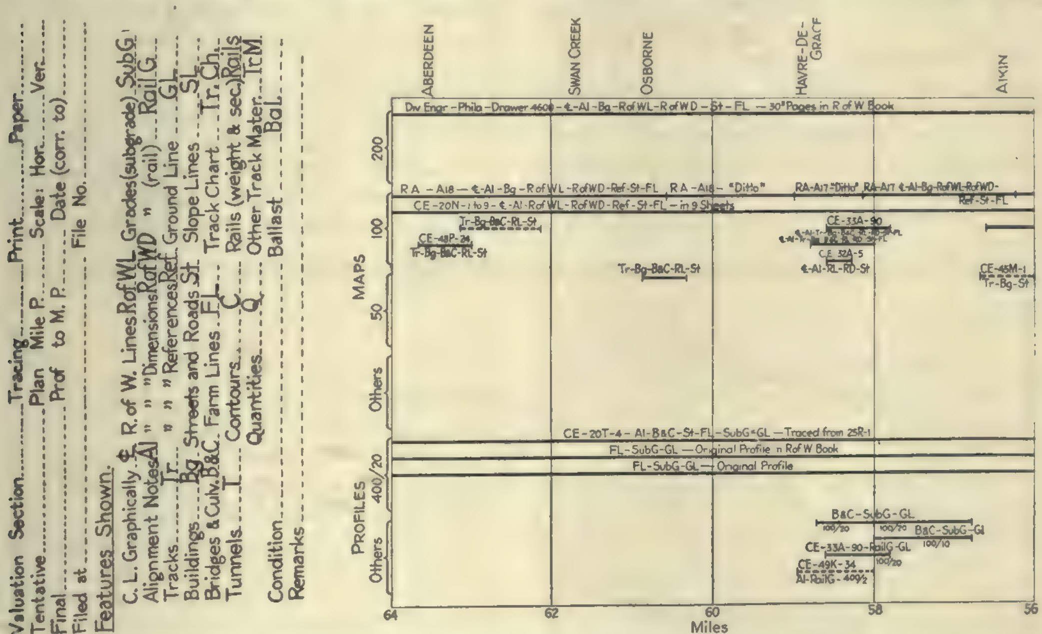
NUMERICAL LIST OF CORPORATIONS B. & O. SYSTEM AND AFFILIATED LINES		
	Symbols Used to Designate Character of Control	
A	An active corporation	
B	An inactive corporation	
DC	Direct, sole control	
DJC	Direct, joint control	
IC	Indirect, sole control, through an intermediary	
(——)	The Corporation Number of the intermediary	
a	Control through ownership of stock	
—%	Extent of interest of parent company or intermediary	
*	Not operated	
**	Under separate operation	
***	Under foreign operation	
No.	**Corporation**	**Character of Control**
1	The Baltimore & Ohio Railroad Company	Parent
R1	The Real Estate & Improvement Company of Baltimore City	A–DCa–100%
P1	The Baltimore & Ohio Equipment Company	A–DCa–100%
P2	Baltimore & Ohio 26th Street Stores, Incorporated	A–DCa–100%
2	The Staten Island Rapid Transit Railway Company	A–DCa–100%**
R2	New York Transit & Terminal Company, Limited	A–IC(2)a–100%
(8)	(The Washington Terminal Company) (Joint with P. B. & W. R. R. Co.)	A–DJCa–50%**
9		
(R9)	(The Union Stock Yards Company of Baltimore County) (Joint with P. B. & W. R. R. Co.)	A–DJCa–50%

Symbol	Operating Division	VALUATION SECTIONS Description	Miles of 1st Track
1–MD–18	Baltimore	B. & O. R. R.—Washington Br.—Relay to Md.-D. C. Line and Branches.	
18.1	do.	Main Line—M. P. 9.0, Relay to Md.-D. C. Line	26 05
18.2	do.	Patuxent Br.—Savage to Guilford (The Guilford & Waltersville Granite Co. has trackage rights from derail, 1700′ S. of end of Branch to end of Branch, 0.32 mi.)	4 11
18.3	do.	Alexandria Br.—Pt. of Sw., E. Leg of Wye at Alexandria Jct. to Md.-D. C. Line	3.30
1–DC–19	do.	B. & O. R. R.—Lines in D. C.	
19.1	do.	Wash. Br., Wye and Metropolitan Branch—Md.-D. C. Line to D. C.-Md. Line	7.23
19.2	do.	Wash. Br.—Slip Switch, 12th St. Tower to Florida Avenue	0.81
19.3	do.	Wash. Br.—Coach Yard, Round House and Shops	——
19a	do.	Trackage over Wash. Ter. Co., Florida Ave. to Union Sta., Wash., D. C.	(0.72)
19.4	do.	Metropolitan Br.—Florida Ave. to Slip Switch at Rhode Island Ave. Tower, Bulk Freight Yard, Coal Yard and Track to L St.	0.92
19.5	do.	Alexandria Br.—Md.-D. C. Line to Shepherd	9.46
19b	do.	Trackage over P. B. & W. R. R., Anacostia Jct. to S. End Long Bridge	(4.60)
1–VA–20	do.	B. & O. R. R. Alexandria Br.—Freight Station at Alexandria, Va. (R. E. & I. Co.—R1–VA–19)	——

THESE TWO FORMS LIST AND DEFINE RESPECTIVELY THE CORPORATIONS MAKING UP THE SYSTEM AND THE FINAL VALUATION SECTIONS

Miles of first track in parenthesis are of trackage rights over the lines of other companies. One of the accompanying tables indicates the form in which the sections and subsections are listed and described.

A large map on a scale of 16 miles to the inch has been prepared, showing the valuation sections of the entire system. The successive use of three simple conventions—a plain solid line, one with cross bars singly and a third with them in pairs—makes it possible readily to see, without the use of color, the limits of each section, as no four sections come to a common point. Lines not yet constructed are dotted, and lines over which the company has trackage rights only are shown light. Each section is designated by its proper symbols. The map also shows state lines, principal bodies of water and watercourses, principal towns, stations or other points defining ends of sections and nothing else other than a legend and a tabulated list of the corporations.



DIAGRAMS VISUALIZE INFORMATION GIVEN IN CARD INDEX AND SHOW AT ONCE WHETHER TERRITORY IS PROPERLY COVERED

VALUATION SECTION Tracing__ Print Paper ✓
Tentative. ~~1-MD-2~~ Map ✓ Mile P 42.46 Scale-H____ V____
Final..... 1-MD-10 Prof__ to M P 43.33 Date (corr. to) 2/4/05
Filed at DIST. ENGR. M. OF W. BALTO., MD. File No. 1-1-16

FEATURES SHOWN

C. L. Graphically		R. of W. Lines	✓	Grades (sub grade)	
Alignment Notes	✓	" Dimensions		" (rail)	
Tracks	✓	" References		Ground Line	
Buildings	✓	Streets and Roads	✓	Slope Lines	
Bridges and Culverts	✓	Farm Lines		Track Chart	
Tunnels		Contours		Rails (weight and sec.)	
		Quantities		Other Track Material	
				Ballast	

CONDITION Good

REMARKS Made by Div. Eng., Phila.

INDEX CARDS RECORD IN CONCISE FORM CHARACTER AND CONDITION OF MAPS

Lining Up the Available Maps

Meanwhile, pending the "final" arrangement of valuation sections, Mr. Jenkins visited all of the map files of the company and noted the character, scope and condition of the maps and drawings found. His observations regarding maps have been recorded on an index card of the form shown, using the "tentative" valuation sections, which were later changed to the "final," for which space had been provided on the cards. Notice that only a few of the spaces require filling out; in the others the indication is made by a simple check mark.

Supplementary to the card index Mr. Jenkins has visualized the situation by diagrams, part of one of which is shown. These are plotted on profile paper, the vertical lines of which indicate distance as in an ordinary profile. Sections of the horizontal ruling are assigned to maps and to profiles and subdivided according to scale as indicated. Each heavy horizontal line means a map or profile for the territory from end to end of the line, full lines meaning that the map is good and dotted lines that it is inferior.

A form similar to that on the index cards—made in fact with the rubber stamp first used for the cards—is stamped on each end of each diagram. The blank spaces, however, are utilized to show suitable abbreviations, and by the proper selection of these symbols in the designation along the map lines the scope of each map is recorded. The small scale of the accompanying illustration precludes the possibility of labeling each line in the compact manner adopted on the original, but the few designations reproduced indicate the usefulness of the diagram.

As stated in the first paragraph, these are only a few of Mr. Jenkins's activities. A look at his primary list and a talk with him about the complications he has encountered regarding land ownership, crossing rights and many other matters will convince one that work can be found for the railroad-valuation department long before the advent of the government's field parties.

STEEL ELEVATED IN CONTRAST WITH DOMED CONCRETE STRUCTURE AT STATION

Elevated Railway of Domed Arch Construction a Strong Contrast to Steel Structure

Queens Boulevard Extension to New York System Has Incased Steel Girders and Reinforced-Concrete Arches Supporting Ballasted Floor

A STRIKING CONTRAST between the usual steel elevated railway and the new reinforced-concrete domed arch structure on Queens Boulevard can be seen from the car windows of the Long Island trains shortly after they emerge from the tunnel under the East River Where the ordinary steel type and the new arch type are joined, with the transition marked by a massive ornamental abutment, the contrast is impressive. Typical details of the steel structure, which is part of the Queens extension of the New York City Elevated Railway, were described in the Engineering Record of July 17, page 76.

The new Queens Boulevard elevated structure has the appearance of a reinforced-concrete dome construction. As a matter of fact, however, longitudinal arch action was assumed in the computations, and transverse steel girders embedded in the concrete at each bent carry the loading to the heavy reinforced-concrete columns. To increase the ornamental effect, recessed panels with tooled finish, inlaid colored tile and curved outlines are used. The mezzanine spans at the stations are steel girders and columns masked by concrete.

Why Arched Structure Was Adopted

Queens Boulevard is one of the most-used automobile highways leading from Long Island to New York City over the Queensboro Bridge. In order to furnish as ornamental an elevated structure at as low cost as practicable, the engineers of the Public Service Commission made several designs and estimates. A steel-frame structure of the usual type, with open floor, but masked by concrete, would probably deteriorate through the effect of impact on the bond between concrete and steel. A through solid floor which would decrease this danger was designed and estimated to cost over one and one-half times as much as the plain steel structure. The domed arch type of construction in reinforced concrete and steel, with steel girders and columns at every station, was adopted as a result of the study, as it was estimated to cost a little more than one and three-fourths times as much as the plain steel structure. Owing to the local conditions and the fact that a greater length would be required, the cost of subway construction would be about four times that of the usual steel structure.

The final decision was based not only upon relative cost and maintenance charges, but mainly upon the superior advantages of the arch structure for architectural treatment. An incidental advantage of importance is the decrease in noise resulting from the use of this type.

General Dimensions

The Queens Boulevard section of the new Queens extension leading from Queens Plaza to Corona, L. I., is about ¾ mile long, running from Hill Street, just beyond the viaduct across the Long Island Railroad tracks, to Gosman Avenue. It carries three tracks on 13-ft. centers, two outside local tracks and one center express track. The width of the elevated structure is 42 ft. 6 in. inside the solid concrete railings projecting 2 ft. above the base of rail. These railings, which will be surmounted by a low pipe handrail, not only add to the height but to the possibilities of ornamental paneling on the outside, and aid somewhat in confining the noise of the passing trains.

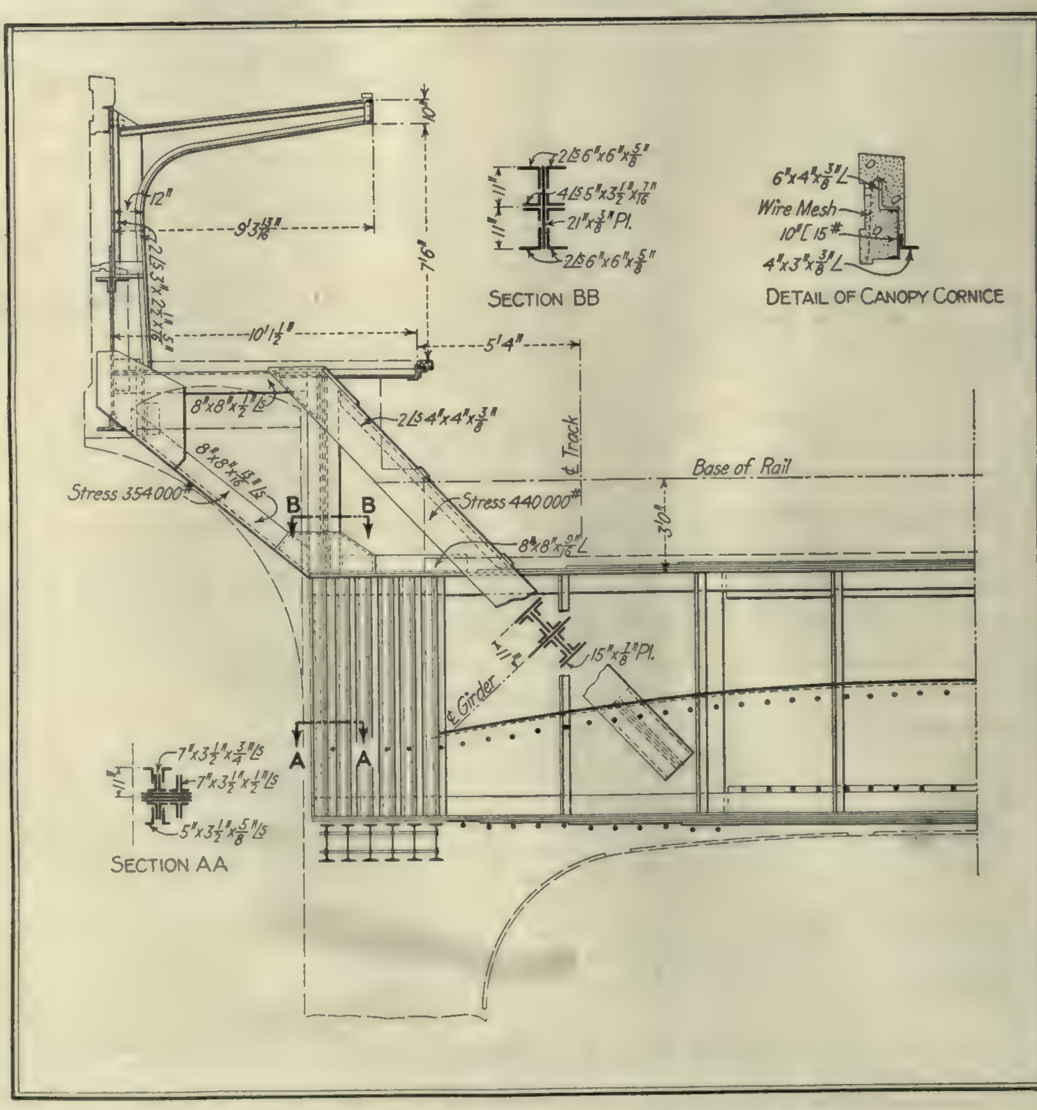
The typical span of the arches is 65 ft., while at the stations, where more room for the mezzanine floor and ticket offices is necessary, the span is increased to 90 ft., and steel plate girders covered by concrete are used. Except for the mezzanine span, the width at roadway level is not increased at the station, but the platforms are supported by cantilever brackets connected to the main cross-girders, and carrying fascia girders covered by concrete.

Loads and Impact

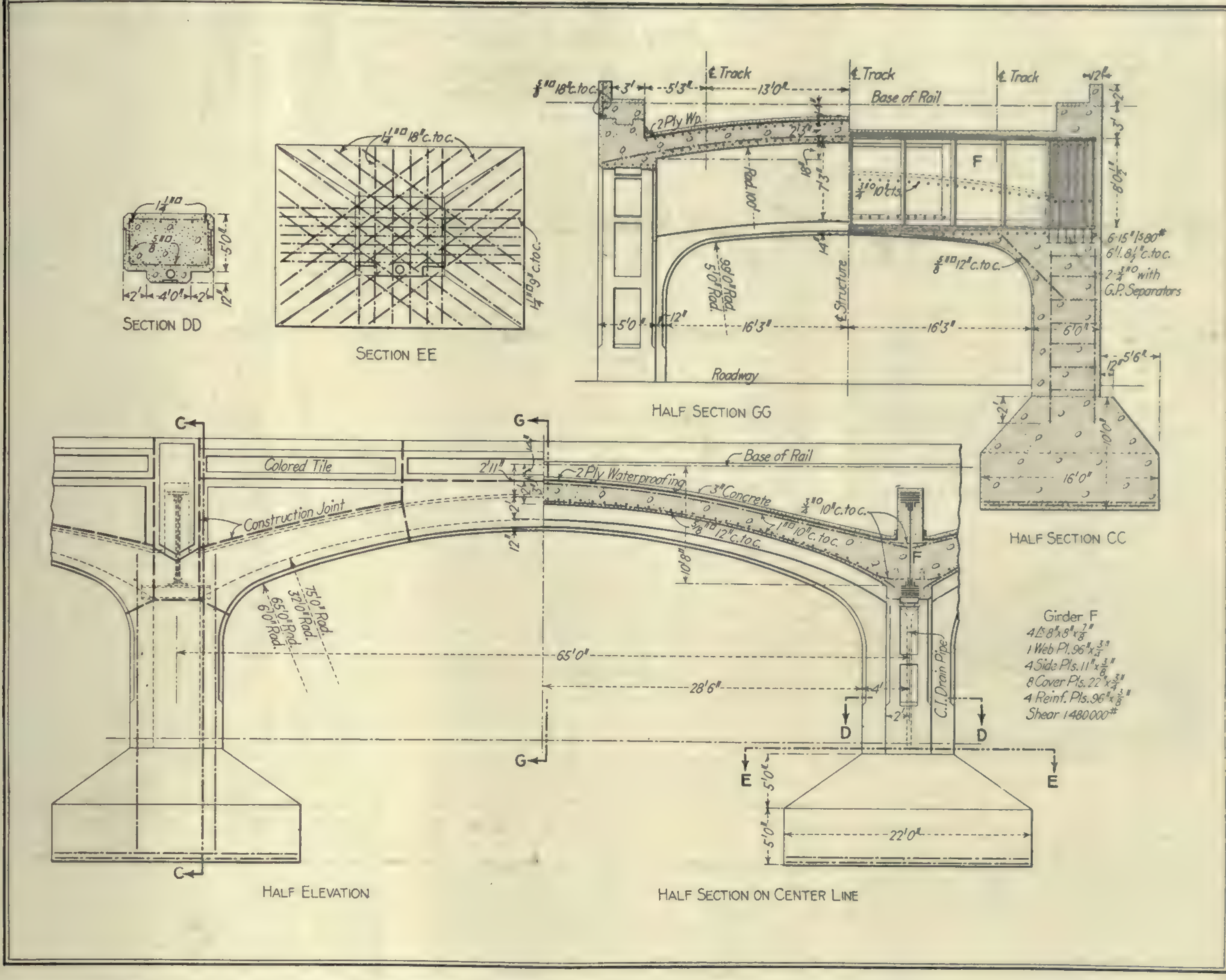
The structure is designed for 60-ton electric cars on each track, the two motor trucks of adjacent cars governing the arch analysis. The concentrated loads were assumed to be distributed by the ballast over 5 ft. longitudinally and 12 ft. transversely. In spite of the fact that these loads are transferred through ballast, impact was added at about 80 per cent of the live load, according to the Public Service Commission formula. In the design of the arches a temperature change of 30 deg. Fahr., rise or fall, was provided for.

The allowable unit compression in the concrete is 600 lb. per square inch, and the allowable soil pressure for the piers is 2 tons per square foot for direct loads and 4 tons maximum, including bending effects. For the steel girders and steel frame construction at the stations the allowable stresses conform to the usual values, as prescribed by the Public Service Commission.

After a preliminary trial outline for an



CONNECTION OF SIDEWALK CANTILEVER TO CROSS-GIRDER AVOIDS RIVETS IN TENSION



DETAILS OF TYPICAL 65-FOOT REINFORCED-CONCRETE ARCHES AND COLUMNS—STEEL CROSS-GIRDERS ON BEAM GRILLAGES

arch with 4-ft. rise had been found to give prohibitive stresses when temperature changes were considered, the outline shown in an accompanying drawing with three-centered circular curves for the intrados and a rise of 6½ ft. longitudinally and 1½ ft. transversely was adopted. A constant arch thickness of 2 ft. is kept from the crown to the quarter point and the thickness then gradually increased to about 4 ft. at the haunch. The longitudinal reinforcement is 1-in. square rods placed on 10-in. centers both top and bottom, with transverse rods ⅝ in. square spaced on 18-in. centers on the bottom only. A transverse arch effect at the bents is obtained by incasing the steel cross-girders in concrete with curved lower surfaces.

In computing stresses in the arch it was assumed that the concrete carried no tension, that the ends were fixed, and that the dead-load thrusts balanced each other at the cross-girders; that is, that the usual fixed-end arch analysis was applicable. In order to carry to the columns the heavy vertical components of the thrusts, it was found that reinforced-concrete arches were not practicable; therefore the steel plate girder was adopted.

The dead-load thrusts balance at the top of the columns, but the column design included the bending effect of unbalanced live loads. In computing this bending it was assumed that the total unbalanced thrust for one span loaded would be distributed equally to three bents. The heavy direct vertical loads and the effect of the bending required very large columns, 5 x 8 ft. in cross-section, with 1 in. square vertical rods, and ⅝-in. square rods for shrinkage, tied together by ½-in. hoops. The typical pier footing is 16 x 22 ft. in plan and 10 ft. deep, reinforced by 1¼-in. square rods both diagonally and, under the column section, parallel to the edges.

At the stations, of which there are three, the special cantilever bracket details shown in an accompanying drawing are used in the main cross-girders to support the outside fascia girders and platform loads. As noted on the members, the stresses in these brackets are very large. In order to avoid connections which would put the rivets under tensile stress, the ties, composed of two 15 x ⅞-in. plates, stiffened by two angles with tie plates, are spread far enough to pass the top flange angles of the cross-girders and allow the connection to be made

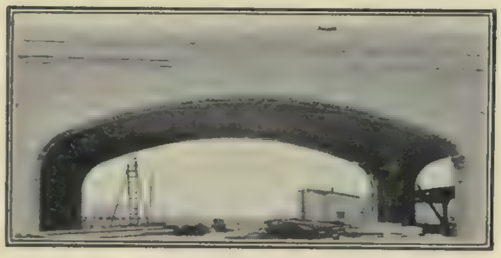
EFFECTIVE ORNAMENTAL DETAILS USED AT STATION

by a diaphragm to the web of the girder, as shown.

At the 90-ft. mezzanine span of the station construction, where steel beams are used in the track floor and in the mezzanine floor, it was necessary to transfer the horizontal thrust from the adjacent arch spans by means of two horizontal steel plate girders at the level of the floors, with a grillage of vertical 20-in. I-beams between them. The expansion details at the station were complicated, and were generally designed to bring the expansion point at the edge of a panel where it would not be noticeable.

SURFACE FINISH—CONSTRUCTION JOINTS

Treatment given the concrete after the forms were removed resulted in a striking contrast produced by the light band around the sunken panels containing colored tile. These bands were finished by rubbing the concrete with carborundum brick. A 6-in. margin around the other panels is axe-finished in parallel lines, and the concrete inside the panel is given an attractive finish by removing the exterior mortar by pointed tools in air hammers. On the outside wall the panels are inlaid with green and yellow tile to give an effective mosaic border.



AS ARCH APPEARS BEFORE TREATMENT

The construction was begun July, 1913, but the first arch was not poured until June, 1914. Construction joints were located as shown on the drawing by dash lines. The wooden forms for the arches consisted of lagging supported upon transverse instead of longitudinal bents, since the transverse curvature is uniform for all spans and the bents could be used for the various spans simply by spacing them longitudinally as required. Concrete was handled in side-dump cars and 1-yd. bottom-dump buckets.

The work has been designed and executed as part of the city-built elevated lines covered by the dual-system contracts, under the general supervision of engineers of the New York Public Service Commission for the First District, of which Alfred Craven is chief engineer; Robert Ridgway, engineer of subway construction; D. L. Turner, deputy engineer of subway construction; Sverre Dahm, principal assistant engineer; A. I. Raisman, senior designing engineer, and Maurice E. Griest, assistant designing engineer. John H. Myers was division engineer and Robert H. Jacobs was senior assistant division engineer. Squire J. Vickers, designing architect, supervised the architectural treatment, and Noble & Woodard acted as consulting engineers. The contractor was the E. E. Smith Contracting Company, of New York City.

Appalachian Petroleum Production

The output of petroleum in the Appalachian field, which includes New York, Pennsylvania, West Virginia, Kentucky and southeastern Ohio, was 22,860,048 bbl. in 1915, a decrease of 1,241,000 bbl., or 5 per cent from the output of this field in 1914.

Bridge Damage Heavy in West Virginia Flood

Every County Structure Over Cabin Creek Swept Away—Chesapeake & Ohio Loss Estimated at $500,000

LACK of rain and river gages makes it impossible to state accurately the amount of precipitation which resulted in the flooding of the Cabin Creek district in West Virginia, as reported in the Engineering Record last week, page 244. The division of sanitary engineering of the State Department of Health, however, has detailed a corps of engineers to inquire of people who had wash tubs, barrels, etc., out in the rain as to the length of time taken for these containers to fill. Director Mayo Tolman, who is in charge of the work of collecting the flood data, has sent to the Engineering Record the following information about the storm damage:

"I am informed by people living on the headwaters of various streams that the storm was not a cloudburst, but an extremely heavy, continuous rain. I am told that the rain fell practically all day Tuesday, Aug. 8, and that the rain started again between 2 and 3 o'clock on the morning of Aug. 9 and continued as a terrific downpour until late the next morning. It should be noted that it was more a rush of water than a gradual rise. A number of people on Cabin Creek have stated that the water advanced as a fairly heavy wave.

"The storm evidently passed southeastward from Horse Creek on Coal River through Nelson and Kayford. At MacCorkle, on Coal River, a private gage registered 50 ft. This gage is set at 1 ft. below low water. By far the greatest property damage was done on Cabin Creek. I am informed by an official of the Chesapeake & Ohio Railway that the damage to that company's property alone will not be less than $350,000, and probably will mount up to $500,000. Heavy girders of 40 and 50-ft. spans were at some points carried over 100 yd. downstream.

BRIDGES FAIL BY SCOUR

"Apparently all the bridges failed by scour taking place under the downstream end of the piers. In some cases, however, the water swept out the fills back of the bridge abutments, and these abutments were forced over backward by the pressure of water or by masses of timber striking them, with the result that the girders dropped into the stream. The girders of a bridge above Sandy City have entirely disappeared; they probably are buried in the sand not far away. At many points only a corner or an edge of a heavy coal car can be seen above the sand. On Cabin Creek alone seventeen fair-sized railroad bridges were swept away. Not a single county road bridge in the entire length of the creek remains. In a great many places the alignment of the streams has been entirely changed. One or two railroad bridges remain standing, but these now span dry ground.

RAINFALL RECORDS

"The only records I have of rainfall at the present time are three—one at Carbon, on Cabin Creek, where an ordinary No. 2 galvanized iron washtub was filled in 20 minutes; at Eskdale the same sized washtub was filled in 40 minutes, and at Sang Creek the water rose 10 in. in an ordinary 31½-gal. barrel. At Eskdale I have one measurement showing that the water rose at least 34 ft. 4 in. above normal.

"The division of sanitary engineering of the West Virginia State Department of Health has established headquarters in the partly ruined Y. M. C. A. Building at Eskdale. From that point we are distributing antityphoid vaccine, chloride of lime and lime throughout the valley of the three rivers. The first day we inoculated 1126, and I estimate that 5000 will be immunized. We are disinfecting all wells with chloride of lime in order to insure the people safe drinking water. As soon as we disinfect a well it is posted with a sign stating, 'This well probably safe for drinking.'"

18 Miles of California Road Surfaced in 24 Days

RECENT improvements in methods and equipment for applying road oil to paved surfaces have made it possible to carry out the work so rapidly that the problem of delivering a sufficient quantity of hot oil at remote points on the highway has become an important factor in work on the California highway system. When the oil was applied from horse-drawn vehicles the application of 1500 gal. of heavy road oil per day was considered good work, but this bogy has been steadily increased, and during the present season 18 miles of paved surface were treated with a double application of oil in 24 working days. This work required six cars of oil, or an average daily delivery of about 3000 gal.

One of the motor trucks carries enough oil to cover about half a mile of road, so that on short hauls it is essential to the efficient progress of the work that ample provision is made in advance for the rapid covering of large areas with screenings. By the use of storage tanks along the road and the use of motor trucks for delivery it has been possible to carry out this work very rapidly. The cost of the finished job is influenced by the way in which the quantity of material was estimated, as well as in the method of delivery.

The careful and accurate dumping of the screenings, so that no material must be picked up after work is finished, makes for considerable cost reductions, and careful attention has been given to this detail. On a recent job near Fresno, by giving detailed instructions to truck drivers, the actual delivery of screenings varied from the computed requirements by less than one-half of 1 per cent.

Resident Engineers on Drainage Work Must Take Pictures

Each of the six resident engineers on the Little River Drainage District of Missouri is required to furnish as part of his own equipment a camera taking postcard size pictures. All monthly estimates must be accompanied by at least two photographs, typical views illustrating the character of the work accomplished. Where defective work is encountered and excepted to, views must be taken and submitted to the chief engineer, William A. O'Brien. In the office the photographs are mounted in a large loose-leaf book, eight prints on a page. They are arranged according to contracts and form a complete visual record of construction work on this half-million-acre project.

Long-Span Concrete Arched Bents Support Roof of Chicago Hebrew Institute

Theory of Analysis and Formulas for This Indeterminate Problem Given—Economy Results from Preliminary Designing of Forms

UNUSUALLY careful methods were applied in the design of both the main arched bents and the timber forms used in the construction of the new Hebrew Institute building in Chicago. By an analysis based upon the method of least work general formulas for arched bents have been developed and applied to this building. Formulas which neglect the variation in moment of inertia and formulas which include it are here given, and the effect in this particular case of neglecting variable sections is determined.

It is claimed that a notable economy resulted from the use of monolithic construction for columns and roof arches and from the careful preliminary design of the forms. Cantilever brackets that carry an 8-ft. running gallery and are tied into the main columns or carried by short columns below the gallery level are illustrated in detail.

General Dimensions

The architectural requirements of the Hebrew Institute building were quite unusual. A high-arched roof and a needed clearance of 36 ft. above the main gymnasium floor made economical the use of reinforced-concrete arched bents of monolithic construction. These bents are spaced 16 ft. apart, with ten panels in the main body of the building, which is 160 ft. long and 98 ft. wide. The total length, including front and rear entrances, is 231 ft., and the total height above the ground floor is 52 ft., the footings extending about 5 ft. below it. The clear span of the arched roof over the high part of the building is 62 ft. 8 in., while a two-story section 16 ft. wide flanks the gymnasium on each side. In the rear of the building are two swimming pools of reinforced concrete, about 25 x 60 ft. in plan and 7 ft. deep.

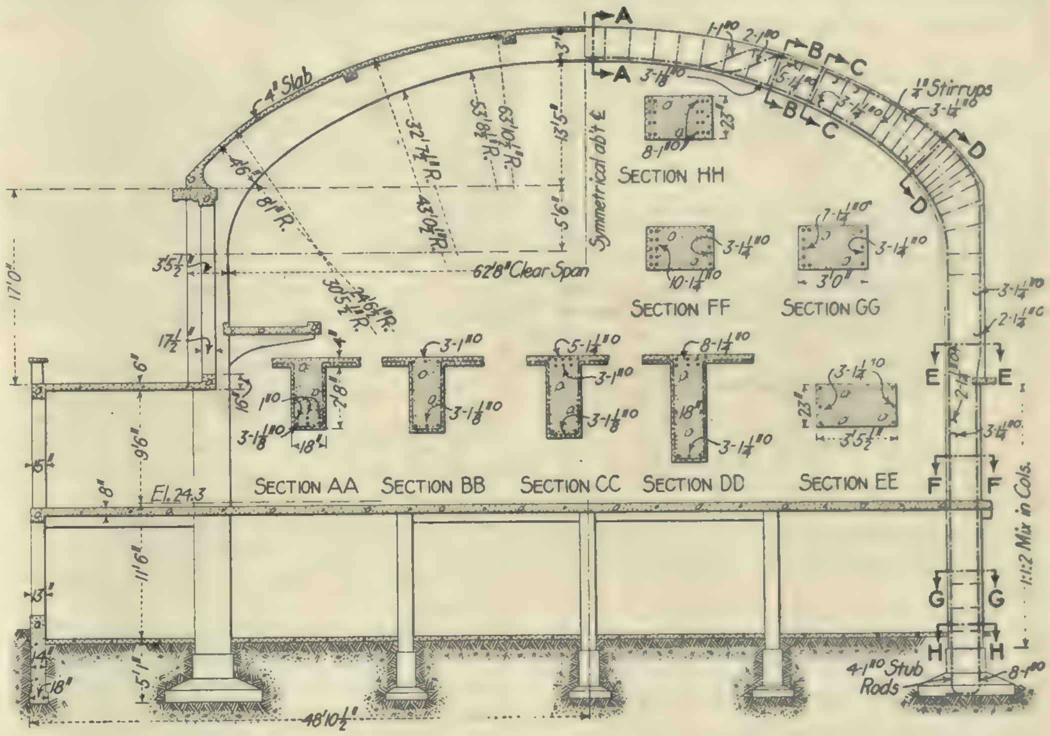
Cantilever brackets 15 ft. above the main floor of the gymnasium support the 7-in. slab of the running-track gallery. This slab, the roof slab of the two-story part and the 8-in. slab on the main floor act as struts to brace the main column and reduce the unsupported length.

Arch Analysis by Least-Work Method

The design of the arched bents supporting the roof beams and the slabs was made on the assumption that the columns are fixed-ended at the level of the gymnasium floor. A first analysis was made on the further assumption that the moment of inertia is constant throughout the length of the arch (I_1) and also constant for the columns (I). A second analysis to include the effect of variation in section for the columns and the arch was made and new formulas were developed. The relatively slight effect of the variation in section is indicated in the accompanying table, in which are given the principal moments and the thrust moment (Th) for each case, in terms of wl^2.

Bending Moment Coefficients for wl^2

	Constant Moment of Inertia	Variable Moment of Inertia
Bending moment M_a at A....	0.0443	0.0392
Bending moment M_b at B....	0.0556	0.0564
Bending moment M_c at C....	0.0198	0.0208
Thrust moment Th at B......	0.1000	0.0956



HALF-SECTION OF MAIN GYMNASIUM SHOWS ARCH AND COLUMN REINFORCEMENT

These values were derived as follows:

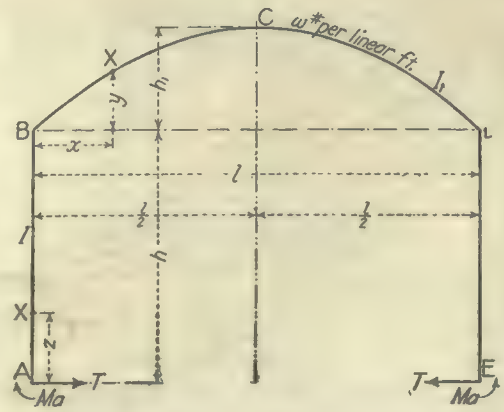
Consider the typical arched bent shown in the accompanying diagram, with the notation there given. Such a structure is, in general, indeterminate to the third degree. Assume a uniform load, w lb. load per foot, over the entire roof. On account of symmetry, the vertical reactions at A and E must be of the same magnitude, and equal to one-half of the total dead and live loads. Hence there remain two unknown quantities, the thrust T and the moment M_a, which can be obtained by the theory of least work, neglecting the small influence of the shortening of the arch. Using a parabolic arch center line, the equation of the arch with respect to an origin at B is

$$y = \frac{4h_1}{l^2}\ (lx - x^2)$$

Calling M the moment at any point X of the column or arch, and W the work done in bending only, neglecting the effect of direct thrust, there can be written:

For the column

$$M = M_a - Tz$$



OUTLINE DIAGRAM OF ARCHED BENTS

For the arch

$$M = M_a + \frac{w}{2}\ (lx - x^2) - T(h + y)$$

For work done, in general,

$$W = \int_A^E \frac{M^2 ds}{2EI}$$

Or, from symmetry,

$$W = 2\int_A^C \frac{M^2 ds}{2EI}$$

Applying the theory of least work:

$$\frac{dW}{dT} = 2\int_A^C \frac{M}{EI}\frac{dM}{dT}\ ds = 0 \qquad (1)$$

$$\frac{dW}{dM_a} = 2\int_A^C \frac{M}{EI}\frac{dM}{dM_a}\ ds = 0 \qquad (2)$$

Considering first the terms in equation 1, for the column AB:

$$\frac{dM}{dT} = -z$$

For the half arch BC:

$$\frac{dM}{dT} = -(h + y)$$

Substituting these values in equation 1 and integrating, after assuming ds equal to dz for the column and equal to dx for the arch, collecting terms and assuming that

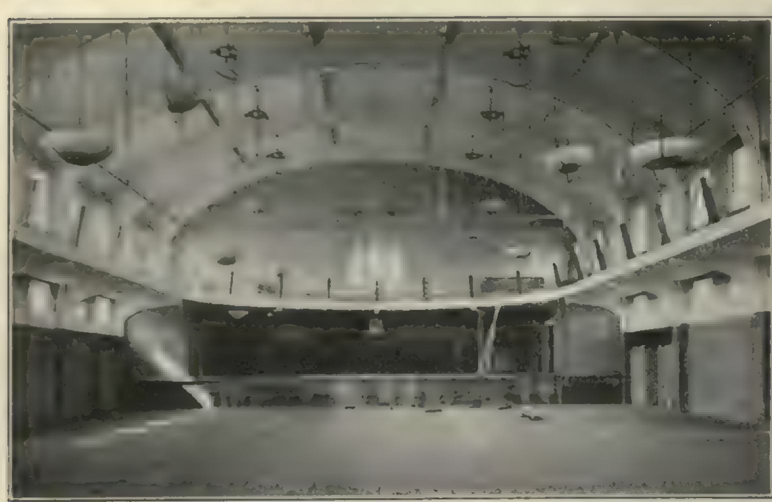
$$\frac{hI_1}{lI} = n \text{ and } \frac{h_1}{h} = n_1$$

there is obtained:

$$M_a\left(1 + \frac{2}{3}n_1 + n\right) - Th\left(1 + \frac{4}{3}n_1 + \frac{8}{15}n_1^2 + \frac{2}{3}n\right) = -\frac{wl^2}{12}\left(1 + \frac{4}{5}n_1\right) \qquad (3)$$

Similarly, differentiating and substituting for the terms in equation 2, noting that for both the column AB and the half arch BC

$$\frac{dM}{dM_a} = 1$$



INTERIOR VIEW OF MAIN GYMNASIUM SHOWS ARCHED BENTS

ERECTING SPECIALLY DESIGNED FORMS FOR ARCHED BENTS

there is obtained:

$$M_a(1+2n) - Th\left(1+\frac{2}{3}n_1+n\right) = -\frac{wl^2}{12} \qquad (4)$$

Applying these equations to the arched bents over the main gymnasium of the Chicago Hebrew Institute there is found that n_1 is approximately 0.5 and n is approximately 0.2. Substituting these values in equations 3 and 4:

$$1.533\,M_a - 1.933\,Th = -1.4\,\frac{wl^2}{12}$$

$$1.4\,M_a - 1.533\,Th = -\frac{wl^2}{12}$$

Solving, there is obtained:

$$Th = 0.1000wl^2 \text{ and } M_a = 0.0443wl^2$$

At the point B the bending moment is therefore

$$M_b = Th - M_a = 0.0556wl^2$$

and at the crown C the bending moment is:

$$M_c = M_a - \frac{wl^2}{8} - T\,(h+h_1) = 0.0193wl^2$$

When the variable moment of inertia was included in the analysis for this case, equations 3 and 4 reduced to the following:

$$M_a\,(1+0.75n_1+1.69n) - Th\,(1+1.5n_1+0.633n_1^2+1.0625n) = -\frac{3}{32}\,wl^2\,(1+0.845n_1)$$

and

$$M_a\,(1+3.75n_1) - Th\,(1+0.75n_1+1.69n) = -\frac{3}{32}\,wl^2$$

These equations are based upon the same values for I and I_1 as before. Substituting $n_1 = 0.5$ and $n = 0.2$, and reducing, the values given in the table are found.

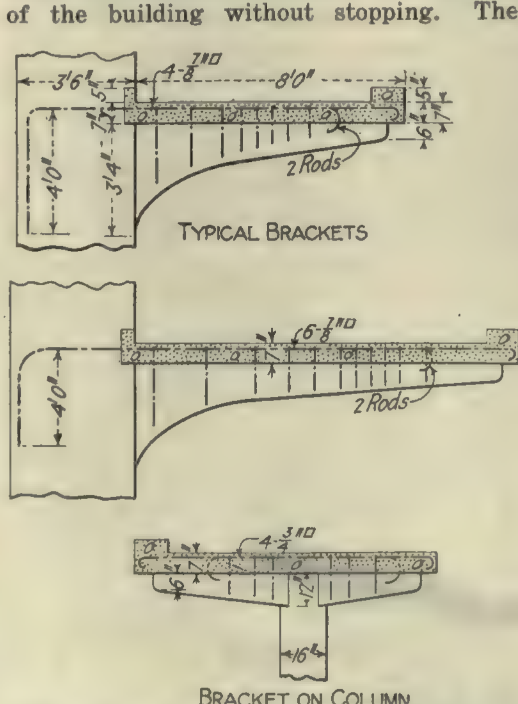
The arches were computed for an arch load of 2200 lb. per linear foot. As the loading upon the cantilever brackets supporting the running track tends to reduce the bending in the main columns, it was not considered in the analysis. The arch thrust T at the base of the column is resisted by four 1-in. round rods with 12-in. end hooks around the column steel and spliced by 4-ft. laps with similar end hooks.

Owing to the high stresses in the lower part of the column and the smaller size necessary for architectural purposes, a 1:1:2 mix was used below elevation 34 ft. 4 in., while the regular 1:2:4 mix was used above this level and for the arches. The manner of detailing the reinforcing steel in the columns and arches by hooked ends is worthy of special note.

All framework was carefully detailed beforehand and all forms were made on a platform on the ground and then erected into place, making possible a large saving in labor and in the total amount of lumber required in the forms. Almost without exception the form details called for mill lumber sized to width, obviating the usual necessity of ripping the lumber to fit the forms. Formwork was given such importance that there were many instances in which the amount of concrete was increased in order to save in forms.

A series of cleats which received battens for the forms were placed on the special platform so that the entire form could rest on an absolutely flat surface. The lumber was then laid down and a template placed over it and the form lumber marked and sawed to the required shape. Each longitudinal half of an arch form was built in a single piece, then cut in two, raised and set in place.

The bottom of the arch form was built up of three layers of ½-in. lumber for the circles of small radius and single pieces of 1-in. lumber for the circles of larger radius sprung into place. Battens in the columns and arches were spaced uniformly throughout, so that duplication of the formwork could be carried out with great rapidity. Due to the speed with which the work was being prosecuted, no forms were used twice. Instead, as many forms as possible were set up so that when pouring was started it could be continued throughout that portion of the building without stopping. The forms for the brackets supporting the running track were constructed with sheet metal bottoms to insure a smooth, even surface and to avoid expensive carpenter labor. In building the forms for columns and girders, 1-in. quarter-rounds were used at the corners to give a finished appearance.



THREE TYPES OF CANTILEVER BRACKETS SUPPORT RUNNING-TRACK SLAB

One of the arched bents was tested by applying twice the live load used in the design over one-half of the span. The resulting deflections and deformations were so small that they could not be measured, certainly less than 1/16 in.

The designer and contractor was L. J. Mensch, of Chicago, who furnished the foregoing design data. A. W. Bee was assistant engineer for the contractor. The architects were Ottenheimer, Stern & Reichert of Chicago.

Bitumen-Testing Needles with Constant Friction

Some Designs Proposed Will Not Correctly Indicate the True Comparative Consistency of the Material

By SAMUEL WHINERY
Consulting Engineer, New York City

[*The author points out that certain proposed designs of needles for determining the penetration of bitumen and bituminous compounds displace varying volumes and have a variable frictional resistance at different depths of penetration. Therefore they give inconsistent comparative results. He proposes two designs which overcome the difficulties.*—EDITOR.]

A SUBCOMMITTEE of the American Society for Testing Materials, on penetration, in its report for 1915 recommended for standard use a parabolic needle having certain characteristics (*Proceedings* A. S. T. M., 1915). Recently Charles S. Reeves, chemist, and Fred P. Pritchard, assistant chemist, of the Office of Public Roads and Rural Engineering, Department of Agriculture, Washington, have recommended the use of a conical needle having a taper extending ¼ in. from the point (*Journal of Agricultural Research*, Washington, March 13, 1916). I think it may be worth while to call attention to the fact that the relative depth of penetration into bitumens of different hardness by either of these needles will not correctly indicate the true comparative consistency of the materials, though such needles may be used successfully to duplicate the consistency of a standard sample.

While the work done by a penetration

needle is as the product of the weight applied and the depth of penetration, the *consistency* of a bitumen is measured by the *resistance* of the material to the progress of the needle. This resistance is made up of two elements—one measured by the force required to displace, or cause to flow, a volume of bitumen equal to the submerged volume of the needle, and the other by that required to overcome the adhesion or friction between the bitumen and the submerged surface of the needle.

Neglecting the element of friction, we may say that the work required to cause a quantity of bitumen to flow is inversely as the consistency or hardness of the material and directly as the quantity and distance moved. The last-named factor is difficult to determine accurately, and for present purposes we may ignore it and safely say that the resistance is at least in inverse ratio to the volume of bitumen displaced by the needle.

FIGS. 1 AND 2

With a cylindrical needle the resisting work thus done would obviously be (disregarding friction) directly as the depth of penetration. But this is not true of parabolic or conical needles, because with these the volume of bitumen displaced increases as the square of the diameter of the needle at the surface of the bitumen multiplied by the depth of penetration.

To illustrate: Assume that a conical needle is used such that at a given distance from the point its diameter is 1, and that at twice that distance from the point the diameter is $1\frac{1}{2}$. If with this needle it is found that the depth of penetration, with like units of weight and time, of one sample is 60 and of another sample is 30, it would be erroneous to assert that the second sample is just twice as hard as the first. For it may readily be computed that the quantity of bitumen displaced in the two cases is in the ratio of 4.5:1; but the work applied (being the weight applied multiplied by the depth of penetration) is, in the two cases respectively as 2:1. It appears therefore that comparing these two samples, while twice as much work was expended upon the first, 4.5 times as much bitumen was displaced; or, in other words, their true relative hardness is as 1:2.25.

It is true that such a needle is of steeper taper than those in common use, but the principle holds good with conical or parabolic needles whatever may be their dimensions.

RESULTS NOT PROPORTIONAL

A necessary corollary is that continuous penetration with such needles during equal increments of time will give different (decreasing) results for each period of time, as experiment has shown.

It is almost certain, though not so easily demonstrated, that with such needles the element of friction increases in a ratio greater than the depth of penetration, which would add still further to the error of assuming that consistency varies directly as the depth of penetration.

Some twenty years ago I designed and used a penetration needle intended to obviate the erroneous results pointed out in the foregoing. It has a spherical head or point and a shank of smaller diameter than the head, to avoid contact and friction with the walls of the cavity in the penetrated bitumen. This needle is shown on an exaggerated scale in Fig. 1. A modified form illustrated in Fig. 2 would doubtless give equally good results and would be more simple to make. In the use of either the enlarged head should be first submerged to its maximum diameter in the sample, as indicated in the sketches, and clamped there, to be released at the beginning of the penetration test.

It is apparent at a glance that the quantity of bitumen displaced in the test by this needle must be directly as the depth of penetration, and that the surface exposed to contact in the bitumen will be equal in area, and the friction a constant quantity at different depths of penetration.

It is not to be expected that scientifically accurate results can be attained by any such apparatus, particularly where the time factor is determined by the observation of the operator and more or less affected by his personal equation; but there is no reason why the apparatus used should not be designed in accordance with sound principleh so that results shall be theoretically correct.

TIMING DEVICE

In connection with the use of the needle described I designed and experimented with an electrical device for automatically controlling the time element in penetration tests, using a make-and-break attachment to the seconds hand of a clock which, by means of a magnet clamp, released and reclamped the needle, thus accurately controlling the time of penetration; but the stress of business prevented me from developing the device fully. I believe a device of this kind is very necessary for a satisfactory penetration apparatus.

Attention is again called to the matter in the hope that those now actively engaged in the study and use of bituminous materials may design and adopt standard penetration apparatus and methods that shall be free, in theory at least, from avoidable errors.

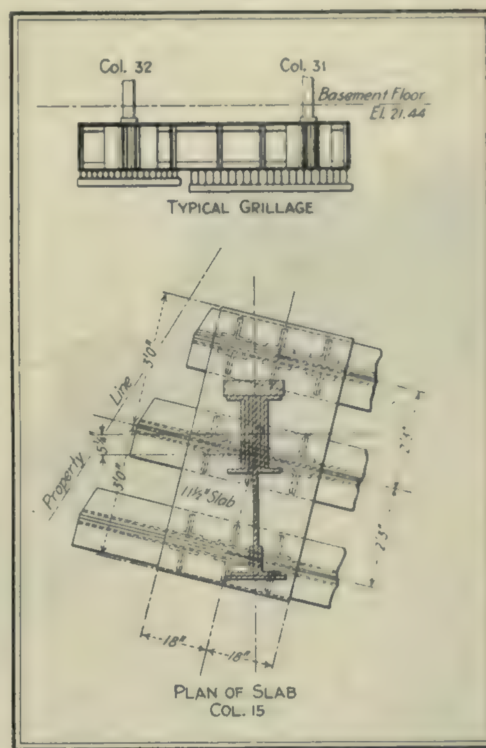
Irrigability of Lands

Secretary of the Interior Lane announces that during June more than 900,000 acres were designated as nonirrigable and rendered subject to entry under the provisions of the enlarged-homestead act.

Steel Girders and Concrete Struts for Foundations

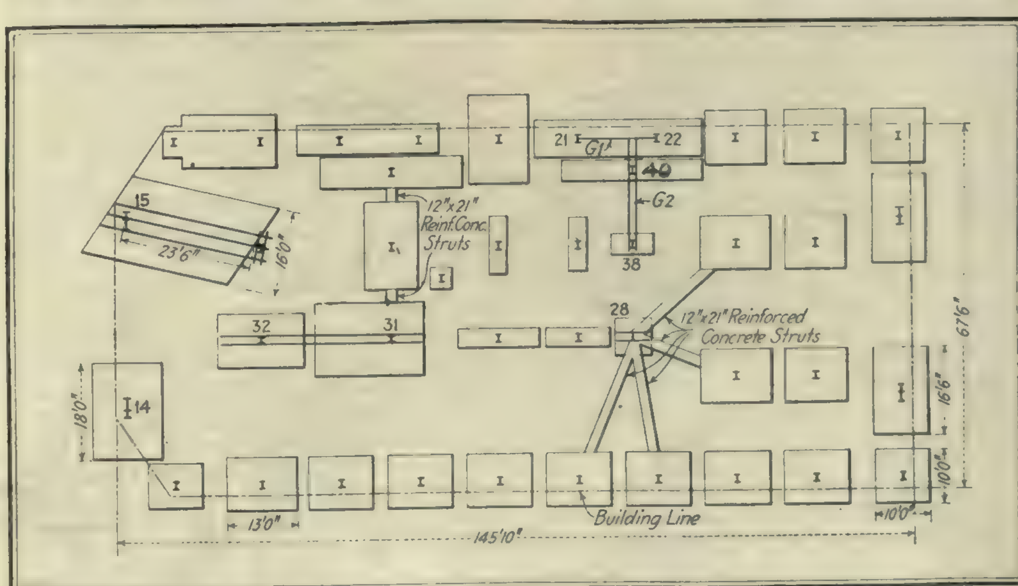
Bell Parkway Building, Philadelphia, Required Special Provisions in Substructure to Resist Wind Pressure and Uplift

SUPPLEMENTING the article describing the general layout, the architectural features and the steel-frame design of the Bell Parkway Building, Philadelphia, in the Engineering Record of May 27, page 712, the special foundation details here treated include the soil test to determine the allowable pressure, the built-up steel girders used to provide against wind uplift and the reinforced-concrete struts between column foundations to distribute the wind pressures.



GIRDER AND I-BEAM GRILLAGES

In general, the main columns are supported by steel slabs resting upon built-up steel grillage girders, which in turn are carried by rolled I-beam grillages, the whole incased in concrete. A 12-in. slab of concrete reinforced by ⅜-in. twisted rods on 12-in. centers supports the I-beam grillage. Owing to the presence of moving ground water, 10 per cent of hydrated lime was



GENERAL PLAN OF COLUMN FOUNDATIONS FOR BELL PARKWAY BUILDING

added for the purpose of making the concrete protection of the columns waterproof.

The bearing soil at the site consists of a compact mixture of sand and gravel cemented together with a little clay, the gravel varying in size from pebbles up to one-man stone. This soil was tested to a total load of 9 tons per square foot, with a maximum settlement of less than 1/4 in. for the last 7 tons, water being present when the test was made. There was practically no settlement in 23 hr. under 6 to 7 1/2 tons standing load, and approximately only 1/64 in. settlement in 24 hr. under 9 tons standing load. The load was applied to a 4 x 4-ft. platform on a 12 x 12-in. post set in a pit about 2 ft. below the bottom of the column-footing level. Water from upper strata was flowing in a ditch in the excavation, and several times during the test the pumps stopped and water rose 6 in. above the bottom of the column-footing level.

Based upon the test, an allowable soil pressure of 6 tons per square foot was used in the design of the foundation for dead and live floor loads, with a 30-per cent allowable overload from wind.

As indicated on the accompanying grillage plan, a steel double girder, G2, was designed to connect columns 38 and 40, cantilevering across the latter and passing about 2 in. below girder G1 connecting columns 21 and 22. This cantilever girder was required to take care of the possible 790,000-lb. net uplift due to wind pressure as resisted by the bracing between columns 28 and 38 and 40. This uplift was transferred to girder G1 by steel shim plates between the two girders and resisted by the ample loading on columns 21 and 22. It was considered best not to detail a rigid connection between the two girders.

A second unusual element in the foundation layout is seen in the use of concrete struts connecting various column foundations. These struts are all 12 x 21 in., reinforced by four 1-in. rods. They are provided for the purpose of distributing the lateral wind pressures brought to the foundations by the columns in the braced bays to adjacent column foundations.

Upstream Face of a Rockfill Dam Sealed with a Sliding Concrete Apron

Strawberry Dam Built with a Concave Face Covered by Concrete Slabs Without Bond—300,000 Cubic Yards of Rock Handled on Radial System of Aerial Cables

ON THE SOUTH FORK of the Stanislaus River in central California the Sierra & San Francisco Power Company is building what is known as the Strawberry Rockfill Dam, which is the second in a series of five storage dams contemplated in a progressive construction program for developing the hydraulic power of the South and Middle Forks of this river. Water stored by this dam will be used in a generating station to be built on the Middle Fork at a point which is 18 miles above a 40,000-kw. hydroelectric plant which the company already has in operation. Thus water stored on the South Fork in addition to its use in the upper plant will be available for the lower power house under a total head of 3300 ft.

DROPPING A 5-TON ROCK—BUMPER CLAMPED TO CABLE AT DESIRED POINT RELEASES LOAD AUTOMATICALLY

The dam is being constructed as a rockfill with a concrete cutoff wall and watertight facing on the upstream side. The rockfill will have a maximum height of 140 ft. above the river bed, while the concrete cutoff wall has been carried down to bedrock 33 ft. below the river bed. The width of the dam at the base in an up and down stream direction will be about 350 ft. In plan the dam is curved on a radius of 1880 ft., the structure being 612 ft. long on its crest. In addition to this curvature in the horizontal plane, the upstream face of the dam has been given a slight concave curve, as shown in the drawing, instead of the usual plane surface. This is expected to afford greater stability to the upstream face of the rockfill.

In laying out the construction plant it was decided to secure the granite of which the entire fill consists from seven quarries which were located on the banks of the cañon, in most cases above the level at which the rock would be deposited in the fill.

In order to convey this rock economically from quarry to fill, it was decided to deliver it by means of cables strung over the dam site, all centering at a point over the fill and terminating at the other end on the sidehill above each of the quarry sites. Accordingly a steel disk, 3/4 in. thick and 48 in. in diameter, called the spider, was used as a hub or central terminus for the cables over the center of the site. The spider is held in place by the cables assisted by six 1 1/4-in. plowshare steel guy cables. These six guys radiate from the spider in such directions as to give the greatest stability to the spider, and are anchored against unequal tendencies from the load lines, anchorage being made to U-bolts grouted into rock in the hillsides. In addition to these guy cables and the seven carrier cables from the quarries, there are also provided one or more anchor cables leading from the spider directly down into the bed of the stream to prevent the rebound of the spider, which would otherwise result when skip loads of rock are suddenly released.

A carrier of original design was developed which makes it possible to hoist, trip and retrieve the rock skips with a single operating cable. The skip is unloaded by means of a bumper, clamped to the cable at the point where it is desired to dump the load, which releases a trigger on the carrier and automatically trips the skip. After the carrier is drawn back to a position above the quarry another device clamped to the cable at this point is so arranged that the carrier is automatically latched in position while the skip is lowered into the quarry or raised again to the carrier by simply operating the one cable. The latch is automatically released when the skip is raised to the carrier, and the carrier with its load is then allowed to slide down the line by gravity, subject to check by the single cable, until the bumper is struck.

The location of the bumpers for releasing loads can be changed readily by loosening

the clamp and sliding the bumper along to a new position. The exact location of the spider, which is always the lowest point in the cable system, is changed by lengthening or shortening the several cables, and with these two adjustments it has been found possible to dump rock directly onto all parts of the fill. The carriers on each cable are operated by 6¼ x 10-in. hoisting engines driven by compressed air at 110 lb. per square inch. On account of the numerous rock-drill equipments installed in the several quarries it was thought best to operate all plants by compressed air, and a $30,000 air-compressor equipment was accordingly installed for construction purposes.

The entire operating force engaged in handling rock consists usually of 15 men to each carrier cable. This includes quarry crew, powder monkeys, engineer, foreman, etc. With seven quarries operating, an average of about 1000 cu. yd. of rock per 10-hr. day is handled continuously, the monthly average being from 29,000 to 33,000 cu. yd. The total amount of rock in the completed structure will be about 400,000 cu. yd., of which 300,000 cu. yd. is being deposited by the cableway system. The maximum delivery distance from quarry to spider is about 800 ft.

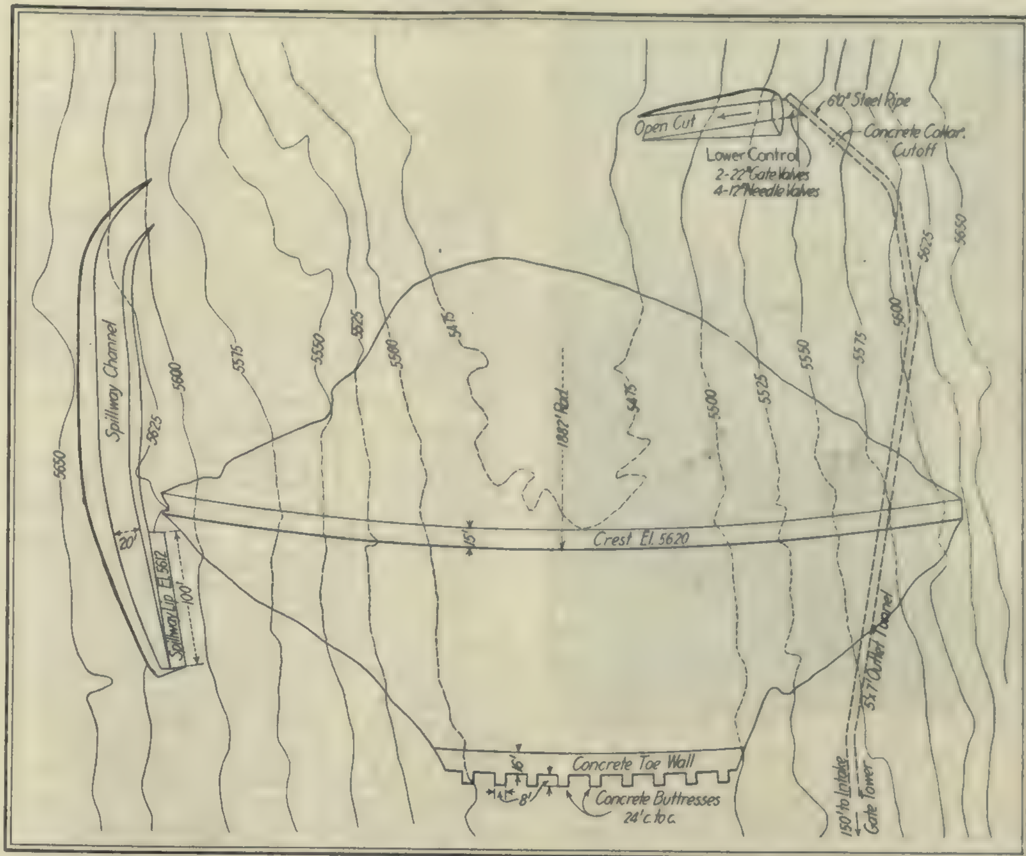
SLIDING WATERTIGHT APRON

The upstream face of the fill is being finished off with a dry masonry wall, as shown in one of the illustrations. Italian and Greek artisans who have become skilled in the work in their native countries are used in building the wall, and it has been found possible to make good progress while limiting the maximum depression or projection to less than 3 in. from the theoretical face of the curved surface as determined by instrument. This becomes even more notable when it is stated that the rock units used in the wall vary from 3 to 5 tons in weight and are placed by derrick. Each rock is wedged tightly between those adjoining with spalls and rock wedges and carried back from the face of the rockfill so that the dry masonry wall is an integral part of the fill itself.

On this dry masonry wall, which affords a comparatively smooth, solid surface, a 3-in. paving of cement mortar is placed, which gives an almost perfectly true surface. Over this mortar surface a ½-ply layer of Malthoid roofing is laid, and the face of the structure is then ready for the sliding concrete apron.

In designing the apron for the dam, settlement of the loose fill and movement of the apron caused by temperature changes are anticipated. Accordingly it was decided to use a reinforced-concrete apron on the upstream face, cast and bonded directly to the rock face for the lower 50 ft. of the dam, but free to move on the face of the dam proper as the latter shifted in course of settlement or from temperature stresses. This apron is being cast in 60-ft. widths, which abut against, and make watertight joints with, concrete ribs that project from the dam proper at 60-ft. intervals.

The sliding apron is 18 in. in thickness from the toe wall up to El. 5530, the beginning of the sliding plane. At this elevation the 18-in. thickness is split into a 3-in. plastered section and a 15-in. sliding apron. Above this point the apron thickness steadily decreases to 9 in. at the crest. The reinforcement of the apron consists of vertical and horizontal reinforcing bars. The vertical reinforcement in the lower third of the apron consists of 1-in. square



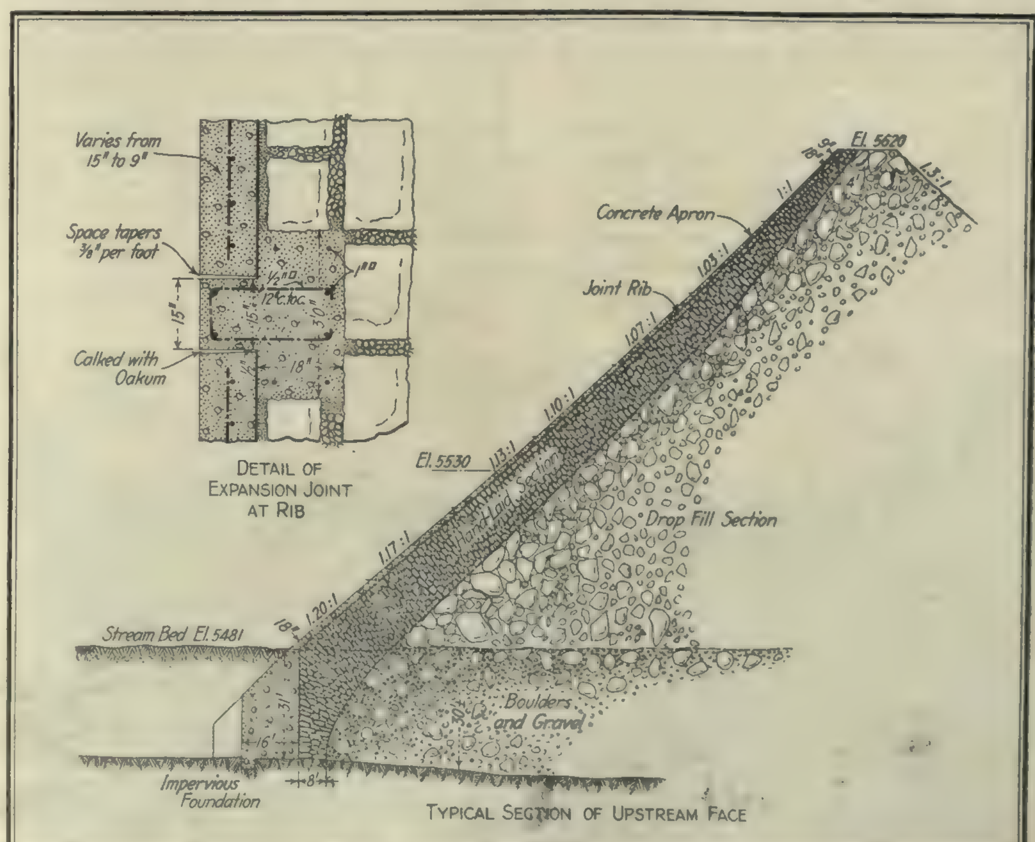
PLAN OF STRAWBERRY ROCKFILL DAM AND POSITION OF CONCRETE TOE WALL

deformed bars spaced on 9-in. centers, while in the upper two-thirds the size is reduced to ¾-in. square bars on 9-in. centers.

Water for power purposes passes from the reservoir through a 5 x 7-ft. outlet tunnel driven through solid granite at one end of the dam. The upper end of this tunnel is surmounted by a concrete tower in whose walls are located six 30-in. sluice gates operated from the top of the tower. At the lower end of the tunnel there is provided an auxiliary control composed of four needle valves and two gate valves.

The duplicate control systems at either end of the tunnel permit of repair work without the loss of the stored water. This arrangement of control units permits the use of one or both of the gate valves for fixed quantities of flow, while the more exact regulation is made possible by means of the needle valves, which can be used effectively for making slight changes in the quantity of flow. Delicate regulation is desirable owing to the great value of this water for power purposes through the total head of 3300 ft.

The spillway is not located on the dam proper, but is adjacent to one end of the



SECTIONAL VIEW OF UPSTREAM TOE OF DRY MASONRY WALL

SECTION OF UPSTREAM FACE OF DAM

structure where a discharge channel was excavated in solid rock. This channel was the location of three of the quarries from which rock from the dam was taken, so that its construction entailed no extra expense. The spillway lip, which is at a level 8 ft. below the top of the rockfill, is 100 ft. long and has a capacity four times the maximum recorded discharge from the drainage basin above the dam. The spillway is to be equipped for 3-ft. flashboards, which will bring the maximum high water level 5 ft. below the crest of the dam.

Designing and Construction Personnel

The dam is being built for the Sierra & San Francisco Power Company by Chadwick & Sykes, general contractors, who designed and patented the single-cable carrier. H. L. Livingston is superintendent for the contractors. Ford, Bacon & Davis, New York City, prepared the plans and estimates, and are general engineers for the power company. J. S. Maloney is superintendent for the power company and F. I. Doane is assistant engineer. The work is being carried out under the direction of H. F. Jackson, vice-president and general manager of the power company, under the immediate supervision of George W. Howson, in general charge of extensions of the power company's hydroelectric development.

RIBS, PART OF PLASTERED SURFACE AND FORMS FOR PORTION OF CONCRETE APRON

Washington Systematizes Subsurface Mapping

Municipal Department and Public Utilities Co-operate in Making Permanent Records of Underground Structures

By ASA E. PHILLIPS
Superintendent, Sewer Department, Washington, D. C.

THE interesting article in the Engineering Record of Dec. 25, 1915, page 792, entitled "Seattle Utilities Pay City for Subsurface Maps," furnishes a valuable addition to the meager published data on this important subject, as well as a new and somewhat radical point of view as to the means by which these useful and necessary municipal records are to be obtained. The contrast that is drawn between the means and methods at Seattle and the means and methods at Cincinnati, as detailed in the Engineering Record of Jan. 9, 1915, page 38, would probably require considerable modification were the local conditions in each case considered. As with most subjects of human interest, particularly those of an engineering nature, these local factors, both as to physical conditions and as to laws and regulations, usually differ so widely as to make fair comparisons of either work or methods hardly possible without complete local knowledge. Doubtless this was true in the case at hand.

Method of Financing Seattle Mapping Objectionable

But however this may be, at least from a point of view of broad application, it would certainly appear that the method of financing the Seattle mapping, as described in the above-mentioned article, is open to fundamental objection, while the statement that the city secures these maps "without costing the taxpayers anything" indicates such a departure from the principles that should govern civic administration as to invite at least the closest scrutiny. It is to be presumed that public utilities in Seattle as well as elsewhere are taxpayers, even as are individuals, and it is clearly unethical that these utilities should be required to furnish gratuitously to the municipality service maps showing the publicly owned functions. So that if such is the practice at Seattle, as this article appears rather triumphantly to indicate, the contrast with the method at Cincinnati of directly appropriating public funds for this work does not seem quite so commendatory nor so worthy of imitation as might at first appear.

For many years careful consideration has been given to the mapping of underground construction in the District of Columbia and very complete records are kept of all work of this character. It is about twenty years since the writer began the preparation of the first complete set of standard large-scale maps of the city of Washington, showing underground construction from actual field surveys. These maps were on sheets 22 x 30 in. to a scale of 1:600. About 200 sheets formed the original set of drainage and sewerage maps, after which sets of water and paving maps were subsequently prepared.

Within the past few years the writer has instituted the preparation of a much more elaborate set of maps on a scale of 1:120, plotted on similar sheets, each 22 x 30 in., to cover the more closely built-in area of the downtown section, required by the complicated subsurface construction of recent years. All this mapping is done from field measurements taken in great detail and recorded in loose-leaf field books. After plotting and checking the field sheets are filed for reference under a carefully co-ordinated card-index system.

What the Maps Show

These maps show all sewers, water mains, gas mains and power, telephone and telegraph conduits, as well as vaults, building projections, curbs and street-railway tracks. The underground construction is shown in soft tints of various colors, while building lines and projections, curbs, railway tracks and other surface work are shown by light india-ink lines. The general appearance of the sheets is artistic and attractive, without any sacrifice as to clearness and legibility. These maps are constructed on heavy mounted drawing paper of the best quality.

This represents what has been done in the way of primary maps. From the original set of 1:600 sewerage maps, tracings were prepared showing only building, curb and other surface lines, and from these photo-lithic reproductions on mounted drawing paper were obtained, one set of these ground maps for a complete record of gas mains, and sets for all telephone, telegraph and power conduits, the latter being shown in colors to indicate the construction of the several companies. Blueprints from these tracings, as well as prints from VanDyke negatives, have been exceedingly useful for special studies, as well as in connection with the underground surveys.

Scale of Maps

The system of 1:600 scale mapping has proved very satisfactory except for areas within the business or semi-business districts, where the 1:120 maps are a necessary feature. It has been found desirable, if not practically necessary, on maps of a scale 1:600 to confine the record to one character of construction if the best results are to be obtained.

Probably few cities in the country have so complex an installation of underground construction as Washington, where for many years all overhead wires have been prohibited by Congress. Some idea of the

extent of the mapping required may be obtained when one recalls that the area of the District of Columbia is very nearly 70 square miles, much of which is subdivided and partly built up.

For a number of years all the underground construction of the public service corporations in the District of Columbia has been under the charge of the writer, who has carefully organized this work. Accurate locations are fixed for each piece of construction on definite, predetermined lines, in advance of issuing permits for the work, and during its progress all construction is regularly inspected. Field locations and measurements are made immediately on completion of the work, from which record sheets are prepared showing the details of each construction, and the work is also plotted on the record maps in precisely the same manner as the publicly owned construction is recorded.

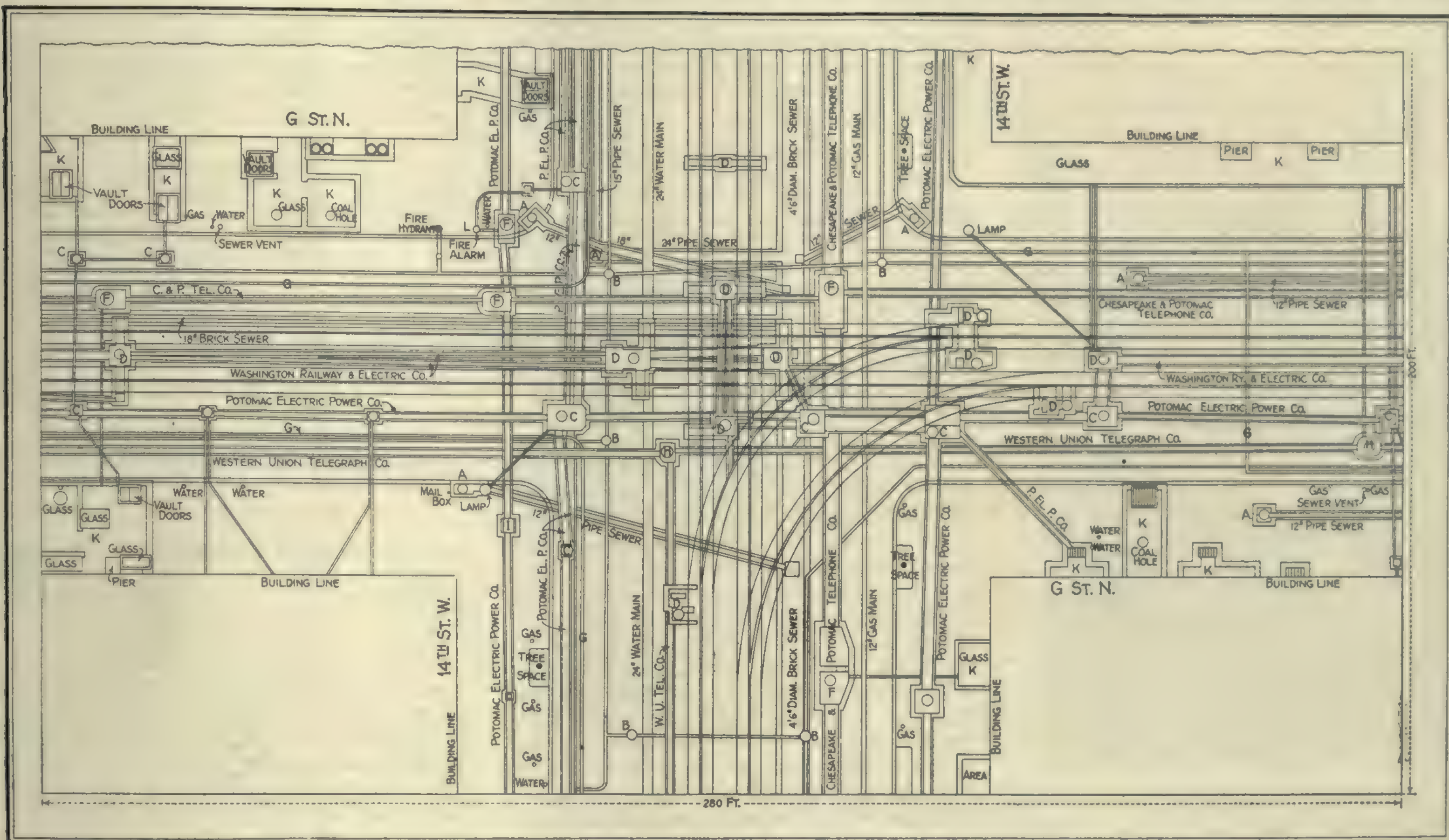
The cost of this supervision is charged to the public service companies, and is prorated among them in accordance with the actual amount of construction of each. A monthly statement is rendered to each corporation showing in detail the work done under each permit, giving location, etc., and the cost charged in each case. Detail accounts are kept and unit costs determined each month for each kind of construction.

Distribution of Costs

At the outset, in organizing this work, it was believed that these municipal records would prove a valuable asset to each corporation, fully justifying the expenditure involved, as well as being of great value to the municipality. So a plan was worked out equitably covering the distribution of costs, and the matter presented to the several companies, with the result that arrangements for the payment for the work were accomplished without difficulty by voluntary agreement.

This was in 1908, and to the present time there has been no complaint in a single instance, either as to matters of supervisory control or as to the costs charged for this work. On the contrary, the department has had at all times only courteous agreement, appreciative understanding and active assistance from the officials of the various companies in this rather difficult administration. At the same time strict consideration has been given to obtaining uniform and proper locations for the various underground structures without regard to questions of merely local or temporary expediency, such as would cheapen the immediate construction at the expense of permanency and good location, and always with a view to the greatest possible conservation of the public space. Equal consideration has been given to securing good construction and the proper handling of construction work. It is believed that the results thus far satisfactorily attained have been due to rigidly impartial treatment, to a spirit of reasonable fairness and the absence of arbitrary dictation, to an expeditious handling of the business so as not to delay work and, perhaps most of all, to a genuine spirit of helpfulness in meeting conditions and solving the various problems that have arisen.

Perhaps of all comparisons in engineering work that of costs is most misleading. Again we have the generally troublesome and complex local conditions to consider, while the inclusion or exclusion, in whole or in part, of administrative and overhead charges is sufficient to vitiate such comparison. To eliminate as far as practicable these disturbing factors it is to be understood in the foregoing table as to the cost of the Washington map work that all overhead is excluded as well as cost of equipment and materials used in the work, but that every item connected with the work which may be classified as labor is embraced in the figures.



THIS MAP FORMS THE STANDARD RECORD OF UNDERGROUND CONSTRUCTION IN WASHINGTON

The various subsurface lines are differentiated by colors as follows: A—Sewers, Vermilion; B—Water Mains, Blue; C—Potomac Electric Power Company, Carmine; D—Washington Railway & Electric Company, Carmine; E—Capital Traction Company, Violet; F—Chesapeake & Potomac Telephone Company, Green; G—Washington Gas Light Company, Brown; H—Western Union Telegraph Company, Orange; I—Postal Telegraph Cable Company, Orange; K—Private Vaults, Black; L—City Electric Conduits, Yellow.

Costs are given separately for (a) field work, including transportation; (b) ground map—that is, with all street, alley and curb lines plotted and inked ready for mapping the subsurface construction; and (c) finished map, which includes plotting and checking the underground, tinting, inking and lettering. These costs per sheet, both for the 1:600 and the 1:120 maps, with the maximum, minimum and mean in each case, are shown in the table.

As stated, the 1:600 maps show the sewerage system only, while the 1:120 maps show all the underground construction, as well as other features not shown on the former, and in addition show the structures in considerable detail, and cover only the most complex and difficult city areas. Reduced to a unit basis of ground areas mapped, the cost per acre for the 1:600 scale was 61 cents and for the 1:120 scale $37.82. The percentage of street area to total for the former is 45 per cent and for the latter 60 per cent.

COMPARATIVE COST OF MAPS

COST OF 1:600 MAPS	Maximum	Minimum	Mean
Field locations	$12.50	$2.80	$9.46
Ground map	16.10	1.40	4.22
Finished map	15.96	4.13	8.18
Complete map	36.80	9.22	21.88

COST OF 1:120 MAPS	Maximum	Minimum	Mean
Field locations	$39.20	$8.92	$21.00
Ground map	12.04	1.20	2.85
Finished map	41.34	6.86	23.27
Complete map	86.22	17.24	49.16

Diagrams for Cost of Placing Steel Reinforcement

Effect of Variable Weight per Foot Included to Eliminate Inaccuracy of Estimates Based Upon Costs per Ton

By DAN PATCH
Aberthaw Construction Company, Boston

ANOTHER application of graphical representation to the interpretation of data, in which the cost of placing reinforcement in concrete structures is put upon a much more accurate basis, is presented in the accompanying diagrams. Labor cost in placing steel is usually rated in dollars per ton, although it is recognized that such unit costs increase when light steel is being placed. In order properly to include the effect of size of rods, a graphical method based on weight per running foot of steel has been devised.

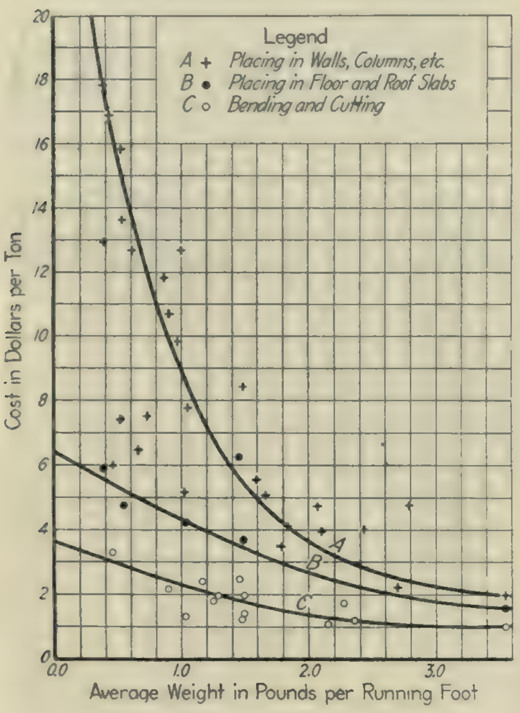


FIG. 1—CHART FOR COST OF REINFORCING STEEL BASED ON WEIGHT PER FOOT

Little Added Work Required

The unit costs are usually obtained by dividing the labor cost figured from the timekeeper's sheets by the tons of steel reported placed by the quantity man. In order to obtain data for studying the effect of size of bars, only one more item must be recorded—the total length of bars placed. This is easily done by the use of a listing adding machine, by which the total running feet of each diameter of rods placed can be obtained. The daily totals are tabulated in terms of rod sizes and linear feet placed, the total length and total weight computed, and the average weight per running foot easily obtained. Knowing total cost and total tonnage, the cost per ton is found, and plotted on the diagrams as shown in Fig. 1.

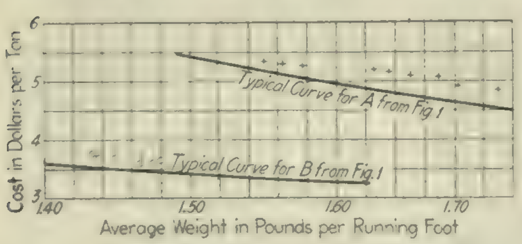


FIG. 2—TYPICAL EXAMPLES OF COSTS AT VARIOUS DATES COMPARED WITH CURVES IN FIG. 1

The curves *A*, *B* and *C*, which are drawn through the fields of plotted points obtained for costs of placing in wall, columns, stairs, etc., in floor and roof slabs, and of bending and cutting respectively, indicate the large effects of average weight upon the cost of labor per ton.

If additional argument in favor of accounting for the weight variable is necessary it will be found in the curves of Fig. 2. This diagram shows on a larger scale the plotted costs for the same kind of work, but for different dates, the steel growing lighter as the roof is approached. Sections of the typical curves of Fig. 1 to this enlarged scale are shown, the costs of placing in walls, columns, etc. (Curve *A*), giving the clearer illustration.

Use of Typical Curves

As an example of the value of these curves, consider the figures on the work recorded in Fig. 2. On Nov. 23 the cost per ton was $4.83. By Jan. 19 this cost had risen to $5.34 per ton. With these figures only and no knowledge of the weight of steel it would be assumed that the work was being less efficiently done, but with the typical curve as a basis of comparison it will be noted on Fig. 2 that while there has been a 10-per cent increase in the cost per ton, the typical cost curve *A* has been more nearly approached, indicating the increased efficiency that can reasonably be expected as a job progresses and the men become more accustomed to their work.

The results obtained in this study lead to speculation as to whether similar curves would not be valuable in eliminating the variation in floor-form costs resulting from differences in thickness of slab and floor heights; in the costs of laying and jointing drains and sewers on account of differences in diameter; in the cost of setting sash as a result of differences in size of openings, etc. There is a wide field for the use of graphics in cost work.

Reports Year's Progress on New York Highways

Deputy Commissioner H. E. Breed Gives Cost Figures and Describes Work Done in Testing Road-Building Materials

LAST year's progress in the construction of the New York State highway system is discussed in the annual report of H. Eltinge Breed, first deputy commissioner, made public this week. Mr. Breed presents figures showing the costs of pavements of the several types constructed during 1915, discusses certain improvements in construction to provide for motor truck traffic and describes the procedure followed by the bureau of tests in determining the suitability of such materials as stone and sand for road building. Extracts from the report follow:

Mileage of Roads

During 1915 1073 miles of road were placed under contract. There were on Jan. 1, 1915, 749 miles of work under contract and remaining to be completed. During the year 759.61 miles of road were actually completed and accepted, while 323.74 additional miles of work were completed, but too late for acceptance, making a total of 1083.35 miles of road completed during the year. On Jan. 1, 1916, there were 739 miles of work uncompleted and under contract.

Types and Costs

Of the 1073 miles awarded 381 miles are of waterbound macadam; 176 miles of waterbound macadam, surface treatment; 347 miles of bituminous macadam, penetration method; 2.2 miles of bituminous macadam, mixed method; 113 miles of cement concrete pavement; 31 miles of brick; 23 miles of all other types; totalling 1073.2 miles.

The following data of the cost of construction for the different types of pavement were obtained, Mr. Breed states, by taking those pavements which total 6 in. in thickness. These cover in general the average condition of to-day. (In the cost per mile figures the 16 ft. refers to the paved width and the 26 ft. to the total width, including earth shoulders and ditches.)

COSTS OF CONSTRUCTION

Waterbound Macadam	
Cost per square yard of pavement only......	$0.648
Cost per mile of 16-26 ft. highway.........	10,250
The cost per square yard was obtained from 434 values and the cost per mile from 419 values.	
Bituminous Macadam	
Cost per square yard of pavement only......	$0.871
Cost per mile of 16-26 ft. highway..........	12,970
Both of these items were obtained from the average of 134 highways.	
First-Class Concrete, 6 In. Thick	
Cost per square yard of pavement only......	$1.121
Cost per mile of 16-26 ft. highway..........	15,320
Both of these items were obtained from an average of 20 highways.	
Brick Pavement on 5-In. Concrete Foundation	
Cost per square yard of pavement only......	$2.015
Cost per mile of 16-26 ft. highway..........	25,750
These were obtained from an average of 23 highways.	

Construction

In all construction the department has been widening the pavement proper on curves and banking it in order that the fast-moving motor traffic might be better safeguarded against accident. The slopes have been cut back and the clearing carried far enough along the inside of the curve to insure better sight distance for users of the road. Greater radius, wherever possible, has been given to the curve, in many cases to the extent of purchasing additional right of way.

During the past year the department has increased the depth of pavements because of the large increase in the use of motor vehicles. There were 208,087 pleasure cars licensed in the state in the past year, and 23,585 commercial cars. Motors of both the pleasure and commercial type seem to be the greatest destructive agents. The increased use of commercial trucks and the damage done by them to the highways, according to Mr. Breed, are alarming. Many of the old roads which were built only 6 in. in thickness have already begun to break up under this traffic, particularly at seasons of the year when ground water seeps through the soil under the pavement making it wet and unstable. At these times the vibratory action caused by the pounding from impact and by shifting of the heavy moving loads creates a shear in the pavement such as to break its bond. Raveling follows, and unless immediately taken care of the pavement rapidly disintegrates and failure is the result. As a factor against this the department has been increasing the use of cut-off drain tile and designing roads of greater thickness—from 9 to 12 in. of stone, according to the soil and traffic conditions to be encountered. It has also been the policy to build quite a

number of miles of concrete roads, as these, Mr. Breed states, seem more adequately to meet this class of traffic.

An attempt was made in the season of 1915 to forestall any early disintegration of a green macadam road by providing for an application of bituminous material and screenings to be placed before the expiration of the contract. In some cases, Mr. Breed reports, this worked out well, while in many others, especially in those where the roads were finished late in the fall, the macadam surface was not sufficiently seasoned to unite with the surface treatment. On later contracts, and during the present year, this difficulty was overcome by providing two methods for surface protection. Such portions of the macadam as have been under traffic for three months and are thoroughly seasoned are to be protected by the bituminous surface application as before, and the remaining portion which is still in a curative state is to be treated with an application of calcium chloride for temporary protection against raveling.

"In dealing with the materials situation we have endeavored to change our specifications so as to afford the greatest amount of competition along every line. This has received some commendation, and I think will result in obtaining better prices for the different articles considered, as well as in eliminating such monopolies as result from restricted specifications admitting only one or two articles of a kind," is one of the comments made by Mr. Breed.

BUREAU OF TESTS

There have been many improvements in the method of conducting the large amount of work done during the past year in the Bureau of Tests. Besides standardizing and expediting the work, instruction has been given to field engineers in charge of construction work so that they have been better able to gage the materials with which they are working and their peculiarities. This instruction is given through theoretical as well as practical work in the laboratory, and also from time to time in the field. This work has been supplemented by reporting to the field engineers the results of all tests on materials where such reports would enable them to know better the quality of the material to be used and would give them better working knowledge for construction.

SANDS

The testing of sand has never been given the relative importance that is required for good work, according to Mr. Breed. In the increase in the building of concrete pavements, greater consideration given to the quality of the sand used has shown that a good result is in many cases dependent upon this important ingredient. Previous to 1915 compression tests were made on sand mortars of 3-in. cubes at an age of 14 days. The only available data were based on this size of cube. However, the department has made several hundred comparative tests on 2-in. cubes as well, so that reliable data have been secured on which to base results. The 2-in. cube is now used exclusively in sand testing. These cubes are broken at 7 and 28 days and, as the quality of the material can be judged at 7 days, this has reduced the necessary time for the sand test from 14 to 7 days, expediting very much the work of the contractor. By this method it has also been possible to make more cubes and to study slow set and low strength action to better advantage.

CONCRETE CUBES

The making of concrete cubes in the field and the testing of them in the laboratory have proved very valuable in determining more accurately the quality of the concrete in the work. There were 1,444 such cubes tested and the following tabulation is given to show the average results obtained:

STRENGTH OF CONCRETE CUBES

Concrete Mix	Average compression, lb. per sq. in.	No. of cubes
1—1½—3	3620	796
1—2½—5 (crushed stone)	1935	222
1—2½—5 (gravel)	1755	200
1—2½—5 (all cubes)	1875	474
1—3½—4 } 1—3—4½ } (mostly slag)	2140	56

Cubes showing compression below 3000 lb. per square inch for 1:1½:3 and 1800 lb. per square inch for 1:2½:5 are considered below the desirable grade. There were 25.8 per cent of these in 1914 and 10.95 per cent in 1915. All cubes showing a compression below this desirable grade are carefully inspected to try to determine to what the low strength is due. Any of them which show indications of carelessness in the mix are returned to the division office with laboratory comments.

The following is a tabulation of the low cubes during 1915 and reasons which seem to cause the low break, with percentage of the same:

Cause of Low Break	Per Cent
Sand dirty, containing loam and also dirt from subgrade	35.4
Stone or gravel coated	35.0
Sand too fine	8.5
Poor quality of stone or gravel	8.2
Poor manipulation in making cubes	4.7
Lack of proper mixing	3.5
Miscellaneous, too wet, etc	4.7

All concrete cubes have heretofore been tested 28 days after casting. This period was chosen because comparative data were available on compression for concrete at this age. During 1915 enough cubes were broken at an age of 7 days to give sufficient data to judge of the quality of the material when broken at this age. Testing at this period will enable us to correct any faulty condition more promptly. It will still be necessary to test occasional 28-day cubes as a check on the increase in strength.

Single-Track Roads in New York

The New York State Highway Department has built near Syracuse 6 miles of single-track road, with a paved width of 8 ft. Contrary to usual custom in building hard-surface roads, the paved section is not in the center of the right-of-way or of the traveled strip, but to one side. The road in question is one which carries most of the loads in one direction, the returning wagons being practically all light. The concrete pavement is put on the side with the heavy traffic. By placing the pavement to one side of the center, and giving it the same crown as a standard 16-ft. road it will be possible at a later date, if the returning traffic becomes sufficiently heavy, to lay another 8-ft. width, giving a 16-ft. paved road. The construction is being carefully watched and if it proves satisfactory the highway department expects to use more of the same type.

Sand Dredged from River for Road Work

Screening Plant for California Highway Construction Takes Material from Creek Bottom — Freshets Continually Renew Supply

MUCH DIFFICULTY has been encountered by the California Highway Commission in many parts of the system in making satisfactory arrangement for a good quality of sand to be used in constructing concrete pavements. Private capital is often unwilling to develop the best deposits; it is hard to secure prompt deliveries, and the execution of workable agreements with contractors has been a source of trouble. The commission decided, therefore, wherever feasible to develop sand deposits of its own, and a thorough examination of all conveniently located deposits was made and a report submitted by the commission's geological force.

COMPLETE CYCLE FOR A BUCKET LOAD OF SAND CONSUMES 1 MINUTE

The plant near San Luis Obispo affords an example of how this plan can be made to work out. Here a cableway excavator was constructed which takes sand from the bed of the Salinas River and delivers it to a washing, screening and storing plant above a railroad spur at a point where delivery can be made into freight cars by gravity.

OPERATED AT PROFIT

In addition to the benefits derived from the elimination of delays and contract difficulties and the ability to control the uniformity of the product, it has been found that the Salinas plant has been operated at a considerable profit, if the sand used is figured at the usual contract price. Furthermore, the installation is considered practically permanent because the winter freshets annually bring down quantities of high-grade sand and gravel sufficient completely to fill the pits excavated during the summer months. The elevation of the screening plant above the river bed is such that it is above flood water level, and continuous production through twelve months of the year has been found to be possible by storing quantities before the flood season.

The dredging equipment consists of 700

ft. of 1½-in. steel cable used as a standing line and on which a traveling excavator is operated on the carrier. The bucket has a capacity of ¾ cu. yd., and is run by lighter cable passing through a sheave in the carrier. One end of the standing line is anchored in a concrete deadman on the far bank of the river and the other end is attached to the top of a 70-ft. mast on a knoll just above the bunkers. The storage capacity is about 4000 cu. yd. in bins and stockpile.

The operating equipment installed at the plant consists of a 40-hp. steam boiler, burning fuel oil, which drives cylindrical screens that grade the sand and gravel. The total cost of the plant in operating con-

SAND PLANT IN OPERATION PREVIOUS TO COMPLETION OF RECEIVING HOPPER

dition, including a 700-ft. railroad spur for handling freight cars, was about $7,000. It was put in operation on May 1, 1915, and since that date has produced 27,000 tons of screened material at a cost of approximately $6,650, or 25 cents per ton, including royalties.

At the usual rate paid for these materials it is figured that the total cost of the installation to date is $400 less than the cost of this material to the commission under the old conditions. In other words, the commission has saved $400 and has in addition the equipment, which is expected to be useful for a long term of years.

A. B. Fletcher is chief engineer of the California State Highway Commission. Walter C. Howe is resident engineer of Division S.

Bermuda Motor-Car Prohibition to Be Modified

The legislative assembly of Bermuda has decided to repeal the present act prohibiting the use of mechanically propelled vehicles of all sorts, and has appointed a committee to draft a bill providing for "a restricted motorbus service under the control of the local government." It is probable that a bill, drafted in accordance with the motion, will pass both the assembly and the legislative council, in which case a motorbus service, under prescribed restrictions, will be inaugurated between Hamilton and St. George and between Hamilton and Somerset.

Calcium Chloride Hastens Seasoning of Concrete

Compressive Tests of Mortar and Concrete Show Large Percentages of Increase in Strength at Various Ages

CALCIUM CHLORIDE added to the mixing water to an amount of 4 per cent by weight will increase by large percentages the rapidity with which concrete gains strength. This conclusion has been reached as the result of a series of tests made at the U. S. Bureau of Standards at Washington, in which the effects of various chemicals were studied in an effort to find a good accelerator for hardening concrete. While the time of setting was not materially affected by adding calcium chloride, there was no difficulty experienced in handling the concrete to which it had been added. Standard 1:3 mortar cubes and standard cylinders of 1:2:4 and 1:1½:3 concrete were tested in compression at varying ages up to 30 days.

Preliminary Tests

In order to determine what chemical compound would prove most effective in causing the strength to develop more rapidly, preliminary tests were made on 2-in. cubes of 1:3 mortar, using Saylor cement and standard Ottawa sand, tested at the ages of 24 and 48 hours. Fig. 1 indicates graphically the results of these compressive tests, the horizontal lines representing the strength obtained for plain mortar.

The most effective percentage of calcium chloride was determined by testing two mixes of concrete, using various brands of cement, with Potomac River sand and gravel, as indicated in Fig. 2. Standard 8 x 16-in. cylinders were used, stored in air and tested at the age of 48 hours. The results indicate clearly that 3 or 4 per cent gives maximum strength.

Tests to determine the time of setting, using neat cement pats, showed little or no effect for the calcium chloride added in amounts from 1 to 5 per cent.

The effects of the addition of 4 per cent of calcium chloride to standard test cylin-

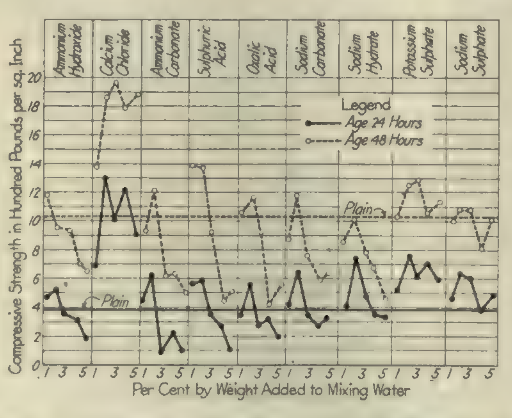


FIG. 1—CALCIUM CHLORIDE MOST EFFECTIVE IN INCREASING STRENGTH OF 1:3 MORTAR

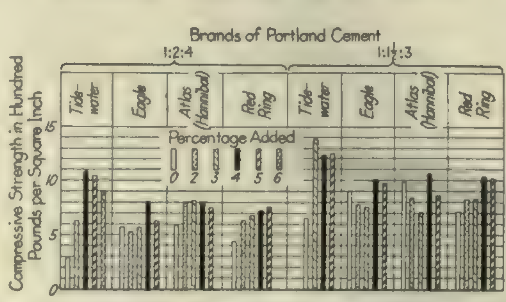


FIG. 2—EFFECTS OF VARYING PERCENTAGES OF CALCIUM CHLORIDE IN CONCRETE

ders of two mixes of concrete, using Potomac River sand and gravel, tested at ages of 1, 2, 3 and 30 days, are indicated in Fig. 3, in which it is shown that in all cases except one the strength was increased for all the brands tested.

To determine the effect of the manner of storing test pieces upon the strength both with and without the addition of 4 per cent of calcium chloride, standard cylinders were stored in air for 24 hours and then in water until tested at the ages of 3 days and 30 days. The results show some increase at both ages over the strength of

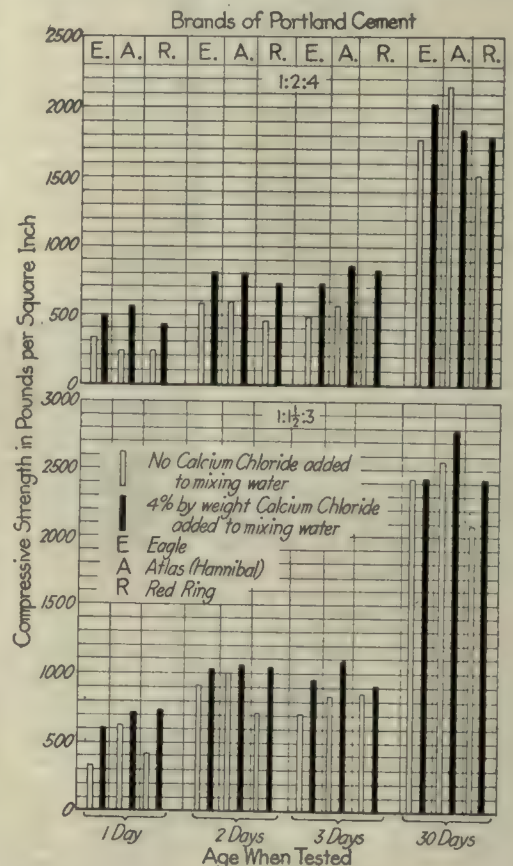


FIG. 3—INCREASE IN STRENGTH OF CONCRETE DUE TO 4 PER CENT CALCIUM CHLORIDE

the test pieces stored in air, both for the calcium-chloride specimens and for the plain specimens.

Conclusions

Tests of the 1:3 standard sand mortar show that the rate of hardening is accelerated most by the addition of calcium chloride, which increases the strength at 24 hours by from 155 to 230 per cent and at 48 hours by from 173 to 190 per cent over the strength of mortar containing no calcium chloride.

The best percentage of calcium chloride to use for all proportions of concrete is from 3 to 4 per cent of the weight of the mixing water. The increase in strength at 48 hours thus obtained varies from 14 to 275 per cent for the 1:2:4 mix and from 11 to 110 per cent for the 1:1½:3 mix.

In all but one case the concretes mixed with 4 per cent of calcium chloride show greater strength for both mixes than for plain concrete, these results being consistent, though variable, for all the ages tested, up to 30 days. This acceleration in strength is believed to be due to the more complete hydration of the silicates and aluminates in the setting of the cement.

The use of calcium chloride increases the cost of concrete by 12 to 15 cents per cubic yard. For best results it is important that the concrete be mixed to a quaking, but

not fluid, consistency. Calcium chloride should be used with caution for reinforced-concrete construction, as it tends to accelerate any corrosion of the steel which may occur.

This work was conducted under the immediate supervision of R. J. Wig, engineer of tests, at the U. S. Bureau of Standards, Washington, of which S. W. Stratton is director.

Motor Trucks Descend Into Deep Building Excavation

Handled Easily and Loaded with Steam Shovels in Digging Basement for Pennsylvania Hotel in New York

NINETY THOUSAND yards of earth and rock are being removed by loading motor trucks on the pit floor with steam shovels in excavating 40 ft. below curb for the new Pennsylvania Hotel, between Thirty-second and Thirty-third streets on Seventh Avenue, New York City. The excavation is being carried down in two main lifts, one to rock and the next to grade. In both operations, as many motor trucks as the hauling contractor could furnish, supplemented by teams, are being employed. Teams are also used where hand loading is required in cleaning up.

PENNSYLVANIA TUBES UNCOVERED

The lot is approximately 236 ft. along Seventh Avenue by 400 ft. deep. Thirty-third Street is more heavily traveled than Thirty-second, which is a stub street facing the Pennsylvania Terminal, and as the Seventh Avenue side is blocked by the new subway construction, two runways on about 20 per cent grade were located leading to Thirty-second Street. The surface of the lot was well covered by the cellars of the brick tenements removed to make way for the hotel. This made it possible for the shovels to start in at a low level and dig downgrade to the roof of the Long Island tunnels along the north side of the lot. The earth was next pretty well removed and excavation of the rock between the Long Island tunnels and the Pennsylvania tunnels, which cross the south side of the lot, was begun. It is this part of the basement that extends 40 ft. below curb.

LOOKING EAST, SHOWING RUNWAY TO BE REMOVED—TEAMS STANDING ON LONG ISLAND TUNNELS

The easterly runway will be taken out as soon as all the remaining earth excavation is finished, and only the runway nearest Seventh Avenue will be used. This descends on to the concrete roof of the Long Island tunnels, which has several vertical steps

STARTING UP THE INCLINE

of 12 to 18 in. over which the trucks must climb loaded in going out. From this roof the trucks descend into the rock excavation on grades of 6 to 8 per cent. These grades can be climbed with a 6-cu. yd. load, but where a truck halts on a grade to load, a snatch team of three horses helps it to start. Double-drum electric hoists, using a line from each drum hooked to the forward part of the frame, pull the trucks up the main runways and also let them down. Two men attend each runway, one to handle the lines and one to hook on a 6 x 6-in. timber, which bumps along the runway behind each ascending truck to chock it in case of an accident to the hoist or lines.

TRUCKS EASILY HANDLED IN PIT

The trucks require some planking in the pit, especially to protect the rubber tires on the rock surface. They make nothing of little irregularities, however, and maneuver around the lot without loss of time. While both the ½-yd. and the 1-yd. shovels were busy in earth, nine of these trucks took out 525 cu. yd. a shift, and at present, with the excavation in transition from earth to rock and roadways being rearranged, six of them are removing 270 cu. yd. a shift. The earth yardage handled by the trucks represents a little more than half the output of the shovels, the remainder having been removed in 3-yd. dump wagons. It is stated, however, that had the hauling contractor been able to supply trucks, not a team would have been used, except for cleaning up. The rock excavation, having to be blasted in small charges because of the location, will be slower, and the trucks will handle nearly all of it.

The trucks and teams make a 1½ mile round trip to Thirtieth Street and the North River, the trucks averaging eight trips per 8-hour shift at present. When faster loading with earth was in progress, the trucks averaged twenty-four trips for the two shifts from 8 a. m. to midnight, no work being done on the third shift.

The hotel is being built by the George A. Fuller Company for the owners, the Pennsylvania Railroad. Jacob Fradus is disposing of the excavation for the contractor.

START OF ROCK EXCAVATION AND RUNWAY UP WHICH IT WILL BE TAKEN IN MOTOR TRUCKS

Oxyacetylene Torch Widens Cable-Line Slot

In San Francisco an oxyacetylene torch has been used for widening the cable line slots of the United Railroads. Where electric lines cross the cable routes the slot tends to close up on account of expansion in the heavy electric rails. Heretofore it has been necessary to take out the pavement and shove back the crossing in order to open up the slot. Instead a thin strip is now cut off one side of the slot rail by means of the torch. On a heavy manganese double crossing, making a cut 46 ft. long, the cost has been $19, as against a cost of approximately $150 by the old method.

Lays Transverse Fissures to Manufacture

Dr. P. H. Dudley of New York Central Lines Declares That Interior Fissures Can and Should Be Avoided

THAT interior transverse fissures in rail heads are induced by a combination of two or more exceptional conditions of manufacture in an occasional rail head by direct rolling, which can and should be avoided, is the contention made in a report, just made public by A. H. Smith, president of the New York Central System, by Dr. P. H. Dudley, consulting engineer of the system. Briefly, Dr. Dudley lays the trouble to the blow of the gag in straightening, following delayed transformations of the metal near the center. His findings are in part as follows:

CAUSE OF INTERIOR FISSURES

Induced interior transverse fissures in basic open-hearth rails are due in part to an occasional hot rail being cooled so rapidly by the rolls and their pressures to elongate the bar, or chilled by gusts of air before recalescence on the hot beds, as to cause a lag of some of the transformations of the metal in the interior of the head. Induced interior transverse fissures can develop in the track only from the effects of preceding causes, neither of which is any longer a mystery, and their progressive stages of development occur in the following order:

Conditions of Manufacture.—The first contributory cause is delayed transformations of the metal near the center of the head, and chemical or mechanical defects. The first defect is induced loss of strength, initial strains and physically a nonductile core of heterogeneous metal near the center of the head.

The second contributory cause is mechanical injury to the heterogeneous metal, the nucleus being checked by the gag. The second effect is the produced defect of an interior invisible portion of fractured metal near the center of the head before the rail leaves the steel plant.

Conditions of Service.—The third contributory cause acts when the conditions of ordinary service for the interior fractured metal become abnormal. The third effect is that the checked interior metal is no longer able to restrict the strains of the wheel loads within the usual range of the elastic limits of the steel, as in the case of sound metal, but develops by "detail" growth, from and around the checks, the specular surfaces of the induced interior transverse fissures until the section ruptures.

NO FISSURES IN HOMOGENEOUS METAL

Interior transverse fissures have not occurred in the countless thousands of rail heads of physical homogeneous metal for the reasons that they do not contain the conditions of the first contributory cause, and consequently, while the metal is lengthened or shortened by the second contributory cause, it is not checked.

Doctor Dudley points out that basic open-hearth rails in the composition of the New York Central Lines specifications and rolled from reheated blooms have not, to date, developed interior transverse fissures, and he believes that what he has set forth can be utilized to prevent the conditions arising in the manufacture of rails which tend to induce interior transverse fissures in the output.

Literature

For the Civil Engineer and Contractor

New Publications

RAINFALL DATA OF BERKELEY, CALIFORNIA. By William Gardner Reed. University of California Publications in Engineering Nos. 5 and 6. Paper, 7 x 10¾ in.; 13 pages and 34 pages. Berkeley, Cal., University of California Press.

CORRECTION OF ECHOES AND REVERBERATION IN THE AUDITORIUM AT THE UNIVERSITY OF ILLINOIS. By F. R. Watson, associate professor of experimental physics, and J. M. White, supervising architect. Bulletin 87, Engineering Experiment Station. Paper, 6 x 9 in.; 20 pages; illustrated. Urbana, Ill., University of Illinois. 15 cents.

THE SLIDE RULE: A PRACTICAL MANUAL. By C. N. Pickworth, editor of the *Mechanical World*. Fourteenth edition. Cloth, 5 x 7¼ in.; 124 pages; illustrated. New York, D. Van Nostrand Company. $1 net.
This edition of a very complete and helpful descriptive and theoretical work on the slide rule has been revised and the contents extended to include the solution of algebraic equations by slide rule.

LECTURES ON TEN BRITISH MATHEMATICIANS OF THE NINETEENTH CENTURY. By Alexander Macfarlane. Mathematical Monograph No. 17 of series edited by Mansfield Merriman and Robert S. Woodward. Cloth, 6 x 9 in.; 148 pages; illustrated. New York, John Wiley & Sons, Inc. $1.25 net.
These lectures on pure mathematicians of England were delivered at Lehigh University during the years 1901 to 1904 inclusive, and abound in lively personal reminiscences of distinguished men whose work was accomplished during the middle of the last century.

AUTOMOBILE HANDBOOK. By J. E. Homans. Cloth. 5 x 7½ in.; 248 pages; illustrated. New York, Sully & Kleinteich. $1 net.
Full description of essential parts and auxiliaries, with directions for rearrangement, operation and care of the gasoline motor car.

WHY HIGHLY OXIDIZED RED LEAD IS SUPERIOR. By G. W. Thompson, chief chemist, National Lead Company. Paper, 6 x 9 in.; 9 pages. New York, National Lead Company.

THE PHYSICO-CHEMICAL PROPERTIES OF STEEL. By C. A. Edwards, professor of metallurgy, Manchester University. Cloth, 6 x 9 in.; 229 pages; illustrated. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Limited.

HOW TO BUILD UP FURNACE EFFICIENCY. By Jos. W. Hays, combustion engineer. Tenth edition, revised and enlarged. Paper, 5 x 7½ in.; 154 pages; illustrated. Chicago, Rogers Park, Jos. W. Hays, publisher. $1 net.

REPORT OF THE RECLAMATION BOARD OF CALIFORNIA, 1916. Paper, 5¾ x 9 in.; 36 pages and 2 maps. California, State Printing Office.
A report of the board's activities in flood control on the Sacramento and San Joaquin rivers up to April 1, 1916, with suggestions relative to the work in hand. It reviews the work done under the powers conferred by the Reclamation Board Act, by virtue of which the board directs private reclamation, and covers the extensive work which has been done on the projects now being carried out in the central California valleys. Tables are given to show mileage of river and by-pass levees proposed, constructed or in process of construction.

Books Reviewed

Structural Timber Handbook on Pacific Coast Woods

Author, O. P. M. Goss, assisted by Carl Heinmiller. Flexible leather; 5 x 8 in.; 289 pages; illustrated. Seattle, Wash., West Coast Lumbermen's Association. $1.

Several very valuable and unique features in the principal tables of this book make it of unusual interest to designing engineers. For example, Table 20, covering 144 pages, contains the safe uniform loads permissible for surfaced rectangular beams, the actual sizes of which are given, the deflections, the pounds carried per foot board measure, and the horizontal shear for various span lengths of beams for nominal sizes from 2 x 4 in. up to 20 x 30 in. Nine different fiber stresses from 1000 up to 2000 lb. per square inch are included. Especially noteworthy is the fact that actual surfaced sizes are used in computing these values. Factors (greater than unity, with a maximum of 1.5) are given by which, if desired, the values can be multiplied to give loads, deflections, etc., for full-size rough timber. Another notable feature is the load per foot board measure presented in this table. It makes possible a quick comparison of the relative economy of various possible beams for a given load and span.

Among other points of unusual value may be mentioned the reports of recent tests of Douglas fir and other Western timbers, with a structural Douglas-fir specification for bridge and trestle timbers; the diagrams and figures for cost of timber and brick mill buildings; data on creosoting of Douglas fir; tables of safe loads on surfaced columns and on surfaced beams governed by shearing strength, and the maximum spans and deflections for mill and laminated floors.

The tables and diagrams are exceptionally well devised, with excellent typographical work throughout. The book should prove of value to all engineers who are concerned with timber design of any kind.

The Practical Design of Steel-Framed Sheds

Author, Albert S. Spencer. Cloth, 6 x 10 in.; 163 pages; illustrated. New York, D. Van Nostrand Company. $3.50 net.

REVIEWED BY F. H. CONSTANT

Professor of Civil Engineering, Princeton University, Princeton, N. J.

This book is intended as a practical guide to the design of steel mill buildings with column supports. It does not enter at any length upon the theory of truss and column stresses, or the design of individual members, a knowledge of which is presumed of the reader; but it consists mainly of tables giving total stresses and required sections for all parts of the several kinds of buildings treated and for the ordinary range of spans. It is expected that by the use of these tables the designer will be able, with little labor, to pick out all the sections needed for a given structure.

The various types of sheds (transverse bents) are classified according to the degree of fixity of the ends of the columns. Types 1 and 2 have no kneebraces; in the former both ends of the columns are assumed as pin points; in the latter the base is considered fixed to an adequate concrete pedestal. Types 3 and 4 have kneebraces, the former being assumed pin-jointed at cap and base, the latter only at the top, the base being considered fixed. Type 1, being unstable and unsuitable, receives no further consideration.

The first chapter pertains to the resistance to wind forces. The system of nomenclature and the stress formulas are given, and the latter are applied in the calculations of numerical examples carried out to the actual sections of the various parts of the structure and foundations.

In explanation of the plan of the book the author states that "by adopting a con-

stant outline for the principal members of the roof frames, by using a constant relative proportion for the main dimensions, and also a similar combination of data, stress coefficients may be obtained, which, when multiplied by certain necessary varying factors, will give the total stresses in the various members. Further, by the compiling of a standard table of sections for sheds of varying dimensions, the manufacture will be accelerated and cheapened." This plan for the "standardizing of shed members" is carried out by the insertion of some hundred pages of tables of stresses and standard sections, with sufficient explanatory text to make the meaning and use of the tables clear.

Doubtless the book will be of considerable service to English designers. Differences in American and English practice, and the existence of so many excellent American books on mill-building construction, will greatly lessen its value in this country. A published set of similar tables (such as exist in the offices of many bridge companies) accurately representing American practice would probably be welcomed by American constructors.

The last two chapters are descriptive of coverings, gutters, pipes, ventilators, etc. There are twelve folding plates, devoted mainly to stress diagrams and tables of stresses and sections for different types and spans of transverse roof frames and details of construction.

Hydraulic Flow Reviewed

Author, Alfred A. Barnes. Cloth, $6\frac{1}{4}$ x $9\frac{1}{2}$ in.; 158 pages; 11 folding plates. New York, Spon & Chamberlain. $4.50.

REVIEWED BY A. G. HILLBERG
Hydraulic Engineer, New York City

In this volume the author presents his investigations regarding the laws for the accurate measurement of water in either large or small quantities. New formulas have been developed and when compared with discharges ranging from 0.0034 sec.-ft., as measured by orifices, up to 320 sec.-ft., as determined by weirs, they have proved correct within a remarkably low percentage of error.

The formulas are all of the same type; that is, $v = Km^{\alpha}H^{\beta}$, which, for pipes and channels, by means of the introduction of the length in the direction of flow, becomes $v = Km^{\alpha}i^{\beta}$, where v is the velocity; m the hydraulic radius (called by the author "hydraulic mean depth," which might possibly be confused with mean depth or area divided by width); H, the head; i, for pipes, the head lost divided by the length of pipe, and for channels, the sine of the angle of inclination, and K, α and β, constants to be determined by experiments.

After a brief introduction and discussion of the formulas developed by Chezy, Prony, Darcy, Ganguillet and Kutter, Bazin, and Barre de St. Venant, the author explains the advantages gained by using logarithmic plotting of experimental data, and uses these advantages as proof of the superiority of the exponential form of hydraulic formulas. Having written the general formula, the author, by introducing values and conditions making $v = k$, states that "in a general way it can be stated that $1/K$ in each case represents a measure of the relative surface friction per square foot."

A list of formulas for the flow of water in pipes, channels, canals and rivers is given. Not less than sixteen different sets of coefficients are required to provide for the differing influence of the condition of the contact surfaces, and including allowances for deterioration in each type of channel. This table is followed by sixteen others, each comparing the formulas with experimental data, including various kinds of pipe, conduit and channel. The wealth of experimental data given in these tables is enormous, not less than 3162 separate experiments being quoted and the experimental data classified.

The second part of the book deals with the measurement of water by triangular notches, weirs and circular orifices. The author proves that by using his formula with the proper constants and exponents the commonly used varying coefficient will be abolished for conditions where the velocities are greater than the critical. As the critical velocities are very small and rarely met with in practice, engineers will not be inconvenienced because of this discrepancy of the formulas.

The author should be complimented for the thorough manner in which he has dealt with the subject, and it is believed that the new formulas developed will be appreciated and used extensively by the engineering profession.

Cambria Steel Handbook

Author, George E. Thackray, special engineer, Cambria Steel Company. Eleventh edition. Flexible leather, $4\frac{1}{4}$ x $6\frac{1}{2}$ in.; 513 pages; illustrated. Philadelphia, Cambria Steel Company. $1.25.

This edition—the eleventh—of the well-known Cambria handbook brings up to date the practice of this company and includes some additions to, and also a few opinions of, matter appearing in the tenth edition. Among the new sections of structural steel are heavier rolled 24-in. I-beams weighing 105, 110 and 115 lb. per foot. Tables are supplied for the properties of all the new sections. A useful amplification of the table giving properties of steel rails is made to include other recently adopted standard sections and the revised values for section moduli.

More than fifty sections of built-up plate girders have been added to the valuable table giving safe loads and weight per foot for such girders. The table of standard pipe has been increased in size by the inclusion of properties, and the tables of extracts from building laws now embrace thirty-one cities. The new revised Manufacturers' Standard Specifications for structural and boiler steel (dated April 21, 1914) are reproduced, and replace the older specifications.

It is interesting to note the great increase in maximum length and thickness of sheared plates scheduled in the latest edition compared with the limits given in the sixth, or 1904, edition. The maximum thickness is increased from $1\frac{1}{2}$ in. to 2 in., and although the maximum width is increased only 1 in., from 125 in. to 126 in., the width of plates of given thickness has been largely increased. For example, $\frac{3}{8}$-in. plates are now listed 125 in. wide instead of 113 in. The limiting length for all the thinner plates is extended in many cases to nearly double the old limits.

Those engineers who are familiar with this useful handbook will find its latest form as satisfactory as ever, with its value much enhanced by the new material.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Abandoned Bridge Difficult to Destroy

SIR: It was with much interest that the writer read the article and studied the illustrations therein, pertaining to the destruction of a reinforced-concrete beam-and-slab bridge at Memphis, Tenn., to make room for a new levee ("Abandoned Bridge Difficult to Destroy," page 132, July 29, 1916).

The way the structure resisted efforts to destroy it is truly remarkable, in view of the fact that the reinforcement of columns and beams was not what could be called good practice. Had the column bars been stayed with hoops or spirals and some stirrups provided in the beams, and longitudinal distributing bars in slab as current practice dictates, it is safe to say that the work of demolition would have been much more difficult.

Photographs 10 and 11 are of special interest, since they show clearly the result of reinforcing and pouring the slab and beams as separate units. In this particular structure no doubt the beams were designed as rectangular sections below and independent of the slab (the location of the top reinforcement in illustration 10 indicates this); but in more than one case of which the writer has data contractors have or have endeavored to pour the beams to the under side of the slab one day and the slab the next (just as was probably done in this particular case), even though the beams were designed as T-beams, which necessitated a monolithic construction of beam and slab in order to obtain the action assumed in design. This would seem to indicate that it is highly essential to state very plainly on detail construction plans that in T-beam construction the slab shall be poured integral with the beams. This at once settles the question of method of design and gives the contractor no recourse, if the inspector attends to his business, except to carry out the intentions of the designer.

Had stirrups been used in the beams with tops anchored in the slab, and had the bent bars in the beams been carried up into the slab, instead of being placed just under the slab, and the slabs and beams poured at one time, no such marked lines of cleavage and separation of slab and beam as indicated in photographs 10 and 11 would have taken place. Other failures and buildings damaged by fire have developed these same faults; and in the writer's opinion, no better or more forceful arguments can be presented to the lax or careless designer than these fruits of the folly of his kind, and more good can be accomplished by their prominent display than by volumes of textbooks. Such is one of the duties of the technical press, an important part of its valuable educational work.

The lack of longitudinal reinforcement in slab, as shown by breaks over one of the columns, reminds one of the failure of the Meriden Street bridge at Indianapolis during the floods of the spring of 1913, where on account of lack of sufficient transverse reinforcement a series of arches split in half longitudinally after the piers had been undermined, one section dropping into the river, while the other remained in place. Some designers fail to appreciate that placing bars in one direction only in concrete work does not adequately reinforce it against temperature and other unforeseen stresses, and thereby prevents it from withstanding sudden and unexpected tests.

It would be interesting to know whether the columns in this Memphis bridge, which failed by pushing out at the bottom, were tied to the footings by dowels or simply rested upon them without connection other than the bond between concrete of the footings and columns. Since by proper design a concrete structure can be made to act as a monolithic frame, thereby greatly increasing its strength, especially in so far as the resistance of unusual loads is concerned, it seems like a rather shortsighted policy to erect concrete like so many blocks of stone masonry. Why not make use of every bit of the latent strength of concrete at critical times by considering something besides mere load-carrying capacity in design?

ALBERT M. WOLF,
Chicago. Assoc. M. Am. Soc. C. E.

Justice to the Contractor

SIR: Commenting on H. G. Shirley's letter entitled "Justice to the Contractor" in the Aug. 5 issue of your paper, page 180, I heartily agree with Mr. Shirley that specifications should be clear and definite and that the engineer or his authorized representative in charge of work should be a man of good judgment and experience, or, as quoted, have "horse sense." Then there would be no need for a board of arbitrators to settle matters in dispute.

I think the reason why so many contractors raise questions and have disputes as to their rights is because in a good many cases a young and inexperienced engineer or inspector is put in actual charge of work. It may be unimportant work, and when a question is to be and should be decided then and there, on the job, the inexperienced engineer feels that he cannot assume the responsibility of varying in the slightest degree from the ironbound specifications, while really he need not vary, but only use a little common sense. On the other hand, we cannot always wholly blame the inexperienced man in charge, when he has been given instructions by his superiors to make the contractors live up to the letter of the specifications regardless of circumstances and constructions.

Specifications are not written for deception and dispute, nor to stand as infallible, but to define in clear and definite terms the scope and class of work to be performed, and should be carried out jointly by the contractor and engineer, working together in harmony, instead of each trying to "do" the other.

Why cannot competent and experienced men be selected to have charge of work and not schoolboys to interpret specifications and direct the work for experienced contractors? The mere ability to give lines and grades correctly does not necessarily mean that a man is competent or suited for the work. He must be a man of good discretion also, so that both contractor and engineer can feel that the work must be carried out with equity and fairness for both sides.

Having been on "both sides of the fence," I feel that too little attention has been given in selecting men for responsible positions of this kind.

What seems to be needed most is "horse sense" specifications, "horse sense" men in charge of the work and a desire to "pull together."

R. M. STAMPER,
Philadelphia. Civil Engineer.

Plumbers or Sanitary Engineers?

SIR: I have just read with interest the editorial in your issue of Aug. 5, page 157, regarding the action of the plumbers of Indiana banding themselves into an organization called "Sanitary Engineers." I most heartily concur with your statements regarding the grave necessity for representative engineering societies taking up the cudgels in favor of the correct application of the term engineering and of the title engineer. It most assuredly seems that our engineering societies are far from awake, in so far as any concerted effort to check this widespread misuse of the term engineer is concerned; but on the other hand, do you not think—in all fairness—that the plumbers of Indiana are not entirely to blame for their presumptive action?

To substantiate my belief in their innocence I would refer you to page 48 of the Engineering Record of Aug. 5, where there appears under the heading "Positions Vacant" the following advertisement: "Hoisting engineer wanted. We would like to have Charlie Nichols and Dick Riley or any other first-class three-drum hoisting engineer who worked at Nicholson in 1913 on the cutoff communicate with us, as we have a position open for a hoisting engineer; steady work."

After reading the foregoing it is not difficult to understand what the advertisement is calling for; but do you not think that this is one of the most unique branches or departments of engineering yet advertised before the eyes of an observant public? To me it seems that the plumbers of Indiana have quite as much right to the title engineer as a man operating a crane or a hoist. From the standpoint of general education and culture, I believe the plumbers would, individually, quite outdistance the type of man called for in your advertisement.

Now, do you not consider it necessary for engineering periodicals to offer some assistance to the very urgent efforts to improve the proper use of the term engineer by placing in print only reading matter that will aid toward a realization of this improvement? It seems logical to me that unless engineers, and particularly our representative engineering periodicals like the Engineering Record, set an example to the world, we can hardly blame plumbers, locomotive drivers, janitors of apartment houses and other individuals equally as remote in their labors from true engineering when they usurp the title engineer.

N. T. BINKS,
Civil Engineer.
Shawinigan Falls, Quebec.

[At first blush it might seem that the Engineering Record stands convicted. Be it remembered, however, that this journal is for civil engineers and contractors, in the field to supply the wants of both classes. Ancient custom has fixed upon the man who runs a hoisting engine the title of hoisting engineer. Civil engineers may resent this; it is suspected that some hoisting engineers, gazing upon young manipulators of tape and plumb-bob, also resent it. Yet few readers of the Engineering Record will confuse the hoisting engineer, as such, with the civil engineer. And in the present state of the art when a contractor is enough in need of a hoisting-engine operator to advertise for one there seems to be no better way than to let him designate that personage just what everybody else does—a hoisting engineer.—EDITOR.]

Test Concrete Cured Under Freezing Conditions

SIR: I have noticed the article in the July 15 issue of the Engineering Record, page 78, on "Test Concrete Cured Under Freezing Conditions." This article contains some interesting and valuable information which should be noted by builders, engineers, and others interested in concrete and reinforced-concrete construction work.

A similar series of tests was carried on by the writer during the last three years at the University of Illinois, and part of the results are embodied in Bulletin 81 of the Engineering Experiment Station. During the past year the writer has conducted a series of tests to determine the effect of alternate freezing and thawing upon the strength of concrete. It is not possible to make known the results at this time, but in a general way the data demonstrated the necessity of allowing concrete to set under a normal temperature before subjecting it to freezing conditions. The duration of the initial set under normal temperature conditions to prevent later disintegration under freezing and thawing conditions was found to depend upon the setting quality of the cement and the proportions of the concrete mixture.

The results of tests and experience still confirm the writer's original opinion that in concrete construction under freezing-temperature conditions the concrete must be maintained at a temperature of not less than 40 deg. Fahr. for not less than 48 hours after placing.

West Baldwin, Me. A. B. MCDANIEL.

Coal Mined in 1915

The production of bituminous coal and anthracite in the United States in 1915 amounted to 531,619,487 short tons, valued at $686,691,186, an increase, compared with 1914, of 18,094,010 tons, or 3.5 per cent, in quantity, and of $5,200,543, or 0.8 per cent, in value, according to C. E. Lesher, of the United States Geological Survey. Of this total output, 442,624,426 short tons, valued at $502,037,688, was bituminous coal and lignite, and 88,995,061 tons, valued at $184,653,498, was Pennsylvania anthracite. Pennsylvania, with an output of 157,955,137 tons of bituminous coal and 88,995,061 short tons of anthracite, ranks first among the coal-producing states. West Virginia, with a production of 77,184,069 tons; Illinois, with 58,829,576 tons; Ohio, with 22,434,691 tons; and Kentucky, with 21,361,674 tons, follow in order of production. Thirty states and the Territory of Alaska contributed to the total.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

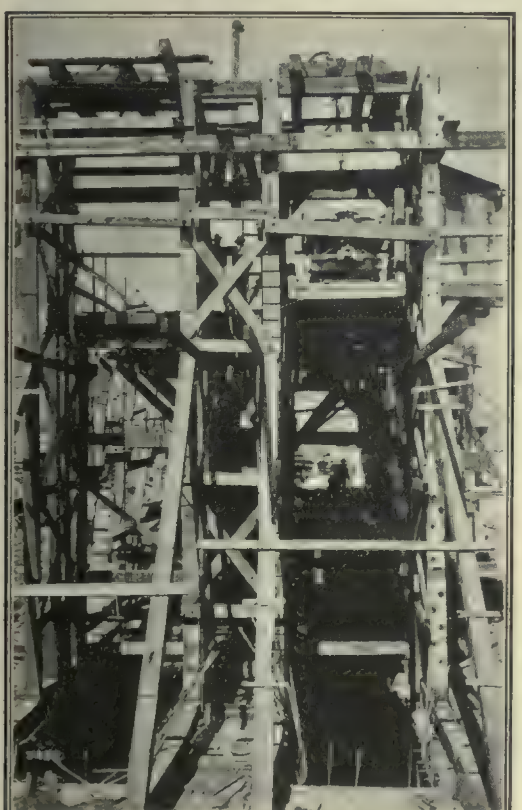
Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Automatic Hoist Stop Saves Extra Man on Crew

IN handling the muck from the Twin Peaks tunnel in San Francisco it has been found economical to control the operation of the hoisting motor by an automatic stop so that there is no necessity for having a man on the payroll whose primary duty is to operate the hoist. The illustration shows the general arrangement of the hoist which brings cars from the floor of the tunnel to surface tracks or to bunkers which load by gravity into motor trucks.

The mule driver who delivers the loaded dump car onto the elevator at the level of the tunnel floor throws a switch which starts the 25-hp. motor operating the hoisting winch. By means of a three-way push-button control he sets the mechanism so that the elevator stops automatically at the desired level. When the empty car is ready to be returned to the tunnel the attendant who handles the cars at the top simply trips the mechanism set for tunnel level. This is controlled to a nicety by a projection clamped to the cable, which trips a switch at proper height. It has been possible to regulate this, it is stated, so that the rails of the elevator meet the stationary track accurately enough to allow the car to be trundled off without delay.



CONTROL OF THIS HOIST IS AUTOMATIC

The total lift is about 50 ft., at which elevation the muck is dumped into bunkers. Timber and other supplies going into and out of the tunnel are handled by means of the tracks at surface level. The capacity of the dump cars used is 2 yd. loose, or $1\frac{1}{4}$ yd. in place. The average quantity handled by the hoist is 90 cu. yd. per 8-hour shift, or 327 cu. yd. loose per day.

The contract on the work is held by R. C. Storrie & Company. M. M. O'Shaughnessy is city engineer.

Derrick Boats Used Inside Coffer Without Extra Digging

THE SCOUR of the Ohio River, confined in a half-width channel between the completed lock and the coffer inclosing the bear trap weirs during the construction of government dam No. 12 at Warwood, W. Va., eroded the river bed to a depth of 26 ft. While this increased the expense of cofferdam building, it afforded an excellent opportunity to use the derrick boats inside the coffer for completing the closing section of the navigable pass next the bear traps. The foundation for this section of the movable dam is on piles. Above it is driven to rock a cutoff wall of wood sheeting, and below it a long 20-ft. wide crib of 10 x 12-in. timber is sunk almost to rock and filled with riprap. A mixer boat equipped with a 78-ft. tower (described on page 89 of the Engineering Record for Jan. 16, 1915) was able to spout the concrete from outside the upper arm, so that the greater part of the derrick work to be done consisted of building, sinking and filling the crib, and handling reinforcing, oak sills and castings for the foundation.

Because of the deep scour, no dredging was needed to float the derrick boats below the line of the crib with the foundation unwatered. The lower arm of the coffer was, however, built 100 ft. below the pass, leaving a space below the channel for the boats into which every yard of excavation was put without rehandling. Because of the economy in spouting concrete direct to the forms, however, the upper arm was built as close in as possible, leaving no room above the foundation for a boat.

The sheet piles were driven by a land driver, and the round piles by a carriage driver rolling forward on the sheeting and the crib and sidewise on the base of the carriage. The cribs were built and sunk and forms, sills, reinforcing and castings set by the derrick boats. The reinforcing was delivered by barge in bundles and carried on the decks of the derrick boats. These boats maneuver with considerable speed by casting out the loaded bucket and pulling forward, backing or turning by keeping a strain on the bucket lines and manipulating the boom. The two of them inclosed in the coffer covered every part of the 350-ft. section, and were busy at productive work practically 24 hours a day.

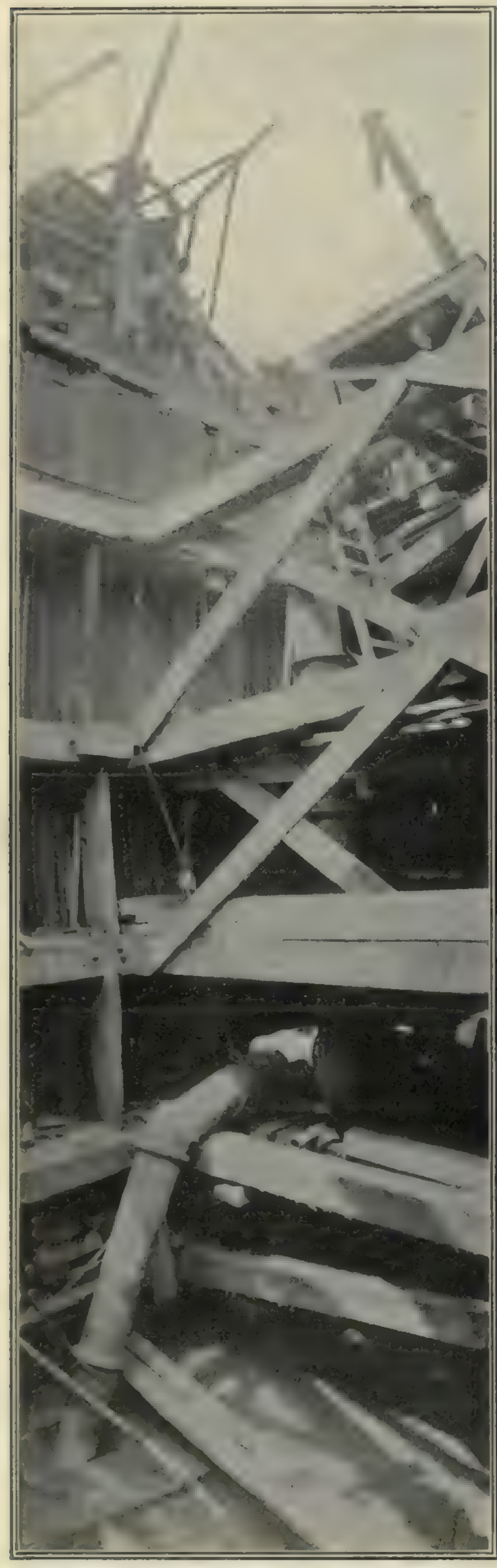
The only part of the work they could not reach was a 10-ft. wide strip of 4-ft. riprap laid along the upstream edge of the foundation. On the Monday morning after the concrete was finished the riggers began to set up a small traveler derrick on the east end of the 350-ft. section of foundation. The following Saturday night they had finished taking this traveler down at the west end next the first bear-trap pier. Meantime it had set the 600 cu. yd. of rip-rap.

TAKE ADVANTAGE OF DIGGING DONE BY RIVER TO USE DERRICK BOATS INSIDE COFFER

The entire section of pass foundation, resting on 560 round piles and requiring 2250 yd. of concrete, 5300 yd. of riprap and 250,000 ft. b.m. of crib timbers, was completed in 40 days after pumping out the coffer. The work, done by the Foundation Company, was at the time in charge of F. W. Adgate, western manager.

Centrifugal Pumps in Tandem Raise Water 68 Feet

TWO 12-in. centrifugal pumps, the suction of the upper one connected to the discharge of the lower one, are being used to unwater an 86 x 110-ft. steel cofferdam 65 ft. deep for the condenser pit of the new American Gas & Electric Company's station on the Ohio River near Wellsburg, W. Va. The two Morris pumps used in this way are intended for low heads, and either alone would raise water economically only 40 ft. Water hammer was overcome by taking off the foot valve, and surge trouble was corrected by slowing down both pumps.



NEW WAY TO "HOOK UP" CENTRIFUGALS

The station is being built by the Foundation Company under its Wheeling district office, of which George R. Johnson is in charge. The pumps described were set up by W. Tuttle, master mechanic.

Double Motor-Driven Brushes Clean Reinforcing Cheaply

By HAROLD E. KETCHUM

Superintendent, Hunkin-Conkey Construction Company, Cleveland, Ohio

THE BRUSH CLEANER shown in the photograph is removing rust from the reinforcing bars used in the Detroit-Superior high level bridge in Cleveland at a labor cost of 50 cents a ton. It was built at the job. The two brushes are belt-driven from a countershaft by a 3-hp. electric motor, and the steel is fed either between them or across the tops of both brushes. Two or three laborers are employed, the bars being cleaned just before they are bent and used. The bridge is being built by the Hunkin-Conkey Construction Company.

REINFORCING BARS ARE FED ACROSS THE TOPS OF THE BRUSHES OVER THE WOOD RACKS

Card Index Handy for Checking Prices on Small Items

By BENJAMIN L. LATHROP

Of Lathrop, Shea & Henwood Company, Scranton, Pa.

A PRICE LIST which combines the advantages of ready accessibility, easy elimination of dead matter and quick discovery of any change in price can be kept on 3 x 5-in. cards made out and indexed in the form illustrated. All items should be indexed after the initial letter of the descriptive noun. For example, rocker arms appear after the index card A.

ARMS

Rocker arm and pin No. ——, Bucyrus Co., Jan. 14, 1914,	$3.50
Rocker arm for Loco. No. 2248, Vulcan Iron Works, Dec. 31, 1914,	10.50

BOLTS

Stay-bolts, ⅞"x6", Utica Boiler Works, 11/30/10—	each	.30
Machine-bolts ½"x8", Hendrick Co. 7/28/11—	each	.03

A bill comes in for piston rings for a certain engine, charged at $1.25 each. The bookkeeper or his assistant finds the card "rings" and finds that the last time piston rings of this type were bought they cost only $1.10. No notice of an advance in price having been received from the manufacturers, a letter of inquiry is sent which brings either a corrected invoice or an explanation of the increase.

A busy contractor may complain that his bookkeeper has no time to keep an elaborate check on prices, but the cheapest kind of office help can run a card price list and compare every item with it. A busy office will save the salary of a young man or girl to do nothing else, and in offices where the force is not overloaded with work there is always some one whose spare time can be profitably spent checking prices.

Unwarranted fluctuations occur most often in the prices of little things like bolts, repair parts, and tool handles, though occasionally an error will be found in billing carload lots of material like cement or coal. The little things, however, mount up, and the saving to be effected by watching them will surprise anyone who has not kept a careful check on prices.

The moral effect on a dealer who receives two or three complaints of overcharge is also considerable. He will be careful to see that the offense is not repeated, and that, when possible, advance notice of price changes is sent to the customer so that he may cover his immediate needs under a contract.

Government Dredger Makes Trip from Baltimore to San Francisco

The United States hydraulic suction dredger San Pablo, after a 34-day trip from Baltimore via the Panama Canal, arrived at San Francisco recently. The dredger, which is to be used to deepen the channel from San Pablo Bay to the Mare Island Navy Yard, was built at Skinner's shipyards, Baltimore, at an approximate cost of $300,000. It is 155 ft. long and has a beam of 65 ft. and a gross tonnage of 834. According to tests made on completion, this dredger has a capacity of 500 cu. yd. in 28 minutes.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

To Place Central Span of Quebec Bridge

5000-Ton Truss to Be Raised to Place from Six Pontoons by Means of Suspender Bars During Second Week of September

The central span of the Quebec Bridge will be placed, according to present expectations, during the second week in September by floating the span at high tide beneath the gap between the ends of the cantilever arms and attaching to its corners suspender bars by means of which the span will be jacked up in short lifts. Eight 1000-ton jacks, two at each corner, will be used, and the span will be guided during its ascent by two hanging trusses, shown already erected in one of the photographs.

All the main members of the structure have been completely erected and work is now being rushed on the installation of mechanical equipment required for placing the center span. This span is a structure 640 ft. long, 110 ft. high at the center and 88 ft. wide. It will weigh in the condition in which it will be lifted to place more than 5000 tons. It has been erected at Sillery Cove, 3 miles below the site of the bridge, and will be floated to place on six large pontoons constructed for the purpose, three being used under each end. Long steel links suspended from the four corners of the cantilever arms will be connected by means of pins to the floating span at the extreme flood tide, when the current will be least. As the tide recedes the pontoons will fall away from the superstructure, leaving it suspended. The jacks will then be brought into play and the span slowly lifted to its proper elevation and coupled up. The whole operation, if everything works smoothly, should not require more than 24 hours.

The actual day on which the floating will take place cannot be decided upon until the time arrives. A 12 to 16-ft. tidal range, producing currents of 6 to 8 miles at the bridge, materially increases the difficulties involved, and a quiet day with practically a complete absence of wind will be absolutely necessary.

Observations of the weather have been carried on with considerable elaboration during the past two years, and records have been prepared showing the probabilities at this season. A wireless storm detector has been installed at the bridge site and records of this have been taken for the past year. This indicator will show the approach of an electrical storm about six hours before it arrives. The bridge will also be kept in close touch with the meteorological observatories in Toronto and Quebec, so that all data will be available as soon as they are obtained.

High tide during the proposed period of floating occurs between 4 and 5 o'clock in the morning. This early hour is chosen in order to give a long day for the operation. Excursion boats and all traffic in the river will be kept at a distance from the work to avoid all chance of their interfering with the operation. More definite information regarding the date and facilities for viewing the placing of the span will be published later.

CENTRAL SPAN, 640 FT. LONG AND WEIGHING MORE THAN 5000 TONS, READY TO PLACE

Undermined by Seepage Flow, Lake Toxaway Dam Fails

Earth Structure in North Carolina, 430 Feet Long and 60 Feet High, Washed Out Following Severe Rainfall

By W. N. WILLIS
Civil Engineer, Spartanburg, S. C.

Undermined by water flowing through fissures in the rock foundation upon which it was built, the earth dam, 430 ft. long and 60 ft. in maximum height, built in 1902 at a cost of $32,000 to form Lake Toxaway, the well-known North Carolina summer resort, was washed out at 7 p. m. Aug. 13. The lake, although created primarily as a tourist resort and for fishing and boating, served also as a storage reservoir at the head of the Toxaway River.

Unprecedented Rainfall

The failure followed a period of unprecedented rainfall in July. Official records at Highlands and Rock House, about 10 miles to the west and near the headwaters, were 17 and 19 in. in 48 hr. on July 8 and 9. This was the same storm which did so much damage along the Gulf Coast and in the Mississippi Valley. It raised the level of the lake about 4 ft. On July 16, with water about 18 in. above normal, another storm from the east, which did so much damage in western North Carolina, raised the lake to 3½ ft. above normal, thus holding the waters of the lake considerably above their ordinary level for about two weeks.

The earth dam, measuring 16 ft. across the top and built with 1:1 slopes, was protected in 1912 with stone riprap, and a breakwater was added at a cost of $12,000. A 400-kw. power house, 16 x 38 ft., of brick construction, also was built. It was supplied by a steel pipe line, 20 in. at the intake, reduced to 12 in. at the power house. The spillway and intake were located around a knoll from the main dam in another gap of the hill. The normal flow of the river is 900 ft. per minute.

There have always been fears as to the safety of this dam by the people living in the upper part of South Carolina, and soon after the Pacolet flood of 1903 a committee from South Carolina visited this dam, but nothing more was done about it. The water elevation of the lake was 2998 ft., and covered 540 acres with a probable average depth of 20 ft.

The dam had a concrete spillway 20 ft. wide, which was undamaged, with a 3 x 3-ft. gap in the center. It was built under the supervision of T. S. Boswell, engineer of the Toxaway & Brevard Railway and of the Toxaway Company, with J. F. Hayes, of Brevard, N. C., as superintendent.

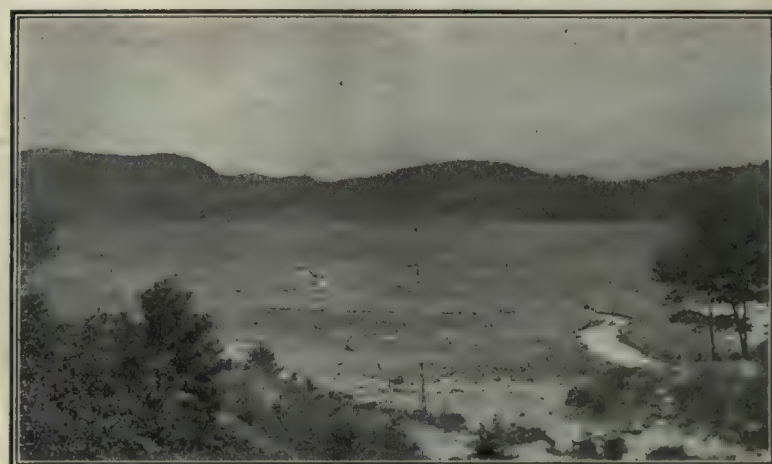
MAIN TRUSSES OF QUEBEC BRIDGE STAND READY TO LIFT SUSPENDED SPAN TO FINAL POSITION FROM SIX PONTOONS THAT WILL FLOAT IT TO SITE

Earth Dam at Lake Toxaway, N. C., Washed Out

FOUNDATION ROCK EXPOSED BY WASHOUT

PORTION OF EARTH EMBANKMENT REMAINING

LOOKING DOWNSTREAM AT DAM SITE



LAKE EMPTIED IN ABOUT THREE HOURS

BOATS STRANDED AS WATER RECEDED

WHERE FLOOD SWEPT AWAY POWER HOUSE

About Aug. 5 a small stream or spring of seepage at the foot of the dam, which had been running ever since the dam was built, was noticed to be larger, but remained constant until about noon Aug. 13, when it was noticed to be muddy. About 6.30 p. m. it began caving, and at 7 o'clock the dam started giving away. About 270 ft. in the center went out, draining the lake in from 2 to 3 hr., leaving thousands of game fish on the lake and river bottom. The waters carried out everything to solid rock, except a small section near the stream bed at the bottom of the original dam, which was well compacted. The stone wall built at the upper toe of the dam was not injured.

Just below the dam was situated a wooden county bridge at the head of Toxaway Falls, which are 300 ft. high. The flood at the bottom of the falls was about 75 ft. high, sweeping on through the gorge from 30 to 35 ft. above normal, though only raising the stream about 10 ft. at the mouth of the gorge some 10 or 12 miles below. The power house was completely destroyed, only a few small pieces of metal and wire having been found of the power house or machinery. But very little damage was done to property below on account of the breaking of this dam.

A very bold sulphur spring which, before

the break, was located near the lower side of the dam on the left-hand end and about half way up the dam, is now flowing from the opposite side of the hill in the lake bed. Silt and mud are deposited near the edge of the lake where the streams flowed into it, but the main body of the lake bed is free from sediment, with trails and roads as plain as when covered.

This dam appears to have been well built for this type of structure, a channel being blasted in the solid rock and earth packed in to obtain anchorage. The break appears to have been caused by water flowing through seams or fissures in the rock about 5 ft. above and 20 ft. to the left of the creek channel. The increased head in the lake, remaining so long, increased the flow of this stream, causing undermining at this point. The water was never nearer than 5 ft. of the top of the dam.

H. C. Jennings of Philadelphia, owner, states that he does not know as yet whether the dam will be rebuilt or not. The hotel is closed, and most of the owners who have summer homes around the lake have left.

Cleveland Intake Tunnel Being Pushed to Completion

The heading from crib 5, at the outer end of the Cleveland waterworks intake tunnel, which filled with mud for a distance of 287 ft. behind the face at the time of the explosion on July 24, has been practically cleaned out. The last bodies have been recovered, fixing the total number of dead at nineteen. The gas flow, which is just as strong now as at the time of the explosion, is under control and is being carried to the top of crib 5. A good many of the concrete lining blocks were found displaced in the section cleaned out, and some timbering was necessary to get to the heading.

C. P. Jaeger, deputy commissioner in charge of the division of water of the Cleveland Department of Public Utilities, has informed the Engineering Record that there is no truth in the report that it might be necessary to abandon the section of the tunnel in which the explosion occurred. It is planned, if possible, to drive the heading from crib 5 for a distance of 200 or 300 ft. beyond the point where the gas flow was encountered, to avoid the risk of striking the same flow in the heading being driven out from the shore. Work in the latter heading is being prosecuted as usual with three shifts a day, and the gap of 1400 ft. between the two headings—the only section of the 16,000-ft. tunnel yet to be completed—is being closed at a good rate of progress.

Iowa and Illinois Waterworks Men Will Convene in October

The Iowa and Illinois sections of the American Waterworks Association will hold a joint meeting Oct. 10 and 11 at Davenport, Iowa, and Moline and Rock Island, Ill. The business session of the Iowa section at Davenport will occupy the time of the delegates during the first day. Oct. 11 will be spent inspecting the filter plant at Rock Island and the pumping stations at Bettendorf, Iowa, and at Rock Island and Moline, Ill. After the dinner at Moline two illustrated papers will be presented, one by Leonard Metcalf, president of the American Waterworks Association.

Describes Results of Concrete Tests

Prof. F. E. Giesecke, head of the division of engineering in the bureau of economic geology and technology of the University of Texas, has issued an advance circular in which are described the preliminary results of a series of experiments in the preparation of concrete. The data seem to show that in preparation of concrete it is unwise to mix the ingredients according to some arbitrary proportion. The preliminary results, including a diagram of those obtained thus far in the experiments, as well as the complete bulletin, will be furnished free on application to the University of Texas.

Texas Hurricane Kills Three and Causes $2,000,000 Loss

A severe tropical storm Aug. 18, extending over ten counties surrounding Corpus Christi, Tex., caused the death of thirteen persons and a $2,000,000 loss in crops and property. The wind, said to have reached a velocity of nearly 70 miles per hour, whipped up such a sea that a large pleasure pier at Corpus Christi was demolished. Many smaller structures along the shore were also destroyed. The storm-stricken area extends about 150 miles along the lower Gulf coast, from Corpus Christi to Brownsville, and from 30 to 50 miles inland.

Concrete Structure Falls But Is Undamaged

The concrete power house of the hydroelectric plant at lock 29 on the New York Barge Canal at Palmyra slipped from its foundations last month into the position shown. In spite of the unusual stresses which must have been caused by the movement, the structure is undamaged—not even cracked. The machinery, too, is said to be in perfect condition and has been stored in near-by sheds. Quicksand is thought to have caused the failure.

THOUGH THIS STRUCTURE SLIPPED FROM ITS FOUNDATIONS IT WAS UNDAMAGED

San Francisco-Oakland Bridge Plans Discussed

A public hearing of the proposed San Francisco-Oakland bridge was held in San Francisco Aug. 15 before a board of army engineers made up of Col. Thomas H. Rees, Col. Charles L. Potter and Major George B. Pillsbury, at which bridge plans were considered as follows:

1. By the associated bridge engineers, Wilbur J. Watson & Co., Cleveland; William R. Davis, Albany, N. Y., and Harlan D. Miller, Albany, N. Y., and Oakland, Cal. The bridge is to extend from First and Adeline Streets, Oakland, to Second and Townsend Streets, San Francisco. It is to have 200 and 250-ft. steel spans, with clearances of from 20 to 90 ft., including one bascule or lift span with 200-ft. waterway. The estimated cost, $23,000,900, is to be met by bonding a bridge assessment district made up of San Francisco, Oakland, Alameda, Berkeley and adjacent towns. It is believed that the revenue from the traffic on the bridge would pay for its construction in about twenty-five years.

2. By Charles Evan Fowler, of Seattle. Bridge of cantilever type, to extend from Oakland to Goat Island, with three 2000-ft. spans, 150 ft. high; then to Telegraph Hill, San Francisco, with 2950 ft. of steel spans, including an 800-ft. cantilever span. The estimated cost is $75,000,000, which is to be met by the formation of a private corporation which will build the bridge and take over the transbay transportation systems and charge a 5-cent rate for street car and bridge.

3. By Alan C. Rush, of Los Angeles. Suspension bridge from Alameda shore to Rincon Hill, San Francisco. It is to be 180 ft. high, with spans of 2000 ft. The estimated cost is $32,000,000. It is proposed that Oakland and San Francisco should donate terminals and secure two-thirds of the bridge stock.

At a final hearing held in Oakland Aug. 17 a fourth plan, by Col. Robert A. Lee Van Folkenberg, was presented for a pontoon bridge to cost $19,000,000. A tunnel was advocated by Taggart Aston, modeled after the Detroit tunnel, to cost $15,000,000 for one double tube. Charles F. Reuter offered plans for tubes and terminals at an outlay of $33,000,000, Jerome Newman filed a plan for a trench type of tunnel and John G. Little proposed a low bridge or roadway for the greater part of the distance across the bay, leaving open only a 2000-ft. channel, which could be traversed through a tube.

The data gathered by the army board will be forwarded to Washington for decision by the War Department as to whether a structure could be built which would not be a menace to navigation.

City Will Experiment with Auto Trucks

An 8-ton truck is to be purchased by the city of Cleveland and experiments will be made to compare its efficiency with that of teams of horses. The machine will first be employed in the collection of waste paper and rubbish. If motor trucks are decided upon, it is estimated that about fifty will be required for the street department.

Course in Practical Concrete at Wentworth Institute

Wentworth Institute, Boston, will add to its courses of instruction this fall one on practical concrete, having for its object the training of young men for concrete-construction work. The institute has set aside one of its best laboratory rooms for this course and is fitting it with modern testing machinery and other necessary equipment to make possible various determinations illustrating the technical as well as the practical sides of the applications of concrete.

This work has been made possible largely by the co-operation of the Portland Cement Association, the work having been planned by its extension division. J. C. Donaldson, field engineer of that division, will be located at Wentworth Institute for some time. He will assist in the necessary preliminaries and in starting and directing the course along the lines planned.

Flood in Missouri Carries Away Bridges and Railroad Track

A 4-in. rain at Hannibal, Mo., and a 6.4-in. precipitation at Louisiana, Mo., Aug. 15 transformed the rivers near those cities into miniature torrents. Probably the greatest damage was that in the Salt River and Noix Creek valleys, where bridges of the Chicago, Burlington & Quincy Railroad at Bush, Grassy Creek, Noix and Buffalo were reported washed away. The tracks of the Burlington and the Chicago & Alton Railroad were also damaged.

Highway Superintendents Meet September 14

The New York State Association of County Superintendents of Highways will convene Sept. 14 and 15 in the court house at Syracuse. Road work in New York State will be the topic of discussion at the meetings, which will be held in the mornings only.

Exhibit at New England Waterworks Convention Opens Sept. 12

The committee on exhibits for the thirty-fifth annual convention of the New England Waterworks Convention at Portland, Me., has announced that the exhibit room will be opened Sept. 12 at noon. As the formal opening of the meeting will not be until the following morning, plenty of time is allowed for an inspection of the various displays before the business sessions.

Chemical Industries Will Exhibit Week of September 25

The Second National Exposition of Chemical Industries will be held at the Grand Central Palace, New York City, the week of Sept. 25.

What Engineers and Contractors Are Doing

CLARENCE D. POLLOCK and GEORGE A. TABER have opened consulting engineering offices in the Park Row Building, New York City. The new firm, under the name of Pollock & Taber, will specialize in paving, water-supply, sewerage and sewage-disposal problems. Mr. Pollock has had more than twenty years' experience, partly in charge of paving in New York City, the Borough of Brooklyn, Havana, Cuba, and San Antonio, Tex. He has also studied and practised sewerage design and construction. Mr. Taber has been engaged in water-supply engineering for more than fifteen years, spending several years in that department of New York City and three years as engineer-in-charge of the Croton Aqueduct Commission. In 1912 he was appointed professor of water supply and sewage disposal at the Brooklyn Polytechnic Institute, the duties of which office consist of conducting lectures in the evening. The last three years he has been associated with Nicholas S. Hill, Jr., and S. F. Ferguson. He will retain his connection with the Brooklyn Polytechnic Institute.

E. C. LARUE, United States hydraulic engineer, formerly at Salt Lake City, has been assigned to the special water-power investigation in Oregon.

E. C. MILLER, superintendent of construction for Iliff Brothers, contractors, of London, Ohio, is now directing the erection of concrete arch work on the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, with headquarters at Richmond, Ind.

H. H. BRAUN has resigned as engineer for E. W. Moir, representative of the Ministry of Munitions of Great Britain, to become general superintendent for M. P. and J. T. Davis. He will have charge of building the $5,000,000 government drydocks and shipyard at Quebec. Mr. Braun was graduated from the University of California in 1908, after which he was made superintendent on the construction of the hydroelectric system of the Arizona Power Company. His next work was as construction engineer for the Mexican Light & Power Company. In January, 1910, he was appointed chief engineer for the Mexican division of the U. S. Smelting, Refining & Mining Company, resigning to take charge of building hydroelectric plants for the Ebro Irrigation & Power Company near Barcelona, Spain. For the past year Mr. Braun has been engaged in organization of the munitions supplies for the British Government.

ROSS L. SHREVE has resigned as city engineer of Tillamook City, Ore., because of the increased demands on his time as engineer of Tillamook County.

H. C. BRENT, vice-president of the Fidelity Trust Company, Kansas City, Mo., was recently appointed president of the Keystone Construction Company and of the Salina Northern Railway. The Keystone Company is building the railroad, of which Mr. Brent is now the chief officer.

JOSEPH RIPLEY and MORTIMER G. BARNES, consulting engineers, of Albany, N. Y., have been retained by the Massachusetts Commission on Waterways and Public Lands to report on the construction of the new drydock in Boston harbor. They will pay special attention to the method of cofferdam construction. After graduation from the University of Michigan in 1876 Mr. Ripley entered the service of the U. S. Government as masonry inspector on the Weitzel lock of St. Mary's Falls Canal. He was made assistant engineer in 1879 and placed in charge of improvements on the St. Mary's River. For a year he had charge of the survey of the Birmingham (Ala.) Canal, returning to Michigan as general superintendent of the St. Mary's Falls Canal. He was made a member of the board of consulting engineers of the Panama Canal in 1905 and the following year principal assistant engineer in charge of locks and dams. His appointment as assistant chief engineer in charge of plans for dams, locks and regulating works came in 1907. Mr. Ripley opened consulting offices in Albany in 1911 and is at present a member of the advisory board of engineers on the New York Barge Canal. Mr. Barnes was graduated from the University of Michigan in 1896. His engineering experience acquired before and while attending college was sufficient for him to qualify as masonry inspector on the U. S. ship canal at Sault Ste. Marie, Mich., which position he left late in 1897 to take charge of a survey of the ship canal from Birmingham to the Warrior River in Alabama. He was employed on the Michigan-Illinois canal from 1898 to 1905 and later served on the Panama Canal, leaving that work to practise consulting engineering in New York City. He has been connected with New York State canal work for a number of years.

HUGH M. STRYKER was recently engaged by the department of agricultural engineering at Montana State College to assist in the collection of data for two drainage projects near Bozeman, Mont.

HENRY L. RIVERSFILE, formerly with the Pennsylvania Railroad on construction of the new line from Indianapolis to Frankfort, Ind., has been made resident engineer in charge of street construction for Gilbert C. White, consulting engineer, of Durham, N. C. Mr. Riversfile is a graduate of Clemson College and for several years engaged in railroad and municipal engineering in Indiana and Ohio.

OSCAR A. D'LUHOSCH, formerly junior assistant engineer in the highway department of the State of New York, is now with the New York Public Service Commission in a similar capacity. At present he is located in Brooklyn on tunnel inspection. Previous to his employment by the New York highway department Mr. D'Luhosch was with B. H. Brevoort, consulting engineer, of Poughkeepsie.

M. P. NORTHAM, office engineer of the Southern Railway at Washington and before that assistant division engineer of the New York division of the Baltimore & Ohio Railroad, has been appointed supervising engineer.

WARREN B. JAMES, assistant at the summer surveying camp of the University of Michigan, will in September assume his duties as assistant engineer on construction of lock 4 of the ship canal at Sault Ste. Marie, Mich.

GEERT BLAAUW is now employed as designing engineer for the Pyrites Company, Limited, of London, England. He is located at Wilmington, Del., where the company is building a new plant, which will be its second in the United States.

Obituary Notes

COL. W. P. CLOUGH, chairman of the board of directors of the Northern Pacific Railway, died Aug. 17 in New York City. Colonel Clough was a close associate of the late James J. Hill.

EDWARD CANFIELD, general superintendent of the New York, Ontario & Western Railway, died Aug. 18 at Middletown, Ohio. He had been employed by that railroad since 1882. After graduation from Hobart College he entered railway service in 1869 in the engineer corps of the Erie & Genesee Valley Railroad, resigning a year later to become division engineer of the Syracuse Northern Railroad, in which position he remained for two years. The year 1872 found him in a similar position with the Pennsylvania Petroleum Railroad, from which he resigned the following year to become assistant engineer for the Atlantic & Great Western Railway. Mr. Canfield left the employ of the Atlantic & Great Western to go to the Syracuse, Geneva & Corning Railway as division engineer, remaining in that road's employ until his appointment in 1879 as assistant engineer for the New York, Lake Erie & Western Railroad. His promotion as roadmaster followed soon, and in 1882 he went to the New York, Ontario & Western as division superintendent. He was made chief engineer in 1887 and general superintendent in 1895.

ERNEST F. TABOR, project manager for the U. S. Reclamation Service of the Flathead project, Montana, died Aug. 20. Mr. Tabor was born in 1866 and had been engaged in engineering work for the past thirty years. For the Reclamation Service he conducted important work in a number of Western states and had charge of the Flathead project practically from its inception, including the design and construction of irrigation works costing upward of $1,500,000.

Civil Service Examinations

United States—Examination Sept. 19 for mechanical draftsman in ordnance department; salary, $1,320. Another for assistant examiner in patent office, salary $1,500, will take place Sept. 13-15. Form 1312 should be filled in by applicants.

Examinations Previously Announced

Date		See Eng. Record
Sept. 2.	Chainman, sanitary-engineering draftsman and superintendent landscape construction, New York State	Aug. 19
Sept. 5.	Subinspector U. S. radio towers	Aug. 19
Sept. 6 and 7.	U. S. structural-steel draftsman	Aug. 19
Sept. 13.	Aid in Coast and Geodetic Survey	Aug. 5
Oct. 11.	U. S. junior civil engineer	Aug. 19

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Complex Structural Detailing

AN interesting example of that type of structural design and detailing which tests the resourcefulness of designer and detailer is the Orpheum Theater in Boston. The required clear lower floor area was obtained by supporting the entire balcony framework of cantilever trusses and diagonal girders on a long, deep truss. A study of the general plan and of the details of connections, reproduced on page 287 of this issue, will indicate some of the problems which arose, and the method of solution. The limiting requirements set by overhead clearances, openings for doorways, etc., further complicated the design, and explain the unusual outline of the main truss. The use of Bethlehem H-sections for the main chords of the long-span roof trusses is claimed to have resulted in economy in material and in simplified details. The structure contains well-devised solutions of difficult problems and merits the careful study of structural engineers.

Houses of Cards

A NEW YORK BUILDER examined by the coroner's jury after a structure on which he was working collapsed, killing two people and injuring seventeen others, admitted that he did not know the requirements of the building code with reference to the proportions of the mortar ingredients. It was further shown that in an endeavor to skin the construction as much as possible there were various violations of the architect's plan. The instance brings nothing new to the attention of those familiar with the work of cheap contractors and with the type of apartment houses which are going up in so many of our cities. The owners desire to make their money go just as far as possible, regardless of the quality of the resulting structure. They figure on first cost only, and hope to dispose of their holdings long before heavy maintenance charges must be met. One good result should come from the disaster —a determination of all who have supervision or authority over such construction to be particularly suspicious of that class of structure, to insist upon rigid inspection and prompt stoppage of work when it is not in conformity with the building regulations. Laxity will sooner or later lead to a repetition of the New York experience.

Facts About Concrete

CONVINCING EVIDENCE that the work being done by the U. S. Bureau of Standards is of great value is presented in Technologic Paper No. 58, on the strength and other properties of concrete. The pamphlet reports investigations of a comprehensive character, made from the standpoint of requirements in actual construction and stimulated by the desire to answer scientifically questions concerning the effects of materials and manipulation upon the properties of the product. The abstract and conclusions presented on page 283 of this issue can only suggest the variety of the tests made, and the nature of the more important results. Two conclusions of practical importance should be strongly emphasized: First, that fluid concrete, so often used on construction work, probably develops only one-half the strength which the ingredients are normally capable of producing; and, second, that great economy results from proper proportioning of the aggregates and the use of large-size stone in plain concrete. These facts are not new, but the strong array of exact independent data presented should convince contractors and engineers of the soundness of the theories which this journal has in the past so strongly supported. It is ridiculous to require cement manufacturers to spend money in increasing the fineness and cementing value of their product by 10 to 20 per cent when misuse of the product in fabrication may decrease the strength by 50 per cent. This investigation is further valuable in the emphasis it places upon the necessity for testing the concrete that goes into a structure, under conditions duplicating construction conditions. Real evidence of fitness to carry stress comes only from such tests. The possibility of economies, through the use of properly proportioned aggregates, should stimulate the making of field tests and result in an improved product.

A Barrier Not Raised

UNDER the Clayton act it is illegal for competing firms to combine or co-operate to regulate prices. That section of the law prevents American manufacturers of a given product from pooling their interests in foreign trade promotion. Without such co-operation, however, it is impossible for small manufacturers to enter successfully into the foreign field and withstand the competition of government aided German firms and of British, French and Dutch export houses of great financial strength and long experience. The Clayton Act was passed, presumably, for the protection of the American consumer. It was not intended to aid foreign manufacturers in their competition with us in our export trade. That is, however, just what it is doing. An attempt was made at this session of Congress to secure legislation which would exempt combinations formed solely for export-trade purposes from the provisions referred to. Congestion in Congress, however, and the opposition of a member of the House have made it impossible to reach the measure at this session. Our foreign trade, therefore, must stumble along as best it can burdened with this weighty handicap. The unfortunate feature of the postponement is that the present is the best time ever afforded the American manufacturer to establish himself in the foreign field. Before Congress meets again or can act peace may have been declared and the situation radically altered. The measure was urgently needed. Its sidetracking is a detriment to the entire country.

Typhoid and Accident Insurance

CAN TYPHOID FEVER, contracted by employees as the result of drinking impure water furnished by their employer, be classified as an "accident arising out of the conduct of the business"? This is the question which the United States Circuit Court of Appeals, Ninth Circuit, was called upon to decide in the case of the Aetna Life Insurance Company vs. the Portland (Ore.) Gas & Coke Company. The defendant insurance company issued a "contractor's employer's liability policy," insuring the plaintiff against expense resulting from accident claims. Employees of the gas and coke company contracted typhoid fever from drinking water furnished to them by the plaintiff. The court held that this was an accidental injury within the terms of the policy and that the insurance company was liable. The decision is one which has an important bearing upon the cost of construction work.

Eccentric Column Loading

VITALLY affecting column design is the question of what provision should be made for eccentric loads. The question lies in the region of indeterminate problems, because of the uncertainty regarding end conditions in mill-building columns and the effects of continuity in the framework of office buildings. The discussion of this question by Mr. Fleming on page 296 of this issue leads to the conclusion, after the more exact formulas are presented, that approximate methods, using ¾ to 9/10 of the computed bending moment for pin-ended conditions, give satisfactory values for these types of buildings. In this connection it is of interest to point out that certain handbooks have published incorrect formulas for the bending moment in mill-building columns. These formulas include the entire eccentric moment Pm, without the reducing ratios a/l or d/l which appear correctly in Mr. Fleming's equations. The customary use of a 20 per cent higher unit stress for the extreme fibers of eccentrically loaded columns is advocated by Mr. Flem-

ing. He presents the results of studies of the involved subject of bending produced by eccentric loads in the columns of steel office buildings, and his statement of the general practice of designers and the discrepancy between theoretical formulas and such current practice raises a question deserving further discussion: Are the fundamental assumptions upon which these theoretical analyses are based sufficiently exact to throw the burden of proof upon the practical designer when he does not conform to the results of such analyses? The Engineering Record urges free expression of opinion on this point.

Sewage Disinfection

WE appear to be entering an age of disinfection. The element chlorine is looking up. In the form of calcium hypochlorite, or bleaching powder, and more recently as the element itself, in the form of liquid chlorine, its application to public water supplies has become widespread in this country. Used under proper conditions its benefits are unquestionable. Being successful in this field there is a natural tendency to extend its use to other fields. To some extent it has been used for the disinfection of sewage and sewage effluents. The latest suggestion is that oysters be disinfected with calcium hypochlorite after being taken from polluted beds. The practicability of this is described by William F. Wells, of the U. S. Public Health Service, in a recent number of the "Public Health Reports."

The extension of chlorine disinfection to new fields must be made with caution. This method of destroying bacteria, while often efficient, has limitations which may not be safely disregarded. The paramount virtues of the hypochlorite method of water disinfection are cheapness, simplicity and availability. Virtues, however, may become vices. It was soon learned that this method was too simple. The idea became prevalent that a few barrels, or tanks, with stirring and measuring devices for applying the solution to water, was all that was required. This was wrong. Brains are required, and constant, patient attention to the simple devices. In times of emergency simple devices like these will receive the attention that is necessary, but after the emergency has passed interest is likely to lag and the process becomes intermittent and unreliable. It would be possible to mention the names of cities where this process has broken down under such neglect and where the germs of typhoid fever succeeded in getting by. One of the chief reasons why the use of liquid chlorine is better than bleaching powder for permanent use in water disinfection is because the devices require a higher grade of attention—although not more attention, measured in terms of labor.

Another virtue of the use of chlorine for disinfection is the rapidity of its action. Although not instantaneous, it is measured in seconds rather than in hours. Bacteria which come within its range are speedily killed. This virtue likewise has its failing. Apparently there is no second blow. It is a case of now or never. If bacteria succeed in passing by this one ordeal they remain alive. In water which contains organic matter the chlorine soon loses potency as a germ killer.

From the foregoing it follows that a rapid and intimate mixture of the disinfecting solution or gas with the water is absolutely essential. There is much room for improvement in this detail of the method, and the disinfection of water in suction pipes, in pipes under pressure, in flumes, and at the inlets and outlets of basins offers a series of problems which must be carefully considered, each by itself. Accidents in the disinfection of water resulting in outbreaks of typhoid fever have already occurred from the failure to obtain proper application of the chemicals, although these have been due more frequently to interrupted service than to imperfect mixing.

Another interesting method of failure of disinfection recently occurred in one of our large lake cities. In order to protect the consumers against the possible taste and odor of chlorine in the water a neutralizing chemical was used, thiosulphate of soda. This was added at such a short-time interval after the disinfectant that the action of the latter was interrupted before it had accomplished its work. This is said to have been the cause of an outbreak of typhoid fever in the city.

The chemical disinfection of sewage has always made a strong appeal to sanitarians. Unquestionably it has possibilities of usefulness, but in making application it must not be forgotten that here again we must consider the fleeting character of the reaction. The solution of bleaching powder or liquid chlorine kills those bacteria which it can quickly reach, and only those. In water the bacteria are present as free individuals or in small chains or clusters. Their surfaces are exposed to the destroying agent. In sewage they are partly free and partly enmeshed in lumps of organic matter. In the process of chemical disinfection only the free bacteria and those on or near the surface of the lumps are killed. Those within the lumps are so protected that they may remain alive until the action of the chlorine has spent itself. Later the disintegration of the lumps may liberate the bacteria which survived. It has been suggested that liquid chlorine has a greater power of penetration than calcium hypochlorite. If true this would be important, but thus far no evidence in this direction has been obtained. Judging from its rapid action in water its greater penetrating power may well be doubted.

There appear to be but two ways of overcoming this difficulty of disinfecting solid particles. The first is to increase so greatly the quantity of disinfectant used that a sufficient amount of the active substance will remain until penetration of the masses, or their partial disintegration, has occurred. The second is to remove the suspended matter from the sewage before disinfection—that is, limit disinfection to sewage effluents. Perhaps some intermediate combination of these might be made to produce the maximum economy, namely, a partial removal of the suspended matter and an increase in the dose of chemicals over that required for a clear liquid. Here as in all cases the process to be adopted must be based upon the required character of the final effluent. The earlier experiments in this direction were made with calcium hypochlorite and the removal of suspended matter by sedimentation and filtration. We now have a new possible combination, namely, liquid chlorine for disinfection and the activated sludge process for clarification. This combination does not alter the main elements of the problem, but it must of necessity change the value of the constants. It is to be hoped that one or more of the experiment stations may not lose the opportunity to obtain new evidence along this line of sewage treatment.

Prizes for Plumbing Theses

IT IS A FACT which few will venture to deny that plumbing fixtures and plumbing equipment generally are not designed from the standpoint of economy, but rather to promote safety and luxury. Elaborate devices and systems of pipes are installed in order to protect the air of houses from the supposedly dangerous sewer air, while bowls, faucets and all sorts of devices are introduced to embellish bathrooms and make the necessary fixtures for water supply and waste disposal attractive. Insofar as this contributes to the use of water, to cleanliness and to artistic features of our homes and public lavatories, it is a good movement. That clean-looking and attractive plumbing fixtures tend to produce cleanly habits and thus promote health is almost self-evident. On the other hand many of the modern fixtures are lavish in the use of water. Sewer air, although objectionable, does not disseminate the germs of disease. Trapping can be carried too far.

There appear to be several reasons why plumbing continues to remain complicated, in spite of the passing of the sewer-gas theory, and even to become more complicated. Dealers are naturally desirous of selling plumbing supplies, and the labor unions are naturally desirous of cultivating the field for labor. Public health authorities, zealous for the welfare of the community, have allowed regulations prescribing elaborate designs to be put in force, not always realizing what it means to the house-owner in dollars and cents.

A more important reason, perhaps, is the lack of interest which has been taken by engineers and sanitarians. The whole subject of plumbing has been left in the hands of those who profit by selling materials or labor. Perhaps the worst feature of the situation is that the young men from our technical schools apparently take little interest in the subject. Last year a prize of $200 was offered to the students of Harvard University and the Massachusetts Institute of Technology for the best essay on some topic relating to plumbing design or the materials used in plumbing systems. Not a single student entered the contest.

This year the donor has decided to throw open the contest to students of other schools where the subject of plumbing is taught and

even to persons who are engaged in the practice of plumbing. Three prizes are to be awarded for the best theses, one to be competed for by instructors, one by students and one by plumbers. Details regarding these prizes will be found in the news section of this issue.

Why should the engineer take an interest in plumbing? Because it represents an annual expense of many millions of dollars; because the great size of the modern steel building has increased the complexity of designs so that they require engineering skill; because there is here an opportunity for applying the principles of efficiency to everyday life; because it is desirable that there be better co-operation between the business and the professional interests of the country; because the details of house plumbing are the connecting links between the water and the sewer systems and good sanitation is needed in the interest of public health and comfort.

It will be interesting to see what topics are chosen by the contestants for the Nelson prizes, for the field is left wide open. It may be the economical design of a wash basin, or a discussion of non-siphoning traps, the relative advantages of cast iron or steel soil pipes or the necessity of maintaining the running trap on the main house drain. There are topics innumerable.

Rejecting a Hard-Won Principle

AT THIS WRITING the most engrossing subject before the American public is the railroad controversy. It is still likely to be the paramount public question when this issue of the Engineering Record reaches its readers. The storm has long been brewing. Conferences between the railroad officials and the brotherhoods were of no avail. Then the federal board of mediation and conciliation failed and now the President of the United States, unable to bring the contending parties to an understanding, is appealing to Congress for legislation which will avert the impending disaster.

There is much talk in the press as to whose will be the responsibility if the strike should come. Last week the President was the favorite candidate for the rôle of scapegoat, though he was valiantly trying to unload the threatening burden on the railroad executives. It appears that the original guilty party would escape from his due meed of blame. Now, however, the public's mind is clearer. The bringing of the controversy before the President has aroused the interest of the dullest citizen. The setting was dramatic and attention has been comparatively easy to get. Both sides have had their say and the public, if deceived before, now comprehends the issue clearly. Newspapers which heretofore have failed to grasp the meaning of the "eight-hour basic day" have, during the last week, presented it correctly in their editorial columns.

Even the most heedless citizen, therefore, knows where the responsibility for the strike, if it should come, must lie. The employees throughout the negotiations have steadfastly refused arbitration on the main issue of the controversy—their demand that they be given ten hours' pay for eight hours' work. They have deceived the public—it appears even that they have deceived the President of the United States—into believing that they were contending for an eight-hour working day. On that false ground they won much sympathy. The advantage was only temporary. A reaction came when the truth became known.

From the very beginning the railroad officials have shown a conciliatory attitude. They were willing to give and take upon the merits of the controversy. In June a conference was held with brotherhood leaders, but it was impossible to secure a fair discussion of the issue with them. The leaders were unyielding on the main point in controversy. Then by an unfairly worded ballot, which compelled the employees to declare in favor of the basic eight-hour day, the men authorized the brotherhood leaders to use their judgment. The chiefs thereupon reiterated the demand that they should have all they asked for, or the trains would be stopped. Another conference was held at the request of the railroad officials. It proved fruitless. The officials then, not the employees, appealed to the federal mediation board. Again the railroads were in a conciliatory mood, the men stubborn in their refusal to discuss the main issue.

Despite the fact that labor has fought for a generation for the principle of arbitration, the brotherhoods have in this controversy rejected the principle. They claim that their demand for the eight-hour basic day is not arbitrable, apparently on the ground that a shortening of hours is vital to their welfare. As has been pointed out, however, the demand is in fact not for a shortening of hours, but for an increase in wages. The men are willing to arbitrate their "time and a half for overtime" request, but not the wage increase demanded under the cloak of a shortening of hours.

But should a demand which seriously affects the finances of the railroads be non-arbitrable? The public has set limitations, through the Interstate Commerce Commission, to the earnings of the railroads. They are at the mercy of the public on the one hand. Shall they be allowed to be at the mercy of one group of their employees on the other?

One would think from the stubbornness of the demands that the brotherhoods were representing all of the employees of the roads. As a matter of fact their membership includes only 18 per cent of the total number of railway workers—though they received 28 per cent of the total wages. Shall the brotherhoods' wage-increase demands be non-arbitrable without giving these other 82 per cent their day in court? The other employees are now awakening to their situation. Some 80,000 of them have signed a petition asking that steps be taken so that their livelihoods will not be interfered with. They have not demanded more pay or shorter hours. That they are awakening to the position in which they are placed by the brotherhoods, however, is apparent. They have rights which surely have some relation to those of the unyielding brotherhoods. Arbitration might shed light on that relation.

Instead of being objects of sympathy, which they were when their demands were wrongly understood, the brotherhoods are now standing forth in their true light—as enemies of American industrial peace. They have rejected the medium, built up through long time and much stress, by which industrial controversy can alone be satisfactorily settled — arbitration. They have tried to carry labor back a generation and to put force in place of conciliation. They have adopted the ways of industrial war rather than of industrial peace.

The strangest feature in the whole controversy is that the President of the United States, claiming he was an advocate of arbitration, should concede to the men their major request and demand of the railroads that they concede a ten-hour rate for an eight-hour day, leaving only the minor demands to arbitration. The railroads were right in refusing to accept the President's terms and, in the opinion of this journal, the country will stand behind them in their refusal.

Yet, true to the conciliatory attitude they have borne throughout the controversy, they have countered with reasonable requests. They are willing to set aside a fund which would represent the difference between present wages and those demanded under the eight-hour basic day, leaving to the decision of an arbitration board the disposal of the fund so created. As an alternative they are willing to grant the President's demand if assured that a rate increase will be given them should investigation show that the increased wages would cut them below a fair net income. To each of these demands, as they became known, the brotherhoods have rejoined their outright refusal. Their course has been consistently one of rejecting arbitration; the railroads', one of accepting it.

Whose, therefore, will be the responsibility if the strike should come?

As has been frequently said with reference to situations arising from the present European war, "peace can be purchased at too high a price." In the judgment of this journal there is no way out for the railroads except to meet the test, to stand where they have stood from the beginning—for arbitration — and let the strike come. Theirs is not the responsibility, and the American public knows it, despite the fact that the President has tried to make them the scapegoats. The issue would have been thrown into clearer light if the President had actually stood for what he claims to stand for—arbitration. By taking an unneutral attitude—untenable in a mediator—he has strengthened the men in their unreasonable position. He must bear some responsibility for the strike. Had he put the employees' attitude clearly before the country, shown up their refusal of an impartial arbitration, instead of siding with them on their major demand, it is hardly conceivable that the chiefs of the brotherhoods could have stood out against public opinion. To our mind the President, in his address to Congress on Tuesday, has unfairly placed the onus on the railroads, while the spirit of his message savors of opportunism and "peace at any price."

THE OLD LOG DAM ABOVE, WHICH DROWNED A SERIES OF RAPIDS, WILL BE BLOWN OUT

Concrete Dam Far from Railroads Built Largely with Materials at Hand

Sand Washed from Hillside, Quarry Opened at Top of Gorge—Interesting Conditions Govern Design of 70,000-Yard Structure for Stream Control

TO BUILD a large concrete dam across the head of Ripogenus Gorge on the West Branch of the Penobscot River in northwestern Maine, 45 miles from the nearest railroad, has required the utilization of every local resource. The boilers are fired with wood cut on the sides of the gorge. A fully equipped sawmill above the dam site supplies all form lumber. A traprock quarry has been opened at the top of the gorge on the south side, and the crusher, sand-screening and concrete plants are strung in order down the hillside to the end of the 850-ft. dam, for the construction of which twin cableways and derricks are being used. Cement and reinforcing rods—the only construction materials brought in in large quantities—are transported over the motor-truck freight road described in the Engineering Record of Aug. 19, page 237.

Unusual conditions dictating the construction for regulation purposes only of a dam at what might seem, to engineers unfamiliar with the conditions, primarily a site for power development, have presented an interesting design problem.

Dam Aids in Making Paper

On the headwaters of the Penobscot and Kennebec rivers, in the vicinity of Moosehead Lake, the Great Northern Paper Company, owner of the dam, cuts annually almost a million logs for the manufacture of paper. Roughly four-fifths of these are "driven" down the streams flowing into the West Branch of the Penobscot, then through Ripogenus Gorge and down to the company's three main mills at Millinocket, Dolby and East Millinocket. A labyrinth of natural lakes enlarged by numerous timber dams makes possible control of the stream flow to secure water for carrying down the logs. All of these dams, however, are comparatively low, except that at Chesuncook, 3 miles above Ripogenus, which is one of the largest timber dams in existence, and the only one above Ripogenus designed for storage. The other dams make available little water beyond that required for the purpose of log driving.

Consequently, after the log drive is over each year there is not enough water in storage completely to regulate the river flow for power development at the mills. Below Chesuncook, however, there is considerable fall, these rapids being at present covered by Ripogenus Lake, a small body of water impounded by a timber dam at the head of the gorge. By constructing a modern concrete dam below this wooden dam, it was possible by raising the level of Chesuncook Lake 4 ft. to El. 940 to secure an available drawdown of 53 ft., 28 ft. of which can be drawn from the area above the Chesuncook dam. Even should the reservoir be left at the level of the lowest log sluice after a dry log-driving season, there would still be available 35 ft. of water. Chesuncook Lake is already 35 miles square, and the new lake will have an area of about 45 square miles. As the entire capacity of 18 billion cubic feet above the old dam, in addition to the 10 billion cubic feet added to the reservoir capacity by the new dam, will be available after blasting out the old timber structure, ample capacity for regulating the flow over the entire year will be secured. Moreover, by constructing a tunnel to the foot of Ripogenus Gorge, a head of 240 ft. can be developed if conditions should ever arise creating a market for the power. The country, however, is not adapted to manufacturing, there are no towns of size within many miles, and the company's developments already in operation are ample for its own needs. Therefore the only power developed at the dam will be the 45 kw. necessary for electric operation of the gates, log sluices and a small traveler handling the spillway stoplogs.

Log Sluices Cover 17-Foot Range

Drop gates, releasing only enough water to carry the logs, are a feature of the two log sluices. These sluices are set side by side in the north end of the dam, the 16-ft. gate with its sill 11 ft. below high lake stage and the 12-ft. gate with its sill 19 ft. below this datum. Each gate is set in a concrete flume of the same width. These flumes come together and discharge into the river about 300 ft. below the dam. South of these sluices are the four gates for controlling the river flow. These have a combined clear width of 38 ft., sufficient to provide water for the mills until the lake stage reaches El. 887, 2 ft. above their sills. The gate openings are entirely lined with cast iron, as it was estimated that concrete would be eroded at the velocity developed by discharging under full head.

For the remaining length the crest of the dam stops 8 ft. below high lake level, or at El. 932. At El. 945 is a concrete roadway across the dam carried on piers between which are seated stoplogs up to El. 940. The spillway openings total 450 ft., sufficient to pass the maximum recorded flow of 23,000 sec.-ft.

The dam is built on traprock, the joint

PULP LOGS GOING THROUGH THE UNCOMPLETED SECTION ON THE SUMMER LOG DRIVE

LEFT, QUARRY ABOVE CABLEWAYS AND CONCRETE PLANT; RIGHT, SLUICING THOUSANDS OF YARDS OF GLACIAL DRIFT TO SECURE SAND

cracks of which are being grouted solid to an elevation 50 ft. below the footings.

Plant Layout Takes Advantage of Site

The construction layout can be readily grasped from the accompanying photographs. Traprock quarried at the top of the south side of the gorge is loaded by a traveler into cars feeding a gyratory crusher. From this the stone drops to secondary crushers and thence to the bins over the two 1-yd. mixers. East of these bins is the cement house, receiving cement from the motor trucks, level with its roof, and discharging it by means of gravity rollers to the mixer platform below its floor. Over this house is a rope conveyor with pans which transports the sand from the team dump to the hoppers over the mixer. The mixers discharge into cableway buckets. These are dumped into the forms direct or are rehandled by derricks, for the dam proper. For the roadway, the buckets discharge into movable hoppers and the concrete is distributed in carts. The south half of the dam and the north section to the south side of the sluice gates have been built with little cofferdam work. As soon as the sluice gates are finished, and the log-driving season is over, a crib dam will be thrown across the main channel, the river diverted through the sluice gates and the remaining section of the foundation finished. It is expected that the present season will see the completion of the project.

The only sand found after a thorough search of the lake bottom and the surrounding country was contained in a glacial deposit of sand, clay and boulders 2 miles below the dam. Pumps were installed below the gorge on the river, and an 8-in. pipe line delivering 1500 gal. per minute run to the top of the pit. After clearing the pit and stripping the surface of boulders and vegetable matter, two channels were cut, down which the material is washed to two large basins each holding about 400 cu. yd. The flow of water and the slope of channels and basins are adjusted so that most of the small boulders are dropped above the basins. Practically all of the sand and pebbles lodge in the basins, while all of the clay and vegetable matter overflows the brush dam below each basin and is carried off into the river.

A large force of men and teams are required to remove the boulders, shovel the sand and transport it to the dam where the pebbles are screened out and run into the stone bin. Blasting is frequently resorted to, as the stream through the pipe line, discharged more than 100 ft. above the river, is not under great pressure and depends for its eroding power on the fall in the channels cut for it. Between 20 and 50 per cent of sharp, coarse granite sand is reclaimed from the material sluiced. The cost is higher than the price of sand at several points in the state, but is still below even the cost of transportation of sand from the nearest rail point.

Most of the construction equipment was brought in during the winter on sleds. A large part of it was hauled across the ice on Moosehead Lake from Kineo in the cold winter of 1914-15.

A camp with two mess halls, accommodations for the 350 men employed and cottages for the men in charge, foremen and office force is located upstream from the dam on the south bank. The dam is now being completed by the forces of the Great Northern Paper Company, of which Garret Schenck is president. J. T. Mullen is in charge of the project as superintendent. H. S. Ferguson, consulting engineer, designed the development and is supervising its construction. He is represented on the work by E. W. Prouty, resident engineer.

CONCRETE AND CRUSHING PLANTS ARRANGED ON HILLSIDE ABOVE DAM

Worn Macadam Road Repaired by Tar Spraying

Inexpensive Equipment Employed to Distribute Tar Under Pressure—Detailed Cost Figures Given

By ROBERT H. McNEILLY
Assistant Professor of Civil Engineering, Vanderbilt University, Nashville, Tenn.

ONE of the most puzzling problems which confront the highway engineer is how to repair a macadam road successfully, without excessive expense for scarifying, rolling and clean surfacing stone, when it is determined to treat the road with oil or tar.

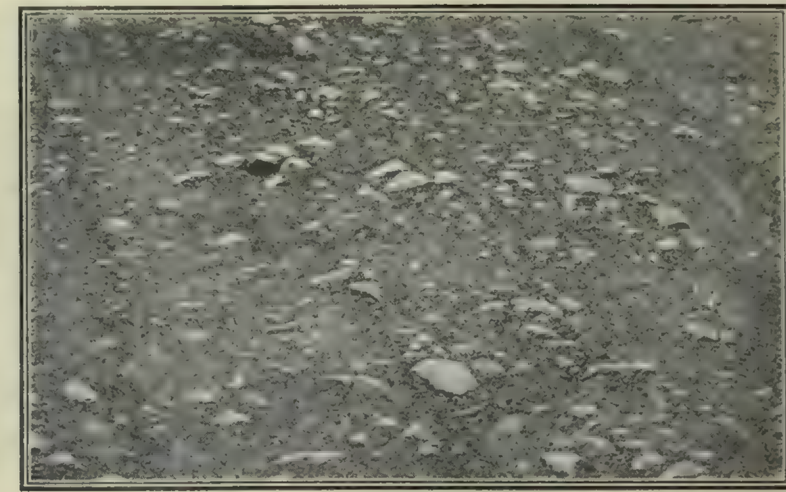
On the campus at Vanderbilt University, Nashville, Tenn., we had a road which was in a peculiarly favorable condition for the application of a light tar. This, it is thought, will serve not merely as a dust preventive, but will act to prolong the life of the road for several years.

Picture 1 shows a general view of this road before treatment. It will be noted that the road is on a steep slope, but carries practically no drainage except the water which falls on its own surface. It was rebuilt about five years ago with a waterbound macadam surface of a peculiarly cementitious limestone. Picture 2 indicates how almost every particle of the binder has when it is determined to treat the road was on the point of going to pieces. On the day when these pictures were taken, difficulty was experienced in finding half a dozen large stones actually displaced in the road surface, while two weeks later, when the work was done, more than 50 such stones were swept out of the road.

Equipment Inexpensive

The road was first swept clean, then Tarvia B, a low-carbon tar, fluid at ordinary temperatures, furnished by the Barrett company, was applied cold by an inex-

1—CONDITION OF ROAD BEFORE TREATMENT



2—EVERY PARTICLE OF BINDER REMOVED BY WASH

pensive equipment developed locally by the Uncle Hiram Roofing & Paving Company, which furnished the labor. The apparatus for applying the tar is shown in Picture 3. An ordinary four-wheel wagon has a 500-gal. tank mounted on it. To this is attached a truck which carries a 2½-hp. gasoline engine, which operates a geared water pump of the single-acting, plunger type. The purpose of this pump is merely to pass the tar, which is siphoned out of the tank, through its suction valves into its pressure chamber. The gasoline engine, at the same time, drives a small air compressor which maintains a pressure of 175 lb. per square inch in the rather large air dome of the pump. The pressure is controlled by a safety valve, which discharges back into the tank if the working pressure is exceeded. This air pressure serves to atomize the tar which is applied to the road through a hose, which terminates in a long gooseneck, with a spray at the end. The total cost of this apparatus need not exceed $500. It will be noted that the equipment is quite similar to a spray-painting outfit.

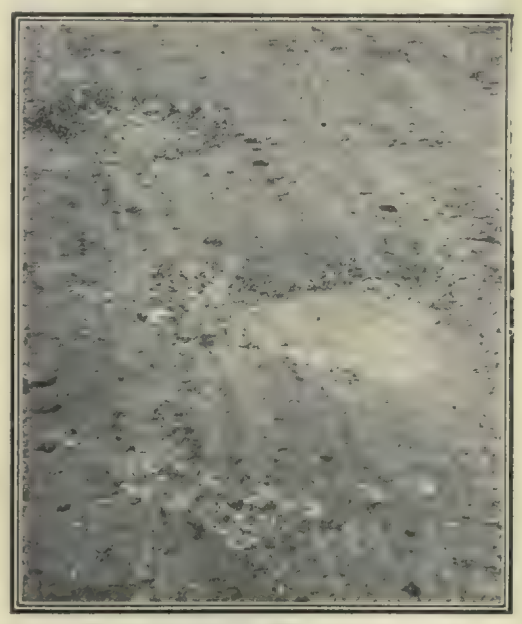
ANALYSIS OF CRUSHED GRAVEL

	Per cent retained
On ¼-in. mesh sieve	3.6
Between ¼-in. mesh and 10-mesh sieve	51.1
Between 10 and 20-mesh sieve	19.3
Between 20 and 40-mesh sieve	8.4
Between 40 and 100-mesh sieve	9.3
Between 100 and 200-mesh sieve	3.2
Passing 200-mesh sieve	5.1

In operation the team pulls the tank and truck about 20 ft. at a time. Then the brakes are applied and the road oiled up to this point, when another move of similar length is made.

The road treated was 595 ft. long and 14½ ft. wide—an area of 933 sq. yd. The time taken to apply the oil was 1 hour 53 minutes, or the rate of application was 8¼ sq. yd. per minute. On larger and continuous work, a speed of 10 sq. yd. per minute can easily be attained.

As the tar was applied, crushed gravel, furnished by T. L. Herbert & Sons, was spread by hand, following close behind the tarring. This crushed gravel is very coarse, and even the material that passes the 200-mesh sieve appears sharp under the microscope. The sieve analysis is shown in the table.



5—POT HOLES DEVELOPED IN IMPROPERLY CONSTRUCTED BITUMINOUS ROADS

This crushed gravel comes from the crusher much drier than river sand and is thus bonded by the tar the more readily. Eight cubic yards were used on the job, which was equivalent to 0.85 cu. yd. per 100 sq. yd. of road surface. This appeared to be rather too heavily applied, and ¾ cu. yd. per 100 yd. of road surface seems to be a more rational quantity. Following the practice developed in Alleghany County, Pa., the gravel was not rolled in, as experience has shown that the ordinary traffic is decidedly more successful in bonding the surface material. Picture 4 shows the detailed appearance of the surface after the work was complete.

The total amount of Tarvia B used was approximately 275 gal. for 933 sq. yd. of road surface, or 0.3 gal. per square yard.

The cost of the normal operation of tarring a road in this manner is as follows:

COST OF TARRING ROAD

Labor	Per day
1 foreman	$3.00
1 engineman	1.50
1 spray man	1.50
4 laborers, sweeping and spreading gravel at $1.35 per day	5.40
1 team and driver	3.50
Gasoline, etc	1.30
Total cost of application per day of 9 hr.	$16.20
Materials, per 100 Square Yards	
30 gal. Tarvia B at 9 cents	$2.70
¾ cu. yd. crushed gravel, at $1.50	1.12
Total	$3.82
Cost of application per 100 sq. yd	.30
Total actual cost to contractor per 100 sq. yd.	$4.12

Assuming a rate of application of 10 sq. yd. per minute, this is equivalent to a total cost for application of 30 cents per 100 sq. yd.

In this connection two interesting pictures are submitted which show some asphalted roads which were more or less a failure. These roads were constructed on Vanderbilt campus in 1910, and were the

3—INEXPENSIVE APPARATUS FOR SPRAYING TAR

4—APPEARANCE OF SURFACE AFTER TAR AND GRAVEL TREATMENT

first penetration-method roads attempted locally. Since that time local contractors have become equipped with proper apparatus for the application of bitumen, hot and under pressure, and thousands of square yards of this type of road have been built in Nashville. Picture 5 shows how pot-holes developed in this road, which was constructed by the penetration method, using asphalt of about 14 mm. penetration. Nearly 2½ gal. per square yard of road surface was used and the total cost of resurfacing, rolling and treating with asphalt was approximately 45 cents per square yard. The "picking up" of this road, shown in photograph 5, is thought to be largely the result of too much asphalt on the surface, this asphalt having been applied by heating in an open kettle and applying by hand from coal scuttles. Limestone screenings were also used as a surfacing, which partly

6—ASPHALT "KILLED" BY SURFACING OF LIMESTONE SCREENINGS

"killed" the asphalt, due to their large content of very fine dust or "flour." Picture 6 shows how this action of "killing" the oil occurred, causing the asphalt to crumble where the road was not subject to travel.

These last two pictures show in a marked degree how our knowledge of this method of road-building has improved since 1910, when these roads were rebuilt, and also, in a more marked degree, do they show the effect of having the local contractors equip themselves with feasible apparatus for doing this class of work.

S. A. Weakley, junior engineer, U. S. Army, took the pictures which illustrate this article.

British Columbia Railway Aid

Bonds to the value of $2,000,000 will be floated at once by the Province of British Columbia, Canada, to enable the Pacific Great Eastern Railway to complete its line through to Prince George. The issue will be sold under authority granted by the last British Columbian legislature, whereby the province is empowered to borrow $10,000,000 for the purpose of assisting the line. Part of the loan is for enabling the railway to complete work already undertaken. Men have been sent north to Clinton, B. C., and from that point track will be rushed ahead along the grade. It is expected that the steel will reach Prince George some time in the fall.

Complete Tests of Mortars and Concretes Reported by U. S. Bureau of Standards

Results of a Most Comprehensive Series of Investigations Into Effects of Single Variables Have Practical Significance

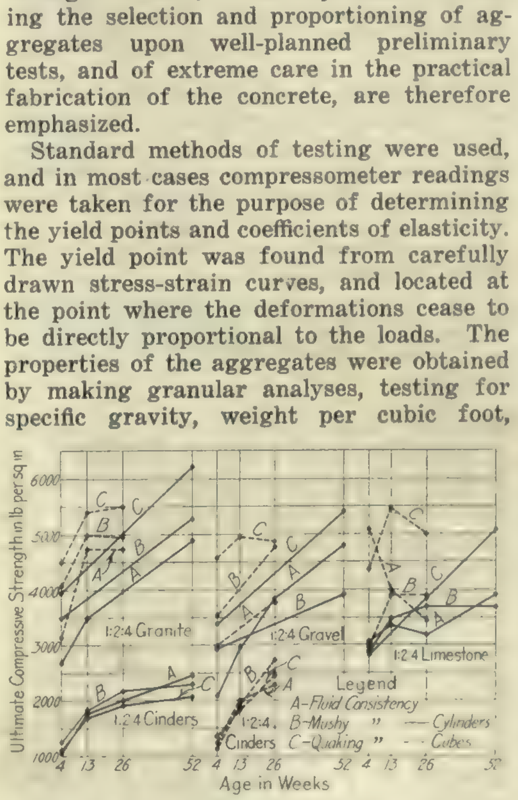
RESULTS and conclusions based on 20,000 tests of mortar and concrete specimens are given in Technologic Paper 58 of the U. S. Bureau of Standards, in which is reported probably the most comprehensive and practical series of investigations into the effects of various factors upon the strength of concrete ever made. By varying one factor at a time, experiments were made to determine accurately the effects of consistency, of age, of density and proportions of the mix, of the nature of the aggregates, of the methods of mixing and placing, and of the manner of curing.

It is shown that in many cases greater compressive strength with lower cost results from other than the usual standard proportions, such as the 1:2:4 mix so commonly used. Concretes differing widely in composition from Fuller's ideal curve were found to give high strength, and conclusive proof was developed to show that the maximum density curve varies for every aggregate and combination of aggregates. The following abstract includes the principal results and important conclusions.

Scope and Method of Tests

Recognizing that concrete differs from other structural materials in the fact that the actual manufacture must be carried out under conditions varying widely, for example, from the easily standardized and controlled methods in the production of steel, it is claimed that the common procedure used in inspecting the materials and in testing the cement only is no more applicable as a measure of the strength of the resulting concrete than would be an inspection of the ore as an indication of the strength of steel. The importance of basing the selection and proportioning of aggregates upon well-planned preliminary tests, and of extreme care in the practical fabrication of the concrete, are therefore emphasized.

Standard methods of testing were used, and in most cases compressometer readings were taken for the purpose of determining the yield points and coefficients of elasticity. The yield point was found from carefully drawn stress-strain curves, and located at the point where the deformations cease to be directly proportional to the loads. The properties of the aggregates were obtained by making granular analyses, testing for specific gravity, weight per cubic foot,



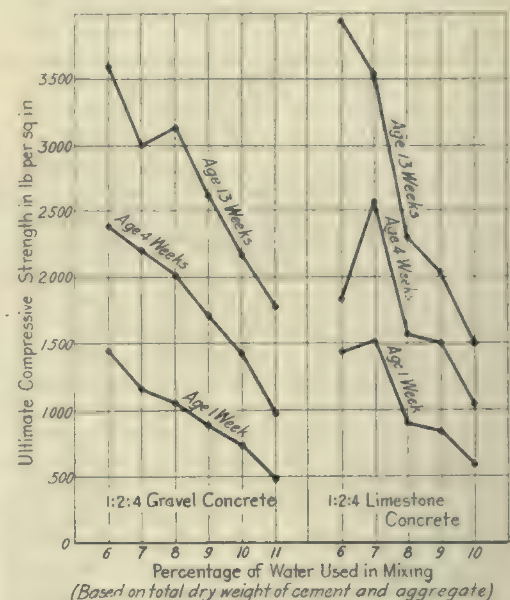
EFFECT OF CONSISTENCY ON STRENGTH OF CONCRETE OF VARIOUS AGGREGATES

Standard 8 x 16-in. cylinders and 6-in. cubes tested in compression

water absorption and percentage of voids. The cement used was generally a mixture of several brands of American Portland cements. Practically all the results given are the average of three or more tests.

Results of Tests

The tests in many respects confirm previous experimental results. For example, the variation of strength with age is indicated by a comprehensive series on mortars and concretes showing decreased strength in long-time tests for neat cement and 1:3 mortars in tension, but increased strength with age for concrete in compression.



EFFECT OF CONSISTENCY ON STRENGTH OF CONCRETE AT VARIOUS AGES

Standard 8 x 16-in. cylinders tested in compression

Results of experiments showing the difference between machine-mixed and hand mixed concretes, the general superiority of the former and the wide variations (as much as 70 per cent) which may occur due only to the method of mixing the materials, are presented.

An experiment intended to reproduce the conditions met in practice when concrete is placed under water was devised, and the results show that there is a considerable reduction in strength of concrete deposited in this manner, especially for leaner mixtures—the 1:2:4 concrete attained 70 per cent of normal strength, while 1:3:6 concrete at one year showed only 25 per cent of normal. These results are to be considered with caution, because in large masses there would probably be less segregation than in the standard 8-in. cylinders used.

The tests made to indicate the effect of method of storage on strength included specimens stored out of doors after four weeks and specimens stored indoors after one week in a damp room. It is noteworthy that the average strength of 1:2:4 concrete was only 1834 lb. per square inch at the age of one month for the former and only 1176 lb. for the latter. These tests therefore indicate that the commonly prescribed value of 2000 lb. for 1:2:4 mix at one month is excessive, and that the factor of safety of concrete structures as usually designed

and fabricated may be nearer two than four.

The accompanying diagrams indicate the vital influence upon strength of the percentage of water used in mixing concrete. The most satisfactory consistencies from the standpoint of strength and durability are the quaking and mushy mixtures. By "quaking" is meant a stiff mixture upon which water can be brought to the surface by slight tamping and which will not flow readily. By "mushy" is meant a soft mixture which is not watery, but can be spaded and readily worked into place in the forms. Fluid mixtures which flow readily into place in the forms with little or no working, often used for chuted concrete on construction work, will give strength far below that properly obtainable by the same ingredients, owing to the tendency to segregate and the formation of laitance.

Relation Between Density and Strength

Results of another comprehensive series show the direct relation between density and strength—the strength apparently varying directly as the density when the relative quantity of cement to aggregate is the same. The effect of varying the proportions of the aggregates is also indicated. The fallacy in the method of proportioning by voids is pointed out, and many results showing high strength for aggregates differing widely from Fuller's ideal curve are given. The great possibilities of economy in the selection and mixing of aggregates are further confirmed by the series, in which large amounts of coarse aggregates were included. The results show that in every case the addition of large coarse aggregates give higher strength than was attained by the 1:2:4 gravel concrete to which various percentages of large-size trap rock were added. Maximum density and maximum strength are usually obtained with a concrete in which the ratio of fine to coarse aggregate is not less than 1 to 3.

Among the other results of practical significance may be cited the accelerating action of steam pressure, up to 80 lb. per square inch, upon the hardening of mortar, accompanied by increase in compressive strength. Steam-cured mortar or concrete is of much more uniform appearance, and the modulus of elasticity and yield point increase with duration and amount of the steam pressure.

Principal Conclusions

The seventeen conclusions given by the authors, R. J. Wig, G. M. Williams and E. R. Gates, as the result of these tests, are considered so important in affecting standard practice in concrete construction that they are quoted in full:

"1. No standard of compressive strength can be assumed or guaranteed for concrete of any particular proportions made with any aggregate unless all the factors entering into its fabrication are controlled.

"2. A concrete having a desired compressive strength is not necessarily guaranteed by a specification requiring only the use of certain types of materials in stated proportions. Only a fractional part of the desired strength may be obtained unless other factors are controlled.

"3. The compressive strength of a concrete is just as much dependent upon other factors, such as careful workmanship and the use of a proper quantity of water in mixing the concrete, as it is upon the use of the proper quantity of cement.

"4. The compressive strength of concrete may be reduced by the use of an excess of water in mixing to a fractional part of that which it should attain with the same materials. Too much emphasis cannot be placed upon the injurious effect of the use of excessive quantities of water in mixing concrete.

"5. The compressive strength of concrete may be greatly reduced if, after fabrication, it is exposed to the sun and wind or in any relatively dry atmosphere in which it loses its moisture rapidly, even though suitable materials were used and proper methods of fabrication employed.

"6. The relative compressive strength of concretes to be obtained from any given materials can be determined only by an actual test of those materials combined in a concrete.

Relative Value of Aggregates

"7. Contrary to general practice and opinion the relative value of several aggregates to be used in concrete cannot be determined by testing them in mortar mixtures. They must be tested in the combined state with the coarse aggregate.

"8. Contrary to general practice and opinion the relative value of several coarse aggregates to be used in concrete cannot be determined by testing them with a given sand in one arbitrarily selected proportion. They should be tested in such combination with the fine aggregate as will give maximum density, assuming the same ratio of cement to total combined aggregate in all cases.

"9. No type of aggregate such as granite, gravel or limestone can be said to be generally superior to all other types. There are good and poor aggregates of each type.

"10. By proper attention to methods of fabrication and curing, aggregates which appear inferior and may be available at the site of the work may give as high compressive strength in concrete as the best selected materials brought from a distance, when the latter are carelessly or improperly used.

"11. Density is a good measure of the relative compressive strength of several different mixtures of the same aggregates with the same proportion of cement to total aggregate. The mixture having the highest density need not necessarily have the maximum strength, but it will have a relatively high strength.

"12. Two concretes having the same density but composed of different aggregates may have widely different compressive strengths.

Relation Between Gradation of Aggregates and Compressive Strength

"13. There is no definite relation between the gradation of the aggregates and the compressive strength of the concrete which is applicable to any considerable number of different aggregates.

"14. The gradation curve for maximum compressive strength, which is usually the same as for the maximum density, differs for each aggregate.

"15. With the relative volumes of fine and coarse aggregate fixed, the compressive strength of a concrete increases directly, but not in a proportionate ratio, as the cement content. An increase in the ratio of cement to total fine and coarse aggregates when the relative proportions of the latter are not fixed does not necessarily result in an increase of strength, but may give even a lower strength.

"16. The compressive strength of concrete composed of given materials, combined in definite proportions and fabricated and exposed under given conditions, can be determined only by testing the concrete actually prepared and treated in the prescribed manner.

"17. The results included in this paper would indicate that the compressive strength of most concretes, as commercially made, can be increased 25 to 100 per cent or more by employing rigid inspection which will insure proper methods of fabrication of the materials."

Inconsistencies Shown in Water and Sewer Laws

Curious Anomalies Exist in Attitude of Legislatures Relating to the Financing of These Utilities

By W. L. BUTCHER
With Metcalf & Eddy, Consulting Engineers, Boston, Mass.

NOTWITHSTANDING the similarity of the functions of water and sewerage works in contributing to the public health, there have grown up in the different states some rather curious differentiations as regards the laws and the attitude of legislatures relating to the financing of these utilities. There can hardly be any question as to the similarity of the health requirements which demand the installation of both water and sewerage works. The difference appears to be one of degree only, the construction of sewers being delayed, possibly, until public necessity arises, with the police power of the state always in the background, while the construction of waterworks often takes place earlier than sanitary necessity might demand, in order to meet the comfort or convenience of the community.

This latter phase of the matter, with its possibility of profit from the sale of water, early led to the installation of many private plants. The difference in the financial procedures may doubtless be partly attributed to this fact. Their similarity is recognized, moreover, as we find in some communities privately owned sewerage systems being run for profit and in other places waterworks construction financed by "special assessments," although the latter scheme is more particularly associated with sewerage works. Probably the element of compulsion associated with sewers, as distinguished from voluntary participation in the benefits derived from waterworks, has something to do with the differing attitude of the law and legislatures in the two cases.

Liens on Real Estate

One of the anomalies is annually brought to mind in Massachusetts through the effort of the New England Waterworks Association to have bills for water made a lien on real estate. These efforts regularly fail, through the plea of the extra work of conveyancing entailed, in spite of the fact that Brockton and other cities in Massachusetts assess and collect annual bills for rental of sewers, based on the extent of use as measured by the consumption of water. These bills are, in common with all "sewer assessments," a lien on real estate.

Of course, a water department has a lever in that the water may be shut off until the bill is paid, whereas it would be against public policy to shut off a sewer connection. It is quite conceivable, however, that the danger from a lack of water might, under some circumstances, be as serious as a lack of sewerage facilities. As a matter of fact, in New Jersey and possibly other states, water bills are a lien on real estate. In the case cited the differing attitude is further emphasized by the long legal fight ultimately carried to the Supreme Court of the United States, which was necessary before Brockton, Mass., could establish the right to charge annual rentals for sewer connections, based on the extent of use. At the same time, of course, every waterworks in the state was doing this very thing.

Pennsylvania Conditions

Passing now to another state, Pennsylvania, we find still other interpretations of the same points. With regard to waterworks we find rates being charged which are sufficient to pay interest, sinking fund contributions and maintenance expenses, the latter including the cost of renewals of wornout portions of the distribution system, parts of which are originally paid for by special assessments on abutting property. On the other hand, in the case of sewers, the courts have distinctly said that renewals could not be charged to the property benefited. It will be noticed, however, that in the matter of waterworks all charges for sinking funds, renewals, etc., are taken care of through the water rates. Carrying the matter still further, we find that, unlike the case in Massachusetts, communities are expressly prohibited from charging annual rentals or maintenance costs for the use of the sewers. The courts to bring about this condition reasoned through the supposed analogy between pavements and sewers, it being a well-established principle in Pennsylvania that the cost of pavement renewal could not be reassessed on abutting property.

Renewal Costs

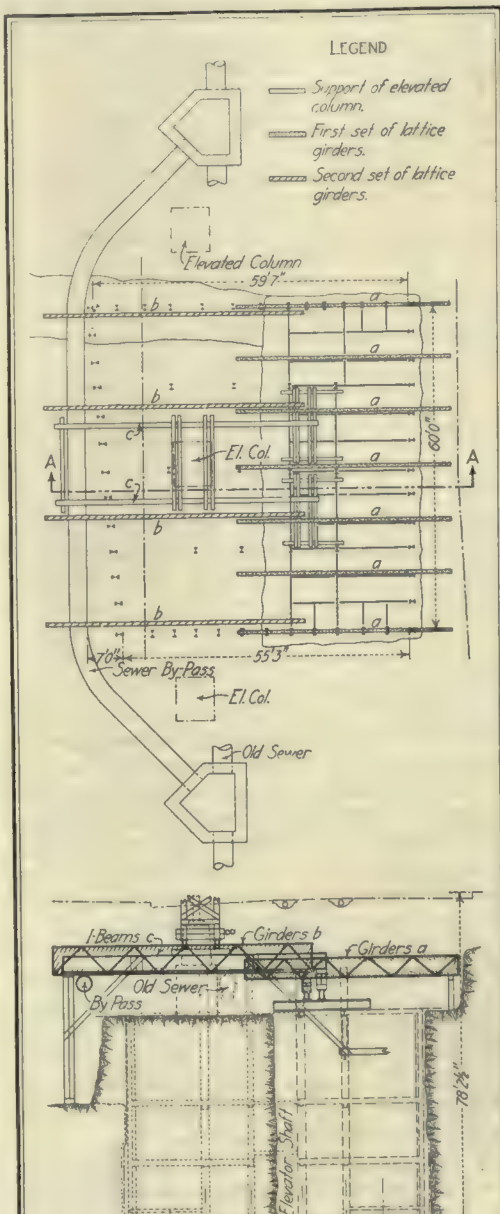
It is, perhaps, easy to see how the different practices relating to the two subjects have grown up. They come partly, of course, from the difference in the functions of the two utilities, although this appears to be a matter of degree only and not sufficient to prohibit absolutely in one case a scheme of financing which is allowed, even if indirectly, in another case. For instance, in those Pennsylvania communities where, in the case of both sewerage and water systems, a portion of the cost is assessed on abutting property, thus assuming them to be analogous to that extent, the possibility of charging any maintenance or renewal costs to abutters is denied in the financing of the sewerage system, but is allowed through the rates in the case of waterworks.

Certainly it would seem, referring to the decisions cited in the foregoing, that the analogy between waterworks and sewers is closer than between pavements and sewers, and whereas it may be inequitable, or at least impossible, to assess any special benefit to abutters, for the maintenance or renewal of pavements, there is no difficulty in at least approximating the extent of special benefit accruing to abutters on account of maintenance and operation of sewers.

New York Subway's Largest Elevator Shaft Sunk Under Forty-Second Street

In Carrying Down Excavation, Rock Was Dropped Into Steinway Tunnel 72 Feet Below the Street and Taken to Shaft at Riverfront

Under East Forty-second Street, New York City, at the present eastern end of the Grand Central Terminal of the New York Central Railroad, and about 90 ft. east of Park Avenue, will be located the largest elevator shaft of the rapid-transit subway system of New York City. In the form of a trapezoid, with its east and west lines parallel and 55 and 60 ft. long respectively, the north line approximately the north curb line of Forty-second Street, 60 ft. long, and the south leg 61 ft. in length, with a sectional area of about 3500 sq. ft., this shaft is the largest structure of its kind in the Greater City. To the platform level of the Queensboro subway below there is a depth of about 75 ft., with a maximum depth of 94 ft. in the three elevator pits.



SHAFT AT STAGE WHEN NORTH HALF WAS EXCAVATED, STEEL ERECTED AND STREET LOADS TRANSFERRED TO IT

This shaft will serve as a direct undersurface connection between the New York Central terminal station and the subway lines intersecting at this point, and transfer by means of elevators and shuttle service under Forty-second Street will be made between the west side subway under Broadway and Seventh Avenue, the east side subway under Park and Lexington Avenues and the Queensboro subway under East Forty-second Street. Owing to the fact that the Queensboro subway passengers are now required to walk about 1000 ft. through East Forty-second Street to transfer to the present subway line at Forty-second Street and Vanderbilt Avenue, work on this elevator shaft is being prosecuted with all possible speed to an early completion.

Support of Street

Situated as this shaft is directly beneath East Forty-second Street, with its heavy traffic at all hours, including the cars of two surface trolley lines, and with an elevated railroad structure above it, heavy timbering and strong support of subsurface structures were demanded during excavation. With a decked area about 100 ft. long along the street, and extending from the north curb to the south building line, none of the operations were visible from the surface. For a depth of about 20 ft. the excavation was in earth, which was removed from the southwest through the subway excavation which had been made in the lot adjacent (the site of the old Grand Union Hotel) for a portion of the diagonal station of the Lexington Avenue subway, which was described in the Engineering Record of Aug. 28, 1915, page 255.

Timber sheeting was placed beyond the east and west excavation lines of the shaft and the vault walls of the New York Central Railroad Terminal on the north curb line were shored, the south face of the shaft opening into the adjacent subway excavation. Transverse latticed girders and timber horseheads supported the street-decking system and the substructures mentioned. The gas and water mains and conduits were slung with wire rope from the rangers above and a 4-ft. trunk sewer was bypassed beyond the south lines of the shaft by means of a circular steel pipe, and the old sewer was subsequently removed.

Excavation and Disposal of Material

It had been determined to excavate the north half of the shaft to subgrade first, thus undercutting only half of the street at a time. In the old north and south tubes of the Steinway tunnel, which lie beneath Forty-second Street, heavy timber supports were erected within the lines of the shaft excavation to overcome the effects of heavy "breakouts" or "slips" in the rock immediately above these tubes. Subgrade of the new track floor was approximately 12 ft. below the old Steinway tunnel invert, with a maximum depth in the elevator pit of 24 ft. below. Accordingly, an area 20 x 30 ft. in the northwest section of the shaft was taken down within about 6 ft. of the old Steinway tunnel roof arch and a small opening was holed through to the tunnel

below. Up to this point all excavated material was removed through the open subway excavation to the south and from there hoisted to the street level and trucked to scows at the foot of East Forty-second Street. For the section first excavated the rock was uniformly free from breaks or bad seams, although it presented a well-defined dip to the west at an angle of about 30 deg. with the horizontal. This formation was identical with the dip of the rock encountered in the tunnels below. Only a small flow of water manifested itself along the west face of the shaft. For this portion of the shaft timbering was found to be unnecessary.

In the old north tube of the Steinway tunnel a chute was constructed beneath the hole broken through from the excavation above and muck was cast by means of it into cars, which were hauled east a distance of about 2650 ft. by a work trolley running through the north tube to the old Steinway tunnel shaft No. 2 on the north side of Forty-second Street east of First Avenue, and thence by elevator to the surface and by work trucks to scows in the East River. It was possible to dispose of from 12 to 15 yd. of spoil per hour in this manner, against about 8 or 9 yd. by trucking over the surface.

Subsequently, the north half of the shaft cut was lengthened and excavated to subgrade and wall footings and column grillages were set. The steel frame for this area was then erected to the roof level below the street deck, and by posting and blocking up most of the weight of the surface and subsurface structures above this area was tranferred to it. An elevated railroad column south of the excavated area, carrying a maximum load of about 100 tons, was then underpinned by independent girder needles, one end of these needles being supported on a horsehead in the adjacent subway excavation and the other on the permanent shaft structure. Timber posts were wedged between successive floorbeams of the permanent structure down to rock about 80 ft. below, it having been found that the possible total load might be in excess of the strength of the floorbeams and their connections.

The concrete of the exterior shaft walls and all portions of the floor system was then poured. The concrete was mixed at shaft 2 and brought in dump cars to the elevator shaft by work trolley and hoisted in a bucket elevator constructed by the contractor's forces to the several floors, from which the material was wheeled to place.

The south half section of the shaft was then excavated to net lines and subgrade, heavy rope mats and timber buffers protecting the steelwork already in place. Chutes to the previously excavated section carried muck to the work trolley below, and the subsurface-disposal method was continued throughout the operations in this south half of the shaft connecting with the south tube of the reconstructed Steinway tunnel at the southeast corner of Park Avenue and Forty-second Street. Badly shattered and fissured areas on the west, east and south rock faces required two sets of timber at approximately 30 and 43 ft. respectively below the street. These timbers were hung in wire rope slings from deck rangers and braced to the rock walls adjacent and to the north portion of the steel structure in place. Steel pins of 1½-in. diameter and from 10 to 12 in. long were placed at right angles to the dip and also served to hold heavy blocks which were found shattered and seamy. Comparatively little water was encountered here and small flows were panned and led away by pipes, it being the intention later to grout these pipes after the main walls of the shaft are completed. The concrete for this section of the shaft structure was spouted to place from a tower within the subway excavation to the south.

Efforts are being made to complete the steel work, install the elevators and finish the Grand Central Station of the Steinway tunnel and the passageway to the New York Central Terminal and the present subway, so that passengers from Queens Borough may have a direct underground connection to uptown and downtown Manhattan and to the Bronx by the early fall. It is hoped to finish the construction work by Sept. 1, and if this is accomplished, the shaft will have been entirely completed in nine months, in spite of the delay caused by labor strikes.

This work is under the jurisdiction of Alfred Craven, chief engineer; Robert Ridgway, chief engineer of subway construction, and John H. Myers, division engineer, for the Public Service Commission, and is being prosecuted by the Rapid Transit Subway Construction Company, of which George H. Pegram is chief engineer and Robert A. Shailer tunnel engineer.

Cumulative Counterweights Feature Spillway Crest

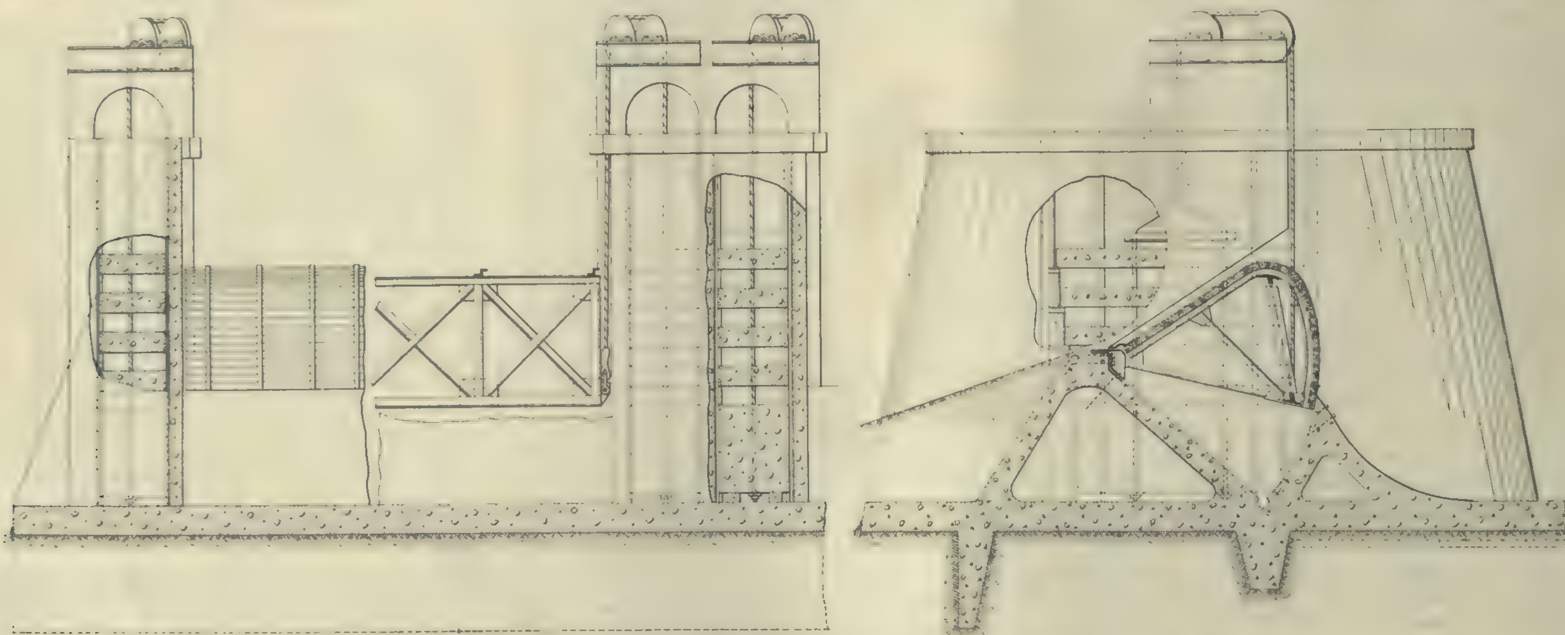
By JOSEPH WRIGHT
Engineer, U. S. Reclamation Service

MUCH EFFORT has been expended in devising means for the automatic regulation of reservoirs. The writer has arrived at the design shown in outline by the accompanying drawing. The controlling factor has been an effort at simplicity and reliability, without regard to possible charges of patent infringement.

Several designs for counterweighted gates have been patented, and it is possible that patents may have been issued upon the basic idea, but, be that as it may, since the writer has no thought of applying for a patent, the design is published for what it is worth.

It will readily be seen that the controlling features are a long-span gate, favorable hydraulic conditions and a direct application of an accumulative counterweight.

The first feature is obtained by the introduction of a truss in the gate construction. The second is merely a matter of outline. The third is attempted by conveniently locating a series of properly adjusted counterweights, one above the other, inside of hollow piers, to be picked up in their turn as the gate descends.



DESIGN OF SPILLWAY CREST FOR AUTOMATIC REGULATION OF RESERVOIR WATER

Simple computations will show that a gate having a lift of 5 or 6 ft. or less may have a length of 50 ft., and even more, and yet be of comparatively light construction. Such a length will permit of the passage of large drift and ice.

The section of crest shown is intended to fit the case of a reservoir having a spillway and chute constructed in earth, the chute descending the sidehill to the stream below.

The counterweighting is intended to be as simple and direct as possible, and certain of operation. Others might prefer a more scientific application of the counterweight, although possibly less certain of action. The counterweights shown may be constructed of cast iron if pier space is valuable. Whether of cast iron or of concrete as shown, they should contain hollow spaces to be loaded with pig iron to obtain a perfect adjustment after trial. In the case under consideration, both the piers and the gate recess may be readily drained—the latter enough to obviate back pressure.

Columns in First Floor of Boston Theater Avoided by Use of 106-Foot Truss

Special Balcony Framing of Diagonal Girders and Cantilever Trusses Involves Complex Detailing for Field Connections

TO COMPLY with the owner's requirement that no columns whatever should be allowed to obstruct the view from the seats on the first floor of the recently completed Loew's Orpheum Theater in Boston, an unusual structural-steel framework of trusses and girders was designed to carry the balcony loads to the outside wall columns.

A main truss of the subdivided panel type spans the distance of 106 ft. between columns. Parallel to this a 53-ft. front truss supported by two diagonal double girders acts as a fulcrum for the cantilever trusses. The diagonal girders rest upon wall columns at one end and upon the main trusses near the center at the other. Clearance requirements which limited depths and door clearances necessary to permit passageways from mezzanine floor to balcony made the main-truss outline unusual and the details of design exceptionally difficult.

In addition to, and closely related with, the limitations in the design of the main members were the complexity of the field connections and the necessity for devising practicable details. At one point three main members intersect—a diagonal double girder, the front or fulcrum truss and a cantilever truss. The details of the connection here adopted are shown in drawings of the various members; the front truss is framed into the cantilever and the latter rests upon the diagonal girder, with its lower chord passing through slotted holes in the web plates of the double girders.

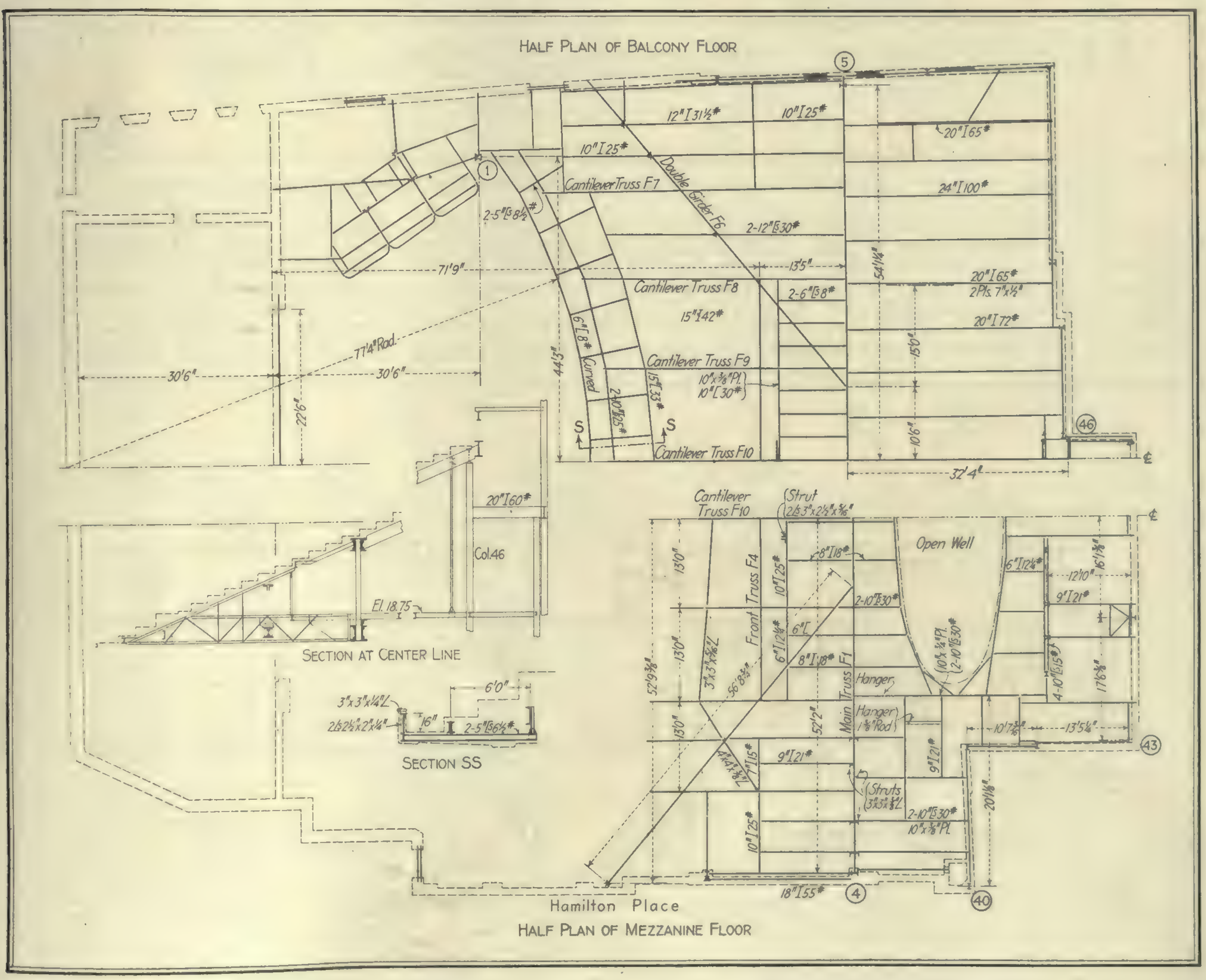
General Plan of Framing

As indicated in the accompanying half-plan and sectional views of the framing for the balcony and mezzanine floor, the building is of unsymmetrical outline, situated on a lot about 158 x 108 ft. on Hamilton Place. It has a seating capacity of 3000. The main 106-ft. truss F1 is supported by built-up box columns of two 15-in. channels with 18-in. cover plates. Most other columns are 8-in. and 10-in. Bethlehem H-sections. The fulcrum truss F4 is 13½ ft. from the main truss, and is supported by the diagonal girders F6 nearly 60 ft. long, which rest upon the main truss at points 10½ ft. from the center.

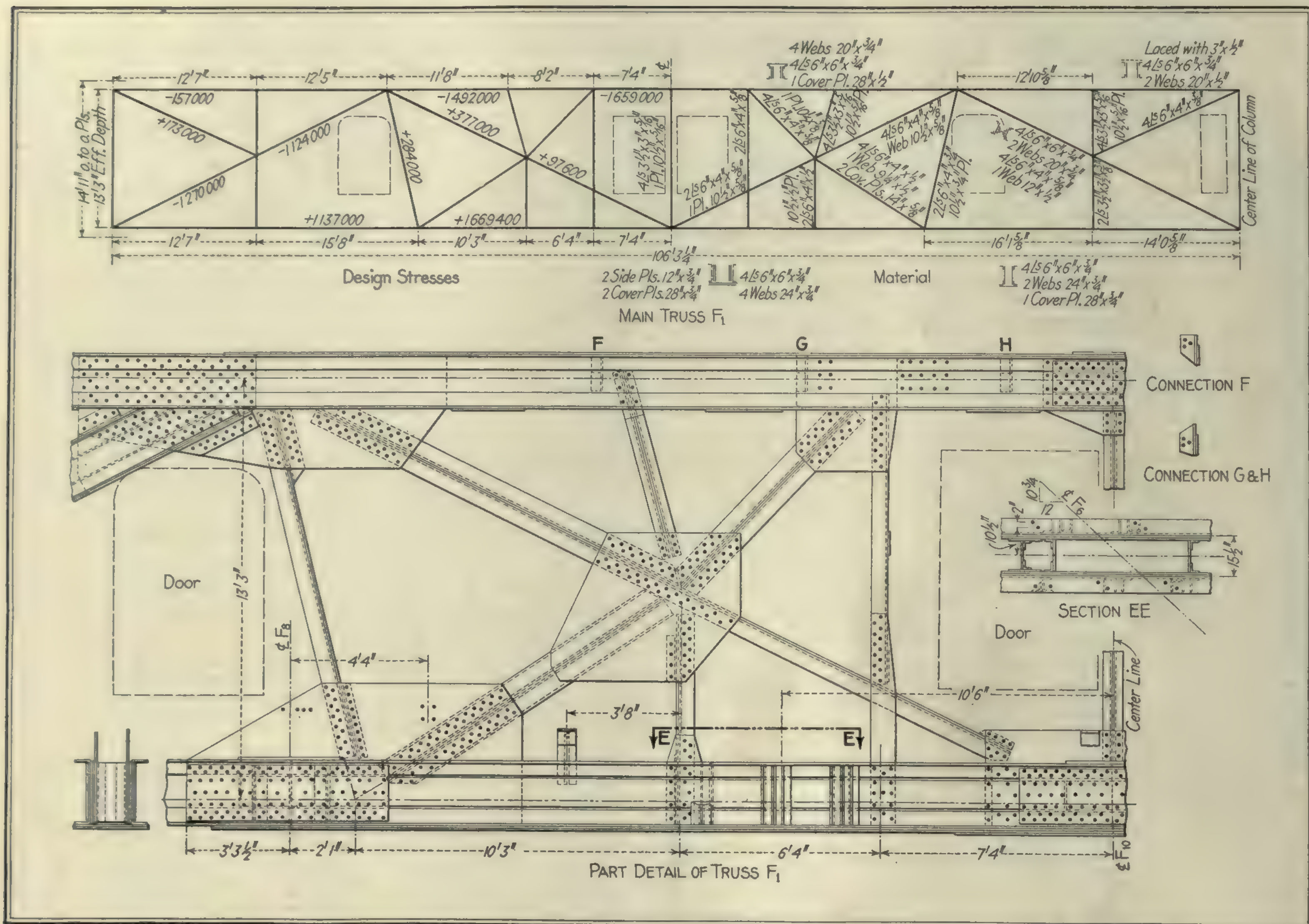
Steel I-beam framing of the usual type supporting reinforced-concrete stepped construction for the balcony is indicated on the sections and plant, designed to conform to a parabolic outline. Curved-face channels for the balcony are carried by projecting cantilever beams of 6-in. channels about 9 ft. long, staggering with the cantilever trusses, the rear uplift being resisted by 15-in. channels. The open well in the mezzanine floor made it necessary to design some of the steel beams in that floor as cantilevers from the front truss or the diagonal girders over the lower chord of the main truss. In some cases rod hangers supported similar beams. Longitudinal beams between the cantilever trusses, in addition to acting as mezzanine floor framing, carry two-angle vertical struts that support the upper chord of the cantilever trusses by longitudinal channels, to which the intermediate sloping diagonal beams are connected.

Main Truss Details

The overhead clearance lines for the lower floor and the necessity for keeping below the known sloping seat lines fixed by the requirements for clear sight lines to the stage limited the depth of the main trusses to 14 ft. 11 in. out to out, as noted on the stress sheet in one of the drawings. The irregular panel lengths were necessitated by



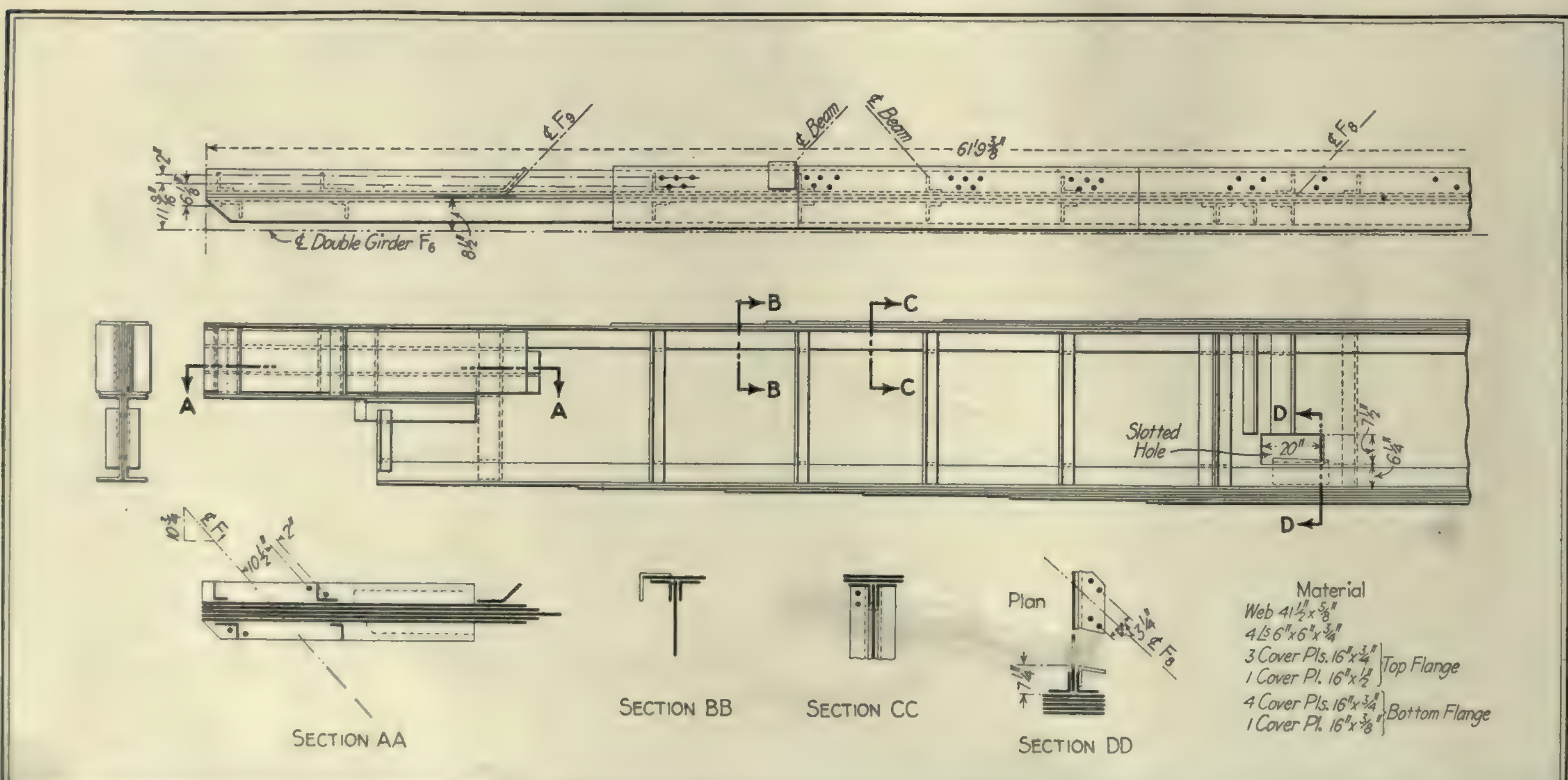
HALF-MEZZANINE AND HALF-BALCONY FLOOR PLANS WITH SECTION AT CENTER SHOW GENERAL LAYOUT



CENTRAL PANELS OF MAIN TRUSS F1 CONTAIN UNUSUAL DETAILS AND SPECIAL CONNECTIONS—STRESS SHEET ABOVE

the openings for doors to accommodate inclined passageways from the mezzanine floor to the balcony as well as the requirement for bearing surfaces on the lower chords at the points where the diagonal girders are carried. As shown on the detail drawings, these girders F6 do not connect to the truss F1 at panel points, but are cut back to pass across the lower chords and rest upon them. The chords are therefore designed for both direct and bending stresses, using typical built-up half-box sections.

The specified live load for all floors was 125 lb. per square foot, with 200 lb. for the stage, 100 lb. for the dressing rooms and 40 lb. for the roof. The heavy sections and high stresses for the main truss are noteworthy, as are also the subdiagonal systems and the large gusset plates. The top chord carries the sloping beams, the connections for which are provided as indi-



PART ELEVATION OF ONE GIRDER F6, SHOWING SPECIAL CONNECTIONS FOR BEAMS AND TRUSSES

FORWARD ENDS OF CANTILEVER TRUSSES AND PROJECTING BEAM FRAMEWORK

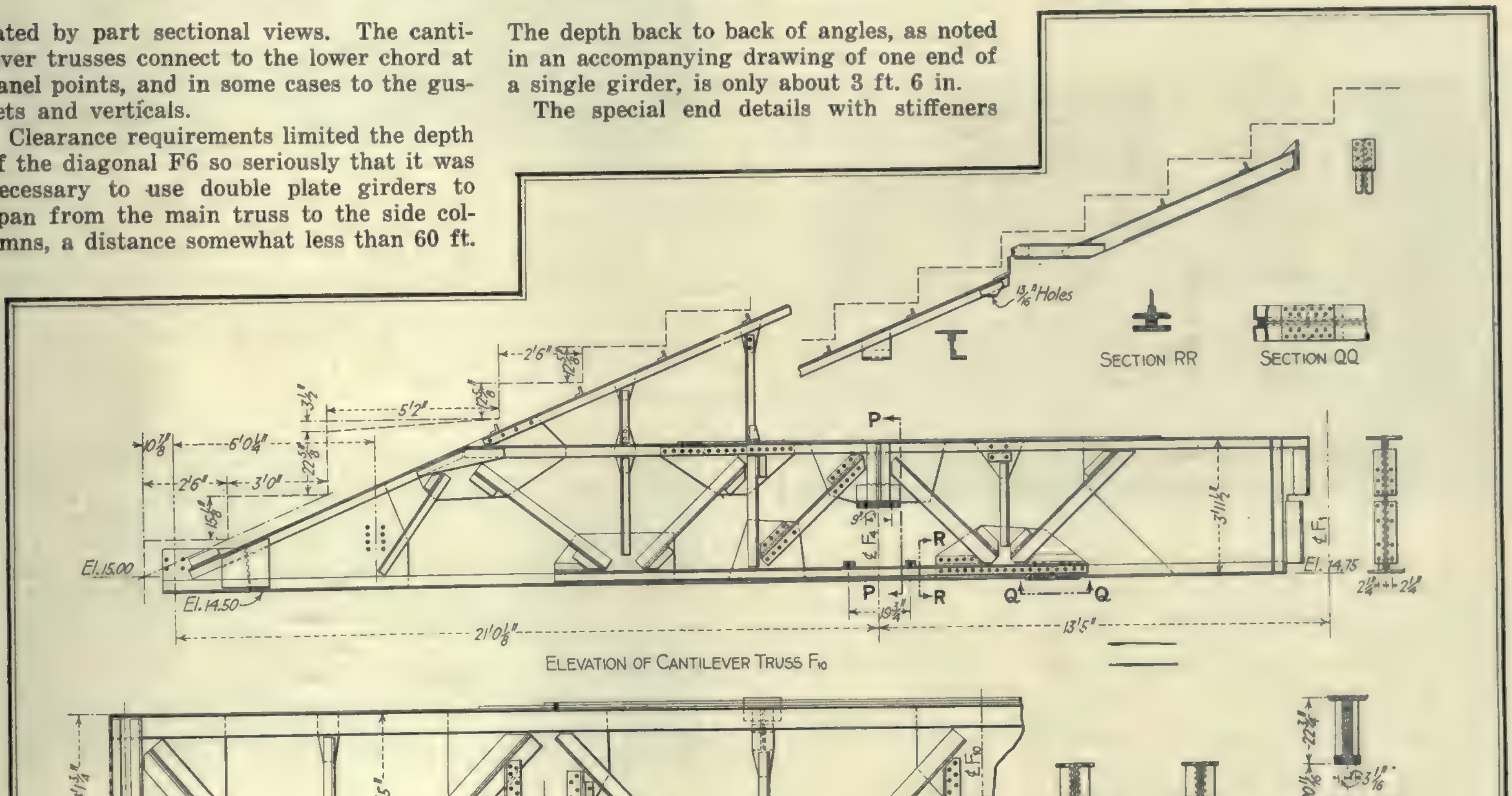
cated by part sectional views. The cantilever trusses connect to the lower chord at panel points, and in some cases to the gussets and verticals.

Clearance requirements limited the depth of the diagonal F6 so seriously that it was necessary to use double plate girders to span from the main truss to the side columns, a distance somewhat less than 60 ft. The depth back to back of angles, as noted in an accompanying drawing of one end of a single girder, is only about 3 ft. 6 in.

The special end details with stiffeners and reinforcement of the web plate where the girder is cut back to pass diagonally over the lower chord of the main truss F1 are indicated in the drawing. The end stiffeners were turned in opposite directions to give better bearing on the main sections of the chord. Clip angles and punched holes in intermediate stiffeners are provided, as indicated, to carry the mezzanine-floor framing beams at the top flange.

To support the fulcrum truss which frames into the cantilever truss F8, the latter rests upon the top of these diagonal girders, and is so framed that its lower chord passes through a slot shown in the webs of the double girders, with connections to shelf angles as indicated in the sectional view.

One of the drawings showing the front or fulcrum truss F4, a triangular truss about 7½ ft. deep, and the cantilever trusses F8 and F10 indicates the nature of the con-



TYPICAL TRUSSES F4, F8 AND F10 INDICATE CONNECTIONS BETWEEN CANTILEVER TRUSSES AND FRONT TRUSS

nections. The fulcrum truss F4 contains double verticals spread sufficiently to permit the cantilever trusses to pass between them over the lower chord and rest upon it by seats to the top chord at their panel points. The end connection of this truss F4 to the cantilever F8 by ordinary end angles framing into a large gusset plate is indicated, together with the large bearing plates of this cantilever F8 upon the top of the diagonal double girder.

The cantilever truss F8 is a typical example of the complicated framing required to provide practicable details at the connections. The location of field splices, indicated by the field holes at the joints, was a matter requiring special consideration in order to frame the various parts in proper order. The broken alignment of the lower chord passing through the diagonal girder webs was necessary in order to avoid interference with the lower flange angles of these double girders.

On the top chords of the cantilever trusses supporting the reinforced-concrete stepped floor of the balcony, clip angles are provided just below the risers to increase the bond. These upper chords must resist both direct and bending stresses; they are designed of unequal-legged angles, detailed with the short legs vertical.

The two main roof trusses, one of 106-ft. span, had chords of Bethlehem H-column sections. These sections were found to be both economical and efficient and permitted simple and practical details of connections and splices.

The grid-iron construction consisted of 2 x 3/8-in. flats, 4 in. on centers, placed with the 2-in. dimension horizontal, battened together on about 2-ft. centers and resting on a 4-in. 5¼-lb. H-spaced about 4 ft. apart, thus forming a removable grating, spanning longitudinally over the stage. This design of gridiron has been installed in a number of New York theaters and found to be very satisfactory, and is generally considered to be preferable to the 3-in. channel construction used extensively in Chicago and the West, which spans transversely over the stage. It is considerably more economical.

The general contractors were the Fleischman Construction Company, of New York City. The steel frame was designed and fabricated by the New England Structural Company of Everett, Mass., of which W. B. Douglass is president; E. N. Pike, chief engineer, and C. L. Downie, chief draftsman, subject to the approval of Hector R. Burroughs, of New York City, consulting engineer. Thomas W. Lamb, of New York City, and the Hoffman Company, of Philadelphia, were the architects.

Solids a Problem at Power Plants in Northwest

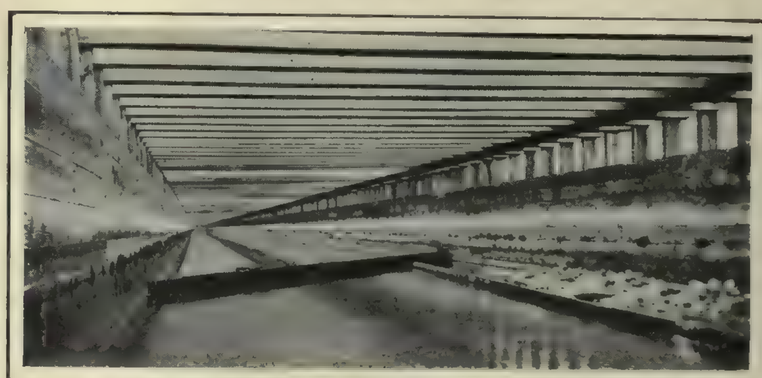
Gravel, Sand and Silt in Streams Originating in Glaciers Must Be Handled Effectively to Obtain Satisfactory Results

By JOHN HARISBERGER
Superintendent of Water Power, Puget Sound Traction, Light & Power Company, Seattle

STREAMS that originate in glaciers in the mountains generally have a heavy fall and carry a large amount of solid matter, which consists mostly of sand, gravel and silt. This is particularly true during high-water periods in the upper parts of streams rising in the Cascade and Olympic mountains. In the design and construction of waterways and reservoirs for the utilization of water from these streams, careful attention must be given to methods of handling this solid matter effectively if satisfactory results are to be obtained. Gravel is the easiest to get rid of, as it settles readily, unless the velocity of the water is very high. It can generally be taken care of by properly constructed rock spillways in the supply canal. As the sand settles much slower, one or more settling basins are necessary, while silt, which has the characteristics of volcanic ash, will stay in suspension for several weeks even in perfectly still water.

GRAVEL IS WASTED THROUGH AN OPENING IN CANAL BANK

PILE OF SILT DISCHARGED THROUGH SMALL LEAK IN FLUME



DIAGONAL DIVERTING WALL INTERCEPTS GRAVEL

Disposing of Gravel in Supply Canal

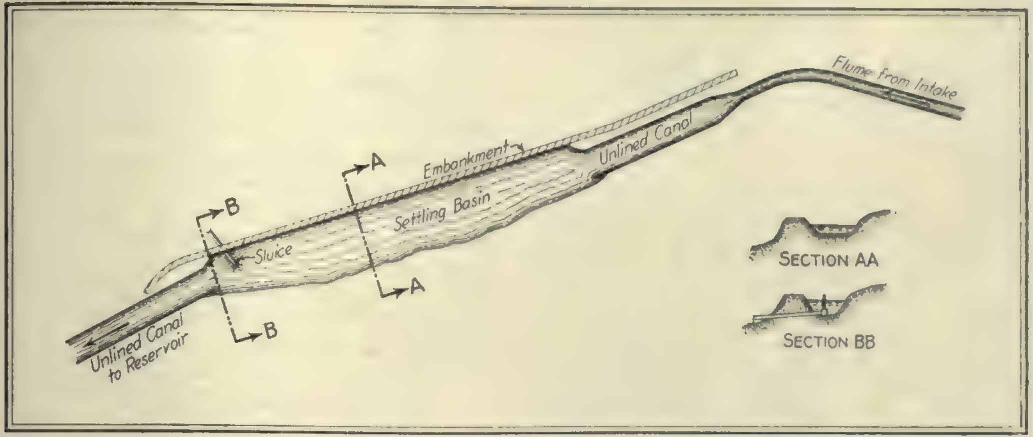
Usually the reservoir formed by a diversion dam across the stream, unless sluiced or dredged out frequently, does not have much value as pondage for any great length of time, as it acts as a settling basin and will soon fill up with gravel and sand on account of the decreased velocity of the entering water.

A smooth channel cut several feet below the intake, at right angles to it and in the direction of the river flow, will prevent a great deal of gravel from getting into the intake. This channel should be so constructed that the velocity of the water will be quite high during floods, when much gravel is moved, and it should be carried by the intake and through the dam. A certain amount of gravel is bound to enter the supply canal, which can be disposed of by means of a rock spillway. The latter generally consists of a diverting wall 2 or 3 ft. high, built diagonally across the bottom of the canal, and an opening through the side of the canal to discharge the gravel diverted. It is desirable that the canal up to the rock spillway be of rectangular cross-section and lined with wood, concrete or iron. The velocity of the water should be high enough to keep the gravel moving.

The sand should be allowed to settle before the water enters an unlined canal in earth, as the low velocity that is made necessary will allow the sand to settle. Where lined canals are used, it is the practice to utilize sandboxes and sluiceways to remove a certain amount of the sand, but unless these are quite large and the sluiceways are kept open at all times, which wastes a great deal of water, they are not very effective. As the velocity in lined canals is generally kept fairly high, most of the sand does not get a chance to settle, although the amount that will get through a small leak is surprising.

As silt stays in suspension for several weeks, it is the most difficult material to get rid of. Fortunately, it does the least amount of damage to waterwheels, pumps, etc., in the way of erosion, but it seriously affects the operation of water-pressure governors and causes rapid scaling in the water-cooling coils for transformers and bearings.

The following seems the best solution of the problem of removing the sand and the heavier silt. There is no method of eliminating the lighter silt carried in these streams, to the writer's knowledge, unless

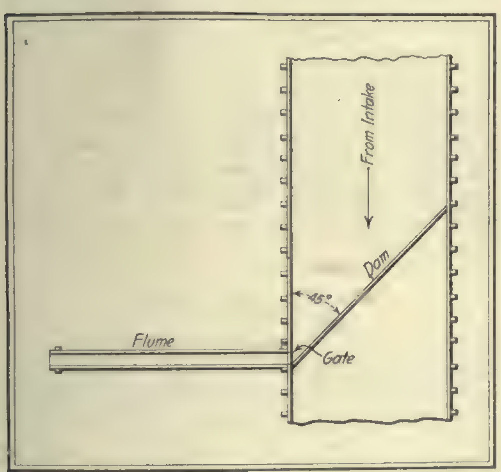


SAND IS DROPPED IN SETTLING BASIN—SLUICE PROVIDES MEANS OF CLEANING

the water could be impounded for several weeks before using.

Location of Basins Important

The location and design of the settling basins should be given careful attention. The regulating reservoirs to which the penstocks connect should not be used as settling basins if it can be avoided, at least not for sand. The best arrangement is to have the rock spillways and settling basins near the intake. The size of the basins will be determined by the amount of water to be handled and the quantity of sediment carried therein. The basins should be of such size that it will not be necessary to clean them out oftener than once a year, also that the movement of the water will be



DAM AND FLUME CONSTITUTE ROCK SPILLWAY

slow enough so that all sediment but the light silt will settle and not be carried to the canal leading to the regulating reservoir.

In the construction of the basins provision should be made so that they can readily be drained and cleaned out. It may be necessary to lay a pipe line around them and to arrange that water under pressure will be available for sluicing to facilitate rapid removal of sediment. Provision must be made to carry the water from the intake around the settling basin while the basin is being cleaned, to avoid interruption to the service for which the water is used.

The cleaning out of the basins should be done at a time of the year when the water does not carry any sediment. In the locations under consideration the most sediment is carried during the heavy rains, which generally occur about November and March, and during June, July, August and September, when the water from the melting glaciers brings down a large amount of sand and silt.

In this discussion it is assumed that the conditions are such that all the flood water of the stream cannot be impounded and utilized, so that the loss of water in rock spillways and in the cleaning out of the settling basins would be of little value. In case the settling basins are so constructed that they cannot be readily drained, or can be drained only through the penstocks, the only solution for cleaning is the use of a dredge, and a suction dredge will be most suitable, as sand and silt are the materials to be handled. A small suction dredge with a capacity of about 5 sec.-ft. will handle from 6 to 10 per cent of solid matter in the way of sand and silt.

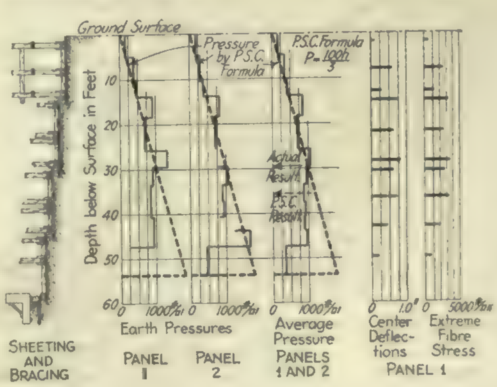
Test Earth Pressures in Subway Excavation

Deflection Measurements on Timber Rangers and Computed Values of Pressures Up to 50-Foot Depths Reported

MEASUREMENTS of the deflections of timber rangers in the subway excavation work at Flatbush Avenue, Brooklyn, indicate that the actual earth pressure follows roughly or somewhat exceeds the values given by the Public Service Commission formula for earth pressure for the first 30 ft. below the surface, while below that depth the pressures do not increase in accordance with that formula. These results and conclusions are given by Max Miller, junior engineer, in the *Public Service Record*. A short abstract of the methods used, with a diagram indicating the results, is presented herewith.

Method of Testing

Deflections were measured for every ranger employed in retaining a bank over an area 22 ft. horizontally and 55 ft. vertically. The excavation at this point is approximately 85 ft. wide and 80 ft. deep in



MEASURED DEFLECTIONS—COMPUTED PRESSURES AND FIBER STRESSES

a soil of glacial formation consisting of coarse sand intermixed with 20 to 30 per cent of clay and some gravel, with occasional large boulders. The excavation was started seventeen months previous to the observations.

As indicated by the accompanying diagram, the 3 x 10-in. vertical sheeting was supported by longitudinal rangers varying from 10 x 10 in. to 12 x 12 in., held every 10 ft. by transverse needles extending continuously across the entire width of the cut.

The deflections were measured from a fine string stretched parallel to the beam to five different points along the inside face of the rangers, the difference between the offsets denoting the relative deflection of the points. The soil-pressure intensity required to produce the given center deflection was computed.

Computed Results

The diagram herewith indicates the resulting computed pressures at the various depths down to 50 ft. for the two panels tested, in addition to the center deflections and the maximum fiber stresses. It is evident that for the first 30 ft. down the pressure increases with the depth to a maximum of about 800 lb. per square foot. Below this and up to a depth of 45 ft. the pressure is practically constant at 900 lb., and the next 10 ft. shows a reduction of pressure. The comparison between actual pressures as computed from the deflections and the pressures by the Public Service Commission formula ($100h/3$) is clearly indicated on the diagrams. The total actual pressure per linear foot is 36,000 lb., which is 75 per cent of the value by formula, and the resultant is about 6 ft. higher, giving an overturning moment about equal to that computed by formula.

Europe May Need Our Lumber

The forests of Belgium and those in northern France on both sides of the fighting front have sustained severe damage from artillery and small-arms fire, according to P. S. Ridsdale, editor of *American Forestry*. Probably greater destruction has resulted, not only in these countries but also in England, from extensive cutting of the timber for engineering construction at the front. It is thought that most of the forests in the British Isles will have vanished by the end of the war, as a result of the imperative need for timber, coupled with prohibitive ocean freight rates and lack of vessels for importing. Little is known of the condition of the Italian and Austrian forests, while those of Russia are so extensive and dense that the ravages of war can hardly have made much impression on them. It is certain, however, that Germany has cut a great deal of timber in occupied enemy territory, especially in Poland and western Russia, as, having that source of supply, it is likely that this nation, with its customary thrift, has kept its own forests intact. An extensive investigation of the lumber situation in Europe has been planned by the Federal Government to aid American producers. A meeting to determine the lines along which the investigation will proceed was held Aug. 21 in Chicago between the representatives of the lumber industry and officials of the Bureau of Foreign and Domestic Commerce, the Federal Trade Commission and the Forest Service.

How Location Affects Track Maintenance

Numerous Difficulties for the Section Gang Are Due to Poor Choice of Site—Higher First Cost May Mean Much Lower Upkeep

By KENNETH L. VAN AUKEN
Chicago, Illinois

THE SUBJECT of gradient, curvature and the like has been fully discussed as it affects the operation of heavy trains over a railroad line, and this subject has recently been given a great deal of attention. The effect of location on the cost of maintenance, however, is a subject but little touched on. The methods of construction and the standards of construction also have a great effect on the cost of maintenance.

The maintenance of track is materially affected by (1) character of soil in cuts and embankments, (2) character of earth beneath embankments, (3) percentage and degrees of curvature, (4) proportion of sidehill cuts, (5) amount of location along river banks, (6) height of embankments, (7) number of tunnels, bridges or trestles, (8) amount of embankment which obstructs old watercourses, (9) gradient in cuts, (10) curvature in cuts, (11) width of cuts, (12) percentage of embankment in countries subject to deep snows, and (13) number and length of reverse and compound curves.

Character of Soil

It is extremely difficult to keep track maintained to a high standard in wet, soft cuts, or even to keep such track comparatively safe. The mud or clay from the subgrade works up between the ties, the ballast in the meantime working down into the subgrade so far that it becomes of no use in supporting the track. About the only remedy for a condition of this kind is a tile drain placed deep enough so that the water will be drained out to the bottom of the ballast.

The clay or mud from wet cuts makes very poor material for an embankment. Not only is a much larger yardage required, because the material will spread out much further, but even after being built, the embankment is unstable and serious slides are likely to develop in rainy weather. Track is likely to heave badly in winter on such a fill, unless precautions are taken early to remedy the drainage.

Character of Subsoil

It is often necessary, or thought advisable by the locator, to run a line through a very soft marsh. There have been places of this kind where a timber float had to be built under the track in order to hold it up, and still other places where a trestle had to be built finally, after many thousand yards had been dumped and disappeared. There is likely to be an upheaval of earth at some near-by point, and occasionally this dams up a stream. A lake will then form and is likely to result in damage suits from land owners.

There have been places where the line was located over a low piece of ground which seemed to be dry but later proved to be simply a thin crust over an underground lake. Usually the conditions are not discovered until after the track has been laid and part of the fill made, and then there is likely to be a sudden giving away of the whole embankment. This defect makes its appearance usually before the track is turned over to the maintenance department.

Rail creeping is serious on a fill with a soft bottom. Rail creeping is caused in part by the deflection of the rails under load, and the softer the bottom the greater the deflection will be. Also, the subgrade and ties are likely to be saturated in a marsh; the ties naturally rot sooner and the rails and fastenings corrode more quickly.

Curvature

Curves are much harder to maintain than tangents, on account of the tendency of the rails to spread and let the gage widen. Of equal or greater import, however, is the tendency of a curve to get out of surface. This is caused by uneven balancing of the slow and fast tonnage, so that one rail gets a greater proportion of the weight of trains than the other. It is usually necessary to elevate the curve high enough for the fast trains, which makes the elevation too great for the freight trains. In such cases if the freight traffic is heavier than the passenger traffic (and usually it is) the low rail will receive a greater proportion of the total loads than will the high rail, and tend to become still lower, thus increasing the elevation and necessitating resurfacing.

Rail wear on curves, especially on those where the curvature is high, is very severe, many cases being instanced where rails last only a tenth as long as they do on tangents. On account of constant regaging of the track, the ties on a curve are likely to be spike-killed and their lives greatly shortened. Because of the fact that all the materials wear much more quickly, inspection must be made more frequently and more carefully on a curve.

It is usually necessary to line the points of curves much more often than any other part of the track, and it is almost impossible to maintain a uniform curvature unless center stakes are correctly maintained all the way around. This is almost impossible. When a foreman lines his curves by eye, while they appear to the naked eye to be smooth they are really composed of a series of compound curves, and the effect on fast trains is easily felt. These are reasons why, from the maintenance point of view alone, curvature should be reduced to a minimum, except in cases where the gradient may be reduced materially by increasing the amount of curvature.

Sidehill Cuts

If sidehill cuts and embankments are not made correctly the embankment part will cause trouble by sliding, because it does not attach itself to the hill. In order to make a good non-sliding joint, the sidehill should be cut off in a series of steps before the earth for the embankment is deposited. Even then the outside of the fill will settle much faster than the inside, so that such track is difficult to maintain, particularly for the first five or six years after being built. Furthermore, frost in winter has a better chance of getting under one side of the track than it does of the other, and this causes difficulty with uneven heaving. The frost will go out much more quickly from the outside of a sidehill cut, and is likely to leave the track rough in the spring when the heaved track is thawing out and settling back.

Where there is a long slope above a sidehill a large amount of water will flow toward the track during heavy storms. This will necessitate surface ditches of very large capacity, if the track is to be entirely protected from overflow water. Where the slope is nearly at right angles to the track or the surface ditches, they are much more likely to overflow, and they will fill with sediment much more quickly than surface ditches in other places.

Location Along River Banks

An embankment built along the bank of a river must usually be riprapped to prevent washing. Even then there is danger from excessive high water, which in some localities covers the track and starts undermining the ballast, thus eating the bank out from the inside. Whenever the water gets into an embankment it begins to soften the foundation, and is thus likely to cause trouble even if the water does not get high enough to wash away the embankment. Track in such location requires more inspection during the spring, or during periods of high water, than other track does.

If embankments are made too low in the vicinity of streams, even where ordinarily there is very little water flowing, they are sometimes overflowed in the spring when there is an immense extra quantity of water from melting snow and ice. Ice often dams up streams where the channel is obstructed, thus causing the water to rise very rapidly. While there is not as much danger of the track being washed out when the ground is frozen hard as at other times, these floods temporarily tie up traffic and occasionally leave the track covered with large chunks of ice, which require hours to remove. As the water recedes it leaves the sags last, one sag sometimes holding up traffic on an entire division for several hours.

Tunnels and Bridges

It is difficult for a track foreman to keep track in line on an ordinary bridge, and even more difficult on a pile bridge. Usually the track is put in fair line when the rails are first laid, but, due to uneven settlement, the line soon becomes imperfect. And frequently the foreman puts off the work of correcting this because he knows he will spoil his ties by too frequent spiking, because he expects the bridge to settle still more, so that his line will be spoiled even if corrected, and because it is difficult to do work on a bridge. On trestles where no refuge platforms are provided, a great deal of time may be lost in getting off for trains.

It is difficult to handle tie renewals on a bridge, and rail renewals are not as easily handled as on the regular roadbed. Furthermore the work of distributing ties or rails on the bridge is more dangerous and more likely to result in accidents.

Tunnels are even more difficult to maintain than bridges. In some tunnels it is dangerous for the section crew to remain in the tunnel as the train goes through, on account of the suffocating gases. The time available between trains is partly wasted by the men walking to and from the point of work. There is very little room to work in tunnels, and there is great danger in operating section or motor cars through them unless they are operated on train orders. The conditions in a tunnel favor the rapid

corrosion of rails and the rapid rotting of the ties, so that the maintenance cost of renewals is also excessive.

Frequently it is found advisable to change the course of the stream in order to cut down the number of bridge crossings. While this apparently shows a saving in construction, frequently the trouble experienced later in trying to keep the river in the new channel entirely overbalances the saving made originally.

Furthermore, there is always the danger of a rapid change in the course of a river which will throw the current strongly against an embankment which, when it was built, was entirely out of the way of the stream at ordinary height of water. Some streams are particularly noted for this kind of behavior, among these being the Missouri River.

Gradient and Curvature in Cuts

A curvature should not be located on a level gradient if possible to avoid it. A cut should preferably have a summit at the center, with descending grades each side, to provide for drainage; if this is impossible it should be located on an ascending or descending gradient. It is almost impossible to get good drainage in a long, level cut. The ditch has to be made very shallow at the middle of the cut and all the slope put in the bottom of the ditch. This does not usually give enough slope, and it is likely to leave the ditch too shallow at the middle of the cut to protect the track, so that trouble is likely to be experienced with soft spots at such places.

Curves in cuts make it very difficult for the engineman or the maintenance crews to see the track ahead, and therefore are a prolific source of accident. Reverse curves in a cut are especially bad. They require more work to maintain and are much harder to drain than a straight cut. Usually a section with many such curves must have extra section men because there is almost a constant necessity for a flagman to protect the section crew in its regular work.

Narrow Cuts

Cuts made too narrow at the base, or with slopes too steep, are expensive to maintain. The ditches fill up quickly, thus stopping the drainage and causing trouble with water pockets in summer and with ice and heaved track in winter. Without drainage there can be no solid foundation, therefore cuts should be made wide enough so that the work of ditching will not consist of widening the cut, but merely of clearing out the débris from the ditches.

The cost of widening a ditch by hand labor is high. A ditcher can be used, but it is always more economical to take the material out before traffic has been turned on the line and when work trains can be operated without interfering with regular traffic.

In northern countries the greater the percentage of embankment the less the trouble with snow.

Not only are reverse curves hard to maintain, but they are not safe for high-speed traffic, because there is no chance to run out and run in the elevation between them. Where there are two simple curves close together it is better policy to make one compound curve of them, because, if the elevation has to be run out and then run right back in again, it not only makes poorer riding track but makes maintenance more costly. Further, a short tangent between two curves always appears to have a swing in it.

This discussion may sound more or less theoretical, as it is not always possible to make a choice which will eliminate bad maintenance conditions. There are almost always, however, two or more preliminary lines considered before the final location is made, and the engineer should take the maintenance conditions on the several lines into consideration when making his choice. Frequently the choice is between a low line located in a valley between a range of hills, or one on top of the range. As far as maintenance is concerned the top-of-the-range site is usually the better one.

It is often possible to select the material which shall be used in embankments, by hauling a little farther or using side borrow and wasting poor material from clay hills. One mistake that is sometimes made is to put in an extra amount of curvature in order to save some yardage in the original location. This may make a cheaper first cost, but certainly does not make a cheaper ultimate cost. Sidehill cuts, by the shifting of the line and the increasing of the amount of excavation, can frequently be cut far enough into the hill to eliminate most of the bad features.

There are places in location where one curve can be made to do the work of two by increasing the yardage. This is also true of many of the other conditions mentioned in this article; and if the extra cost of maintenance is figured, a location requiring increased yardage will often be found ultimately profitable.

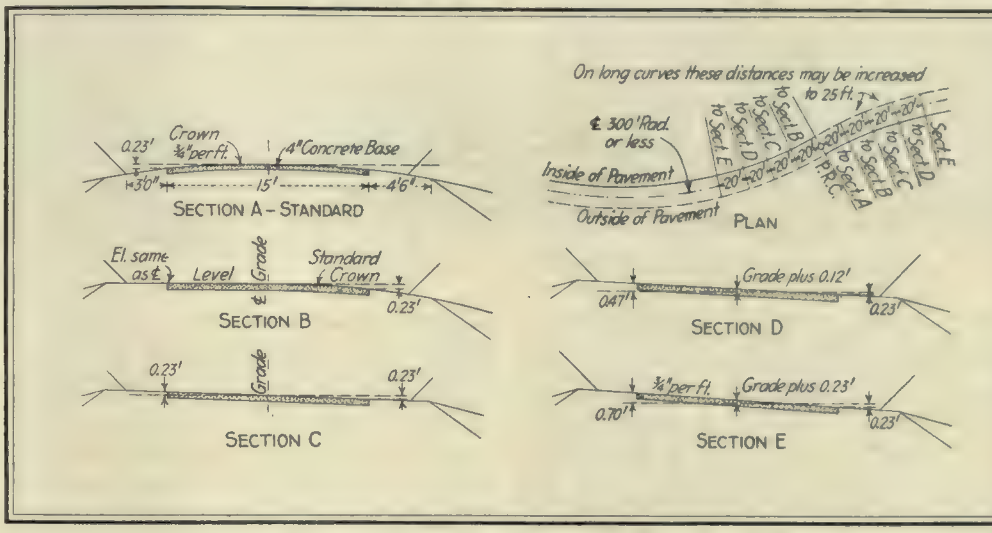
Superelevation Determined for Highway Curves

Formula, Giving Relation of Radius, Grade and Length of Arc to Proper Superelevation, Used by California Commission

THE California Highway Commission has announced as its policy on the superelevation of pavements that only such conditions as would make ordinary motor travel dangerous are to be eliminated. It is not considered necessary to go into great refinement in laying out superelevation, but rather to strike a happy medium between the theoretically exact analysis or a neglect of the subject, and so to provide superelevation only where actually required as a safeguard against accident.

It has been noted that if crowned sections are used on short radius curves of considerable length, the driver of a motor vehicle traveling at a fair speed is tempted to keep to the inside of the curve, although he may thus have to travel on the left side of the road. This is due to the desire to take advantage of the crown of the road as a superelevation. This tendency becomes almost a necessity in wet weather, particularly with small speed motor trucks loaded so that the center of gravity is high.

In determining what superelevation is advisable, in view of the foregoing, three elements of the layout are given consideration—namely, degree of curvature, grade and length of curve. The controlling factor, however, is the degree of curve. In other words, it is really unnecessary to superelevate the large-radius easy curve where the speed of vehicles is limited by law to 20 or even 30 miles per hour, inasmuch as the average driver almost invariably reduces the speed on curves, particularly where the view ahead is obstructed. It is therefore



TRANSITION FROM CROWNED TO SUPERELEVATED SECTION ON REVERSE CURVE

the sharp curve, introducing considerable centrifugal throw, which is considered as warranting particular attention as to superelevation.

For a given width of pavement established as suitable for the volume of traffic involved certain proper speeds on specific radius curves can be assumed, the commission believes, and the following relation, based on the unit amount of superelevation necessary to eliminate the outward throw, can be used to determine the unknown:

$$V = \frac{\sqrt{32.2 \times R \times e}}{w}$$

in which R equals radius of curve in feet, e equals superelevation in feet, w equals width of roadway in feet, and V equals velocity in miles per hour. It might be noted that considerably higher speeds than the theoretical ones given in the table are safe and comfortable for passenger machines on account of the margin against overturning inherent in their construction. The formula gives speed at which centrifugal force is perfectly balanced. In general, the practice is to superelevate all curves having a radius of 300 ft. or less, with special consideration for curves of greater radius on steep gradients and of considerable length. After numerous experiments with superelevation ranging from ½ to 1 in. per foot, a standard for all curves has been adopted at ¾ in. per foot. It has been found that the theoretically correct speeds for a ¾-in. per foot superelevation on a

15-ft. roadway are as follows for curves of different radii:

Radius, ft.	Speed, miles per hour
300	16 to 18
250	15 to 16
200	13 to 14
150	11 to 12
100	10

This table has been based on the finding that almost invariably the speed of motor vehicles varies directly with the radius of the curvature, and if this assumption is true, it has been pointed out that theoretically, as well as practically, the adoption of a constant rate of superelevation is warranted within the limited radii under consideration.

In constructing concrete pavements the method of transition from crowned to superelevated sections is indicated in the accompanying drawing. This layout has been adopted after trials of numerous methods of joining such sections and an observation of how traffic is affected. It is recommended that different templates be used so that smooth curves of a gradually changing section are obtained. Whether the work is done by hand templates or by machine tamper, the setting of the header boards is of utmost importance, and they should be carefully checked before "striking off" by either method.

On a mountainous section of the highway, where a great deal of curvature was necessary, and where the foregoing principles were rigidly adhered to, Walter C. Howe, resident engineer in charge, has stated: "It is probable that considerable objection will be made to this method and the arguments advanced that the center line of pavement should be true to grade and the superelevation accomplished by depressing the inner edge and raising the outer edge of pavement equally. This has been tried out on numerous occasions, but better results have been obtained by the method just described."

Exclusive Rainfall Reported

Supplementing the information regarding the recent flood in West Virginia, as given in the last two weeks' issues of this journal, Mayo Tolman, director of sanitary engineering of the State Department of Health, reports a precipitation of 5.8 in. in 3½ hours at Kayford. The flood wave traveled 18 miles in 2 hours 20 minutes between Kayford and Cabin Creek junction.

Failure of Roxbury School Building Apparently Caused by Faulty Brick Piers

Sanford E. Thompson Reports Investigation of Collapse of 63 x 203-Foot Structure Having Four-Way Reinforced-Concrete Floor Slabs

FOLLOWING the failure of the shop building of the Boys' Industrial School at Boston, Sanford E. Thompson, consulting engineer, of that city, made thorough examinations of the structure and reported, as a result of computations of strength, tests of the materials and tests of samples cut from the actual construction, that the cause of collapse was the failure of brick piers between the first and second floors, due to improper design, poor quality, freezing temperatures and the use of lime-and-cement mortar.

The building, 63 x 203 ft. in plan, consisted of two stories and basement for the front three bays, about 61 ft. in length, and one story and basement for the rear portion. The floors and roof were constructed of four-way reinforced-concrete flat slabs, supported in reinforced-concrete interior columns spaced about 22 ft. apart and on wall beams on brick piers, with brick walls. To give proper slope to the roof a cinder concrete fill with 2-in. mortar surface was used, varying in thickness from 17 to 3 in. This concrete had been placed on the high point of the roof on the day before the failure, when the weather turned warmer, tending to take the frost out of the masonry.

The conclusions and extracts from Mr. Thompson's report indicating the principal features of this failure follow:

CAUSES OF COLLAPSE

"The evidence points clearly to the brick piers between the first and second floors as the place of initial failure. The cause of the failure of these piers we find to be due to (1) their improper design for carrying a long-span flat slab; (2) the quality of the brickwork, which was not adapted to sustain the normal load of the long-span slabs; and (3) the use of lime-and-cement mortar, where the specifications called for cement mortar.

"If the structure had been built with properly designed concrete wall columns, it undoubtedly would be standing to-day.

"In reaching the foregoing decision, due account is taken of the fact that the concrete in the floors and roof at time of collapse was not thoroughly hard, and in fact had not attained nearly the normal strength of concrete. I find, however, by actual test of the strength of the column concrete that the columns were amply strong to carry the load; also, from my knowledge of the action of flat slabs even of partially hardened concrete, I consider that such a sudden failure as wrecked the building could not have been produced by the failure of the slab.

HISTORY OF CONSTRUCTION

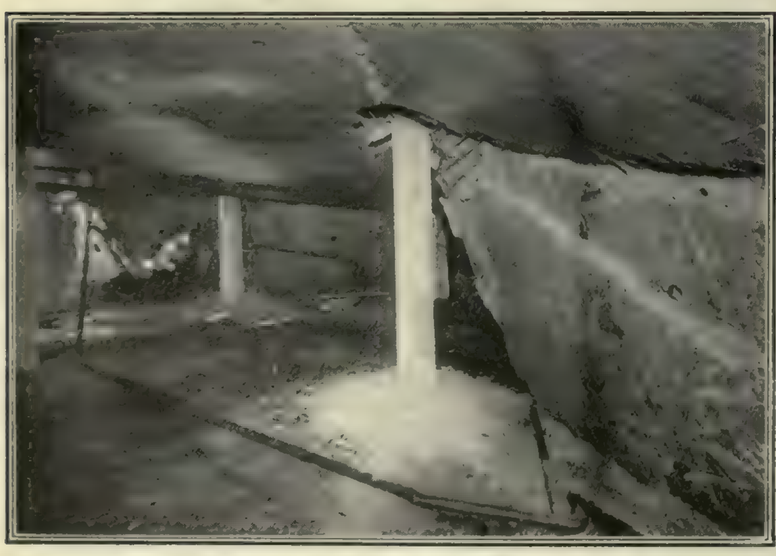
"From an inspection of the original records on the job I have the following information:

Location	Concrete poured	Forms removed
Basement columns	Nov. 24, 1915	Dec. 9 and 10, 1915
First-floor slab	Dec. 1, 3 and 4	Dec. 24, 27, 28 and 31
Columns supporting second floor and roof (low)	Jan. 5 and 6, 1916	Feb. 10, 11, 12 and 19
Second floor and low roof	Jan. 6 and 7	March 6, 7, 8, 9, 20 and 22
Columns supporting high roof and high roof itself	Feb. 2 and 5	Feb. 29 (column)
Cinder fill on low roof	Jan. 24, 25 and 26	March 22 (posts next to wall)
Cinder fill in high roof	March 23	

Collapses occurred March 24, 25 and 29.

"I understand that the sand and stone for the concrete were thoroughly heated. I am advised also that the brickwork was laid in advance of the concrete construction, that the window openings were protected by canvas, that salamanders were used on the floors, and the fresh concrete protected.

"The foregoing table shows that the forms under the second floor and low roof were left in place more than eight weeks. Occasional 3 x 4 in. posts spaced about 11 ft. apart were under the low roof at the time of my first visit after the first collapse. Before removal of the forms, I am advised that the concrete was examined and tested by blows in the presence of the city building inspector.



BASEMENT COLUMNS SUPPORTING BROKEN FIRST-FLOOR SLAB

CRUSHED FIRST-FLOOR COLUMNS STILL CARRY HEAVY LOADS

Note the remarkable toughness of the slabs and columns which survived excessive loads and impact from the collapsed upper floors and posts

VIEW OF BRICK PIER AT CORNER SHOWING VERTICAL JOINT

NEARER VIEW INDICATING NATURE OF MORTAR WORK

"At the time of my first visit on March 25 I found the roof and the second floor of the high portion of the building had collapsed and were hanging on the reinforced-concrete beam which was designed to support the rear wall of the second story. The remainder of the building remained intact. On the following day I was advised of a further collapse at 7 o'clock the night previous, and again visited the job. I found the low roof had fallen, bringing with it a part of the first floor at the south end of the building. The first floor in the north end, although badly deflected and cracked, and the column cap badly cracked, held the weight of the entire material of the second floor and roof, besides having sustained the impact of the fall.

"Not until three days later, on March 29, did this portion of the first floor finally fall, leaving even the basement columns still in a nearly vertical position.

Frozen Mortar in Brickwork

"The mortar in the brickwork was, much of it, frozen, and the part which had thawed easily crumbled in the fingers. From the appearance it was evidently a lime-and-cement mortar, with a preponderance of lime. This afterward proved to be the case by chemical test. The brickwork was not constructed with the care required for piers or a wall supporting a long-span slab. The horizontal joints varied in thickness ranging up to 1⅝ in. The vertical joints were, many of them, open for a depth of several courses. Headers in some cases were blind instead of being full. The face brick in many cases was peeled off from the backing, and cracks between them are shown in the photographs. The piers between the windows in the top story of the main building, which were laid under conditions corresponding to those of the shop building, were found by measurement to have buckled, the face course being bulged out from the backing. As a whole, the brickwork in the shop building was very poorly constructed for carrying out the intent of the design.

"The concrete in the second floor and the roof slabs was not thoroughly hard. It contained moisture and some frost. I found a marked difference in the concrete, however, in different portions of the structure. The columns both in the basement and the first story appeared well hardened. This was shown by inspection and also by the fact that in places the surface of the column had been chipped with a cold chisel without crumbling. The concrete in the low roof slab was least hard and very much weaker than the concrete of the second floor, which was laid as a part of the same slab. The harder condition of the floor slab was due evidently to the better protection from the cold and the opportunity to dry out.

"The concrete of the roof slab was well bonded with the cinder concrete fill, so well, in fact, that they would act together in resisting stress.

Criticism of Design

"My criticism of the design relates chiefly to the improper combination of the reinforced-concrete flat slab with the brickwork. Such combination is a poor construction at the best, and, if unavoidable, special precautions should have been taken to provide for eccentric stresses and bending moments. Even the slight normal deflection of the slab which occurs under working loads tends to throw excessive stresses on the brick piers because of the eccentricity.

"In the slab design I would criticise especially the shape of the haunch, which is flatter than required by good authorities at the time of the design of this building.

"Turning to the walls, we find a 12-in. thickness for the two upper stories (4 in. of this being face brick), a quality of construction very poor for the requirements, and a mortar consisting largely of lime and sand. I am informed also that instead of slaking the lime in advance, it was slaked just before using. As evidence of this, I find at various places in the mortar small pieces of unslaked lime. The mortar materials, I am advised, were not heated. Computing the stresses, I find that on account of the weight of the long span the brickwork probably received a stress of more than 250 lb. per square inch, whereas tests of a portion of one of the brick piers showed the beginning of failure at 167 lb. per square inch.

Results of Tests

"The specifications for piers require 1 part cement to 3 parts sand, with not to exceed a shovelful of slaked lime to a bag of cement. Samples from the wall where the failure first occurred represent approximately 1 bbl. of lime to 1 bbl. of cement. Allowing for the expansion of lime in slaking, we find instead of one shovelful of slaked lime per bag of cement (the limit of the specifications) 13 shovelfuls, 15 shovelfuls and 4 shovelfuls of slaked lime respectively for three samples of mortar analyzed chemically.

"*Brickwork*—Two pieces of brickwork from brick piers in the portion of building which collapsed were tested for compression. The first sample showed a drop of the gage of the testing machine at 167 lb. per square inch, or 12 tons per square foot, showing that a constant application of this load would have produced failure. The specimen actually broke at 550 lb. per square inch, or 40 tons per square foot. The second specimen showed initial failure at 240 lb. per square inch, or 17 tons per square foot with a breaking strength of 635 lb. per square inch, or 46 tons per square foot. It is of course evident that the lower figures represent the actual value of brickwork in resisting the load.

"*Concrete*—Chemical analysis of the concrete showed it to be in proportions 1 part cement to 6 parts of aggregate, or substantially 1 part cement to 2 parts sand to 4 parts stone, as called for by the specifications. A sample of this concrete hardened

satisfactorily upon boiling, indicating its good quality and the fact that the low strength was due simply to the cold-weather conditions.

"A sample of the concrete corresponding to the concrete in the column between the first and second floors of the part of the building that failed first showed a strength in compression of 1350 lb. per square inch, which is very much in excess of the stresses found by computation as caused by the loads. No specimen of the slabs large enough to test could be obtained from the end of the building which first collapsed without endangering the men making the test. Inspection of the concrete, however, indicated it to be strong enough to carry the loads which came upon it.

"In view of these conditions and as a result of examination, computations and tests, I am convinced that the failure of the building originated with the brick piers supporting the second floor. The conditions on March 24, the position of the columns and the rest of the failed portions, indicate that the subsequent failure started at the junction with the ruins of the first mentioned failure."

Eccentric Loading on Columns Discussed, Accompanied by Formulas and Table

Moments Caused by Crane Loads in Mill Buildings and by Eccentric Loads in Office Buildings Can Be Found by Approximate Methods

By R. FLEMING
American Bridge Company, New York City

BUILDING CODES and specifications usually contain a clause stating that in proportioning columns provision must be made for eccentric loading. That some provision should be made is self-evident, but just what that provision should be is a matter of discussion. This article presents methods that have been used satisfactorily, are easy of application, and for all practical purposes are near enough to being correct.

Loads on Brackets

The most common cases of eccentric loading are those of crane runway girders carried on column brackets. In Fig. 1 the load P acts at a distance m from the center of the column, and the couple Pm is held in equilibrium by a horizontal couple Wc. Then

$$Pm = Wc \text{ or } W = Pm/c$$

If M_b is the moment at bottom of column where R_b is the reaction, M_t moment at top of column where R_t is the reaction, M_1 moment at point A and M_2 moment at point B, then for columns with both ends considered hinged it is easy to write:

$$M_b = 0 \text{ and } R_b = -\frac{Wc}{l} = -\frac{Pm}{l}$$

$$M_t = 0 \text{ and } R_t = \frac{Wc}{l} = \frac{Pm}{l}$$

$$M_1 = R_t d = \frac{Wcd}{l} = \frac{Pmd}{l}$$

$$M_2 = R_b a = -\frac{Wca}{l} = -\frac{Pma}{l}$$

The bending-moment diagram for ends hinged is shown by Fig. 2.

If both ends are considered fixed, we have the following equations, furnished the writer by his colleague, Stanley Smith:

$$M_b = \frac{W}{l^2}\left[-d^2(l-d) + a(l-a)^2\right]$$

$$R_b = \frac{W}{l^3}\left[d^2(3l-2d) - (2a+l)(l-a)^2\right]$$

$$M_t = \frac{W}{l^2}\left[-(l-d)^2 d + a^2(l-a)\right]$$

$$R_t = \frac{W}{l^3}\left[(l-d)^2(l+2d) - a^2(3l-2a)\right]$$

$$M_1 = \frac{W}{l^2}\left[-d(l-d)^2 + a^2(l-a) + \frac{d}{l}(l-d)^2(l+2d) - \frac{d}{l}a^2(3l-2a)\right]$$

$$M_2 = \frac{W}{l^2}\left[-d^2(l-d) + a(l-a)^2 + \frac{a}{l}d^2(3l-2d) - \frac{a}{l}(l-a)^2(2a+l)\right]$$

The bending-moment diagram for ends fixed is shown by Fig. 3. The points of contraflexure x_1, x_2 and x_3 from the ends can easily be located by plotting the values of the moments, as indicated by the figure.

In the table herewith the values of M_b, M_t, M_1 and M_2 are given in foot-pounds for both fixed and hinged ends when P is taken at 10,000 lb., l is 24 ft., m is 18 in. or 1½ ft., c is assumed constant at 2 ft. and a and d vary in accordance with the vertical position of the bracket.

MOMENTS IN 24-FOOT COLUMN DUE TO 10,000 POUNDS 18 INCHES FROM CENTER

		Hinged Ends		Fixed Ends			
a	d	M_1	M_2	M_b	M_t	M_1	M_2
6	16	10,000	3,750	1,354	4,896	7,461	5,990
8	14	8,750	5,000	1,147	4,896	7,383	5,872
10	12	7,500	6,250	3,021	4,271	6,875	6,263
12	10	6,250	7,500	4,271	3,021	6,263	6,875
14	8	5,000	8,750	4,896	1,147	5,872	7,383
16	6	3,750	10,000	4,896	1,354	5,990	7,461
18	4	2,500	11,250	4,271	4,479	6,940	6,823
20	2	1,250	12,500	3,021	8,229	9,049	5,143
22	0	0	13,750	1,147	13,647	12,604	2,096

An effort is usually made to fix columns at the base by set anchor bolts and at the top by rigid attachment to a truss or girder. The actual condition, however, is between fixed and hinged ends. An easy method of calculation is to assume the maximum bending moment to be 8/10 or 9/10 of that obtained from ends considered hinged. This is a close approximation, as may be inferred from the maximum values in the table.

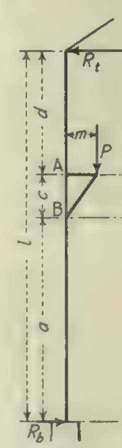


FIG. 1

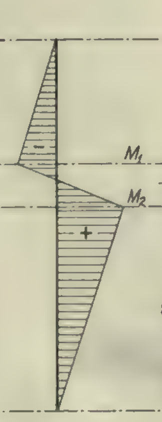


FIG. 2

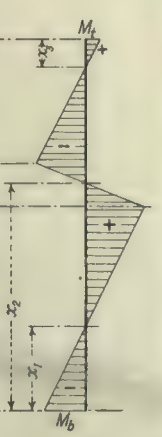


FIG. 3

FIGS. 1, 2 AND 3—ECCENTRIC LOAD ON COLUMN

In proportioning parts for the combined stresses due to bending and direct loads the allowable working stress is increased 20 per cent, provided the section thus obtained is not less than that required for bending or direct stress alone.

The specifications for a building of unusual magnitude contain the clause:

> No cantilever brackets for crane loads shall be used when capacity of crane is in excess of 10 tons.

This is an excellent rule for all buildings. It is better to avoid eccentricity than to make provision for it. Where practicable, columns as in Fig. 4 should be used. The crane load should be carried to the base by the channel and the two connecting angles with the portion of web plate between them.

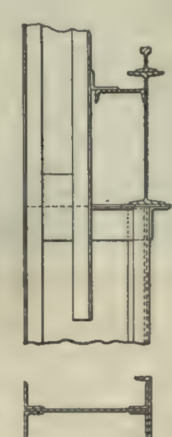


FIG. 4

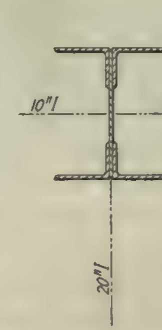


FIG. 5

FIGS. 4 AND 5—CRANE AND BUILDING COLUMNS

Office-Building Columns

In office buildings eccentric loading on columns is usually caused by unbalanced floor loads. Fig. 5 is a familiar instance. If the column were turned 90 deg. there would be little or no eccentricity, but columns cannot always be turned in order to lessen eccentricity.

A practice sometimes followed in office-building design is to neglect eccentricity altogether. This is reprehensible and needs no comment. Another practice is to add the flexural unit stress found by a formula for eccentric loads to the unit stress due to direct load, and to proportion the column so that the combined stresses do not exceed the allowable unit stress obtained from the formula used for axial compression. This method is more severe than need be, as office-building columns are continuous through two or more stories. It is probably for this reason that the Bethlehem Steel Company's handbook permits the maximum fiber stress due to direct load and bending to be 25 per cent in excess of the permissible stress on the column obtained from the formula for concentric loading. Burt, in "Steel Construction," 1914, writes:

> Some authorities allow three-fourths of the bending moment to be used in computing the effect on the column. This practice is satisfactory and is followed in the illustration used later in this book.

Ernst F. Johnson, in "The Theory of

Continuous Columns" (*Transactions* of the American Society of Civil Engineers, June, 1906), finds the bending moment caused by eccentric loading on office-building columns to be $M = W(c + b/2)$, in which W is the load, b the eccentricity, and c a constant to be deduced from the particular building law or specification under which the work is to be erected. From the New York building code he finds the value of c to be 1/16 in. per foot of column length.

Heller's Investigations

Heller, in "Stresses and Structures," finds for a ten-story building that the maximum bending moment of a column with equal loads P and equal eccentricities e at all floors, is at the roof line or top of the column and equal to Pe. At the top of the second segment from the bottom the moment is 0.39 Pe. For intermediate points (three stories or more from the top or bottom) the moment is 0.5 Pe. For a single load at any point, the bending moment in the column passes from a value of about +0.5 Pe just above the load, through zero to a value of about —0.5 Pe just below the load.

In "Stresses in Tall Buildings," by Cyrus A. Melick (Ohio State University Bulletin No. 40, June, 1912), Chapter 4 is devoted to a study of the effect of eccentric loading on columns. The conclusions pointed out by Heller are verified. The author presents his own theory in Chapters 7 and 9, and in the final chapter he gives a "résumé of all findings and suggestions for designers as derived therefrom," in which he writes:

> It is evident, then, that it is not safe practice to follow the conclusions deduced in Chapter 4, which are identical with Professor Heller's. It is further shown that the value of the bending moment may materially exceed even the quantity Pe so commonly used by designers. Also, it is shown that the bending moment is not a constant throughout the story height but reverses in sign, and at the foot of the column it may be a much larger quantity, of opposite sign, than the moment at the top of the column.

The findings and suggestions of Melick have not been used to any appreciable extent by designers.

For the usual office-building column with an eccentric load the practice of the writer is to use three-fourths of the bending stress found by Rankine's formula for eccentric loads. As in proportioning mill-building columns, the allowable working stress is increased 20 per cent for the combined stresses due to bending and direct loads, provided the section thus obtained is not less than that required for bending or direct stress alone.

In conclusion, the writer believes that more attention should be given to the details of eccentric connections than is done at present. Good detailing is fully as important as, and often more difficult than, determining stresses and proportioning parts.

Asphaltic Road Oils Heated Quickly in Retort

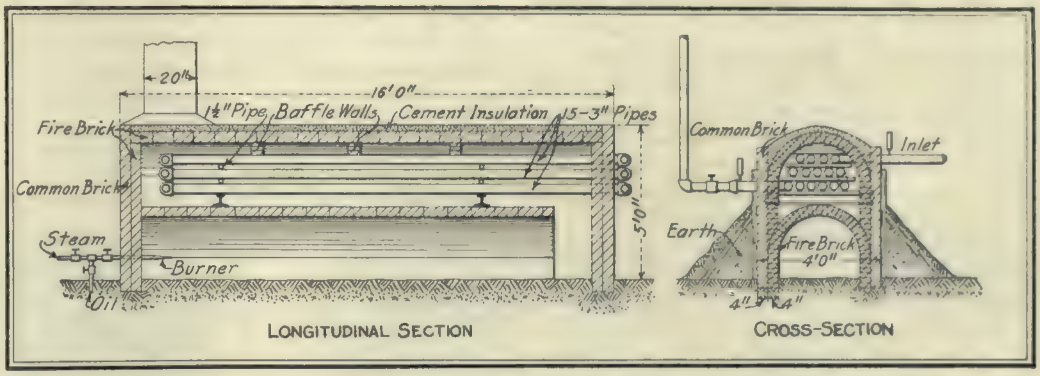
Permanent Plants That Can Heat 6000 Gallons Per Day to 375 Degrees Are Installed in California for About $2,000

IN applying thin bituminous surfacing to concrete pavements according to the specifications of the California Highway Commission an asphaltic base oil is used, refined to the point where the asphalt content is 90 per cent. To spray this heavy oil on the surface in two coats, of ¼ gal. per square yard each, it is necessary to heat the oil to high temperature. In order that this may be done economically a very careful study of the conditions was made and the practice, in large measure, standardized as described in the following notes.

Two types of oil-heating stations are used. Where only comparatively small quantities of oil are required, semiportable plants are installed at the nearest railway siding, and are moved to other locations when the work is completed. But when the area of operations extends from 20 to 30 miles in either direction the economics of a permanent plant warrant the more expensive construction. These oil-heating plants were referred to briefly in a report on California road construction and maintenance, published in the Engineering Record of May 6, 1916, page 603.

Heating-Plant Layout

In both types of installation the cycle of operations is practically the same and the unit members of the equipment are similar. Cars of oil are unloaded by gravity into storage tanks or pits varying in capacity from 10,000 to 25,000 gal. and the oil is delivered thence to trucks by pumping. Steam coils in the tank cars are necessary in order to heat the oil so it will flow. The same requirement holds for the storage pit or tanks, and a retort is necessary for heating the oil up to the high temperatures at which it is delivered to the trucks.



THE RETORT IS DESIGNED TO MINIMIZE HEAT LOSSES FROM INCOMPLETE COMBUSTION OF FUEL AND FROM RADIATION

The drawing shows the design of the retort for heating the oil in what is practically a tubular boiler. In semiportable installations the storage tank is usually made of steel, and in permanent plants a concrete sump is used, the capacity in each case being determined by the availability of the oil supply. The hot-oil pump in most general use is a 6 x 4 x 6-in. duplex piston pump, oil fitted.

The circulation tank, or oil pit, is either a concrete-lined sump, a reinforced-concrete box, or a steel tank, with a capacity between 2000 and 3000 gal. It is heavily piped with steam coils and is tightly covered. In some cases where the large oil storage tank is a concrete sump this circulation tank is made as a chamber of the larger tank, but is always separated from it by concrete walls.

Oil Heated Quickly

It has been found that the time saved in handling the oil rapidly makes it very desirable to secure a quick-heating retort. Saving time in loading trucks increases the output of the plant and thereby reduces the cost per barrel for heating, inasmuch as the daily operation charges are practically fixed, irrespective of the quantity of oil treated. The type of retort illustrated herewith has been designed to reduce to a minimum losses from incomplete combustion of fuel and from radiation. The long firing chamber allows complete combustion of fuel oil and the large number of pipes that practically fill the upper arch absorb the maximum of the heat. The design shown keeps radiation down so low, it is stated, that it is possible to place the hand upon the retort at any point during heaviest firing. The number and lengths of pipes were determined by dividing the

IN THE GALVANIZED IRON BUILDING BESIDES THE RETORT ARE THE STEAM BOILER AND THE OIL PUMPS

square feet of heating surface required into some number of convenient lengths for handling. The 3-in. pipe was taken as giving the maximum heating section without introducing undue friction. To determine the square feet of heating surface needed it was first ascertained by various experiments and trials that it would be necessary to raise the temperature in the oil while passing through the retort coil about 200 deg., when loading into trucks.

Speed of Operation

To put a truck load of 1000 gal. through in a short time, say 20 to 25 minutes, without burning pipes and without preheating to excessive temperatures in the circulation tank, required about 150 sq. ft. of heating surface, with a furnace temperature of 1800 deg. to 2000 deg. Fahr. (this being the maximum that can be carried with safety). The calculations were based on 3 B.t.u. per hour per square foot of heating surface, per degree of mean temperature change, which accuracy of assumption was accepted for temperatures up to 300 to 325 deg. Fahr.

A feature of this retort design which has been found very useful is that of carrying the pipe at once to the outside of the retort and, in place of return bends, using a special fitting which permits the removal of the ends of individual pipes so that access may be had to each of them to clean out the carbon which is continually deposited in slight quantities.

Operating Methods

In preparing to deliver oil to a motor truck, warm oil is first pumped from the storage tank through the retort and into the circulation tank. As soon as the circulation tank contains a truck load the suction from the main storage is closed and the oil in the circulation tank is re-run until it has reached at least 200 deg. The retort fire is then increased and the oil pumped through direct to the truck tank at temperatures from 325 to 375 deg. Fahr. The entire operation of circulation and loading consumes about 1½ hours, so that it is possible to load about six 1000-gal. oil trucks per day from a plant laid out and operated on the lines just described.

When the oil is to be conveyed less than 10 miles in trucks, it is delivered to the trucks at 325 deg. Fahr. For distances greater than 10 miles, the specified temperature is 350 deg., the desideratum being a temperature of approximately 300 deg. Fahr. at the time of application. The commission has found that at this temperature the more fluid condition of the oil provides a better bond with the concrete than is obtainable with temperatures considerably lower.

Costs

A completely equipped oil-heating plant of standard type described in the foregoing has cost the commission approximately $2,000, installed. Records of costs covering unloading from tank of cars, heating and loading into motor truck tanks on approximately 5000 bbl. of 90 per cent asphalt road oil show a total expenditure for labor and fuel, repairs and supplies, interest and depreciation, of about $2,250, or 45 cents per barrel of road oil unloaded and delivered hot.

A. B. Fletcher is chief engineer of the California State Highway Commission. Walter C. Howe is resident engineer of Division 5.

Double Tank Proposed for Residential Sewage Plants

Better Operating Results Claimed for Septic and Imhoff Units in Series—"Greenhouse" Sludge Bed Advocated

By WALDO S. COULTER
Of Hansen & Coulter, Consulting Engineers, New York City

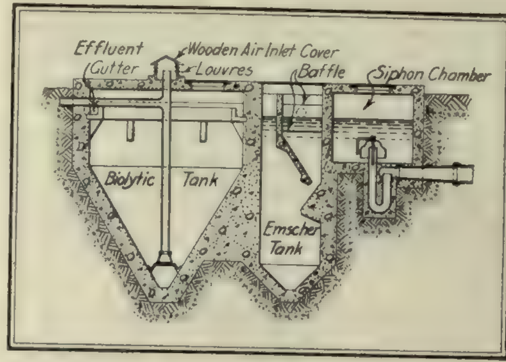
RESIDENTIAL sewage-disposal plants are usually constructed after a fixed pattern that has undergone little or no modification since its inception in the days of Colonel Waring. Such installations usually consist of a single-story septic tank followed by a siphon chamber and some simple form of secondary treatment.

Engineers and superintendents who have been associated with the practical operation of the single-story, horizontal-flow tank know that, unless operated as a plain sedimentation tank, with frequent cleanings, it is a very unsatisfactory sedimentation device. During hot weather gas discharges from the sludge deposits on the tank bottom commence about three weeks after placing the tank in service. During the winter from six to eight weeks usually suffice to establish active ebullition in northern latitudes.

"Unloading" Hinders Sedimentation

Gas production is accompanied by such disturbances of the tank contents that efficient sedimentation is precluded and suspended matter appears in the effluent in considerable quantities. This "unloading" goes far toward explaining the phenomenon of the septic tank that has been in operation for several years and yet contains less than 50 per cent sludge. The writer has never seen any arrangement of baffles that prevented unloading from a single-story tank in active ebullition.

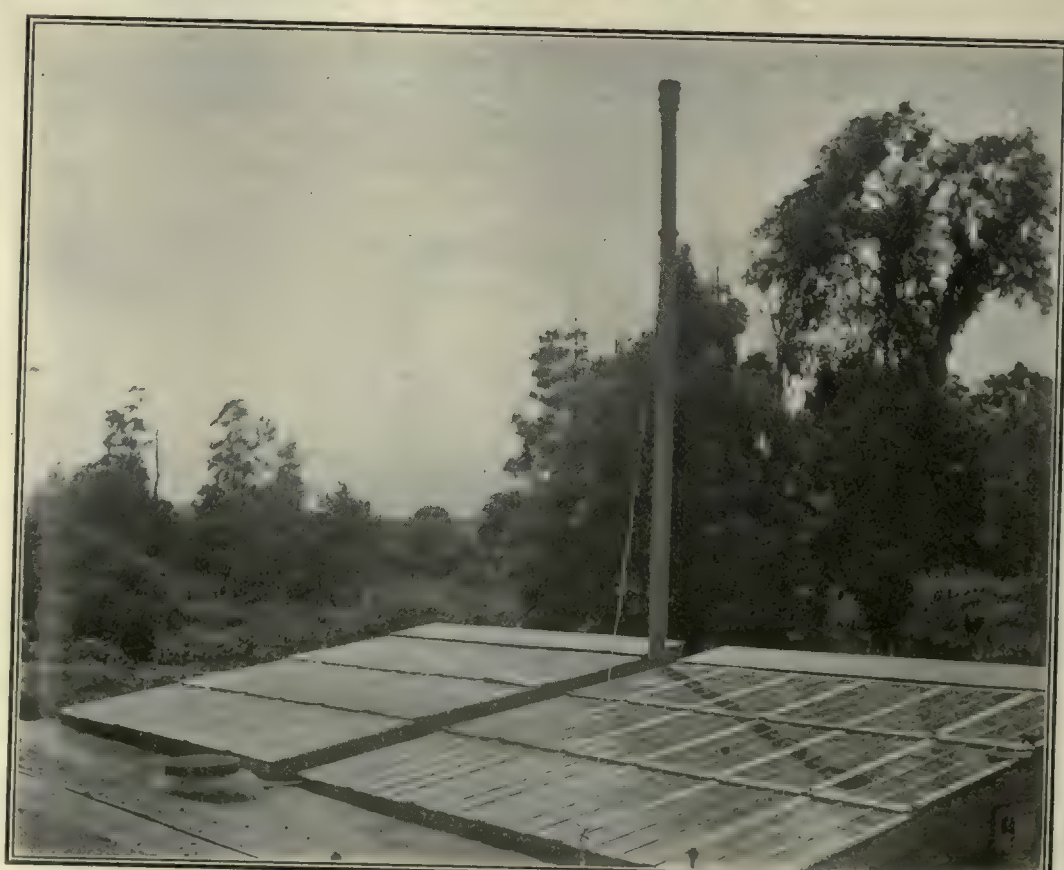
If the tank is cleaned as soon as septic action begins very good results can be secured. This is not ordinarily admissible in the case of the residential plant, where such constant cleaning cannot conveniently be done, and where the proximity to dwellings makes a nuisance quite probable if undigested sludge is handled.



SUGGESTED ARRANGEMENT OF SEPTIC AND IMHOFF TANKS FOR RESIDENTIAL SEWAGE PLANT

Soon after being placed in service the tank of the standard-type residential plant begins to unload into the tile field, sand filter or contact bed that provides secondary treatment. The field or bed is soon choked up with sludge, and constant scraping is necessary to keep the filter in service. Choked tile fields, where the sewage appears at the surface to form "wet ground," and whence the water is dissipated by evaporation or by seepage into adjacent unclogged areas, are common. The owner very often supposes that this is as it should be and makes no protest unless the stench becomes pronounced.

The common septic tank has, nevertheless, certain advantages as applied to residential installations that the two-story type does not possess. Residential sewage arrives at the tank in a fresh condition with unbroken fæces, paper intact, and having a higher percentage of grease than commonly appears in municipal sewage. These matters pile up against the scum baffles of an Imhoff tank or adhere to the slopes of the settling channel and call for unusually painstaking attention.



"GREENHOUSE" TYPE OF SLUDGE BED AT PLEASANTVILLE, N. Y., HAS 648 SQUARE FEET OF GLASS

The logical arrangement for the residential plant, which will be found desirable in many larger plants as well, appears to the writer to be a septic tank and a short-period Imhoff tank, placed in series. The two-story tank then serves to intercept matter carried over from the septic tank and, if given reasonable attention, should insure a well-clarified effluent. The Imhoff tank should be provided with light, strong checkered plate covers to allow unobstructed access to the slopes and gas vent. In the opinion of the writer, the upward-flow type possesses advantages peculiarly fitting it for the primary tank in such a series, the influent being admitted at a point near the bottom and caused to pass upward through the sludge accumulation, after the manner of the Boston biolytic tank, so called, suggested by Professor Phelps.

Two principal faults have heretofore appeared in the operation of tanks of this type:

First, suspended matter unloads. This has been aggravated in most upward-flow tanks by improper design, which has permitted too high velocities. Unloading is, however, characteristic of this as well as of horizontal-flow, single-story tanks. The Imhoff tank in series would correct this deficiency.

Second, foul odors are produced. This may be overcome to a considerable extent by carrying the influent pipe above the outside of the tank in such a manner that the inflowing sewage entrains sufficient air to enter the sludge stratum saturated with oxygen. The sludge layer acts not only as a strainer to intercept true suspended matter, but the colloids and fats are thrown out by adsorption. The writer is aware of the fact that this type of tank produced considerable amounts of hydrogen sulphide at the Chicago Sewage Testing Station, but this action has not been duplicated elsewhere to his knowledge, and the fact remains that it was by far the most efficient clarification device at the station. Sludge containing entrained gases and rising from the tank bottom to appear in the effluent will readily settle again if subjected to such agitation as ordinarily occurs at collecting troughs or outlet weirs. A simple test at any septic tank will readily demonstrate this condition.

"Greenhouse" for Sludge Disposal

The removal and disposal of sludge are other matters which have usually been accorded scant attention in residential and institutional plants. Too often plants of considerable size are provided with no means for the withdrawal of sludge other than by pails or buckets passed up through manhole openings in the cover slab. Disposal in the vicinity of the plant is avoided because of probable nuisance.

The solution of this problem may, in the opinion of the writer, be frequently found in the glass-covered or "greenhouse" type of sludge-drying bed, with vent stack and air-inlet openings. To his knowledge, the first operative bed of this type was designed by him while connected with the firm of Lederle & Provost, of New York City, and installed and operated under his direction at the plant of the Hebrew Sheltering Guardian Society at Pleasantville, N. Y. It was constructed and placed in service during the summer of 1915. The results have exceeded expectations. Plain sedimentation sludge dries sufficiently to permit removal in from ten days to two weeks, and the action of the bed is unaffected by rainy weather.

Last winter the bed operated efficiently and without freezing, although no artificial heat was applied. One unit was built first in order to observe its behavior, particularly with regard to odors, as it is located about 200 ft. from the nearest of several dwellings. This unit was entirely successful and a second one was afterward constructed.

Aëration of Tile Fields

Referring to tile fields, one defect which may be noted among others is lack of aëration. In any oxidizing unit, such as a tile field, oxidation is accompanied by the production of a considerable volume of carbonic acid gas, which should be removed from the system as rapidly as formed, since it operates to retard or prevent oxidizing action. This gas is heavier than air and, in the case of a sprinkling filter say, built above the ground surface, tends to sink to the lower portion of the filter and escape through the under-drains, etc. The tile field, being entirely below the ground surface, retains the CO_2 in the soil pores and tiles, excluding the air, until displaced from time to time by applications of sewage. This must markedly reduce the efficiency of the field. An evident improvement would be to connect the ends of the tiles at one side of the field with a ventilation duct terminating in a vent stack with a ventilating hood, the opposite ends being provided with suitable air inlets.

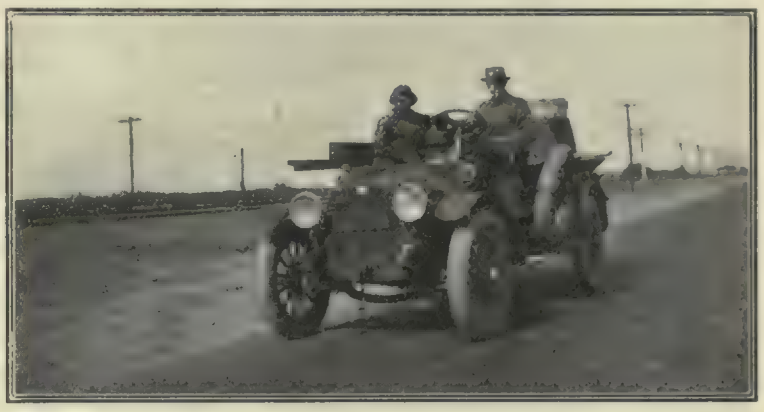
Further constructive criticisms could be made, but enough has been written to call attention to the fact that the standard type of residenial sewage-disposal plant is deficient in many respects and merits a portion of the attention that has been heretofore almost entirely devoted to larger installations.

Road-Maintenance Stations for California Highways

Depots Make It Possible to Supply Materials for Repair Work to Remote Sections of State Highway System

THE California State Highway Commission has established maintenance stations along the highways which are to fulfill a twofold purpose—namely, to maintain the roads in their original first-class condition and to be able to deliver, at the proper temperature, oil used in surfacing or resurfacing the pavement. In many localities the latter function is very important because of the great mileage of roads to be surfaced, and it has been found economical to use first-class permanent construction in building the heating plants.

An example of the policy in the location and construction of these maintenance stations is afforded by the three main yards in Division 6, which embraces nine San Joaquin Valley counties. In this division there were 150 miles of highway to be surfaced when the maintenance station was laid out, and altogether a total of 180 miles to be maintained.



THIS BROKEN GUARD RAIL WAS REPAIRED QUICKLY WITH MATERIAL DELIVERED BY MOTOR FROM CALIFORNIA MAINTENANCE STATION

The first station in this division was built at Merced, and was used as a distributing center from which 40 miles of pavement were oiled. The second station was located at Fresno and the third at Bakersfield. About 40 miles have been surfaced with materials distributed from the Bakersfield station. All three of these stations are on property which the state bought outright, as it has been found advisable to build permanent structures only on land owned by the state.

Station Equipment

These stations are situated so that it is possible to unload the heavy asphaltic oil directly from the railroad tank cars in which it is delivered, into concrete storage pits. The stations are provided with steam generating equipment with which to heat the oil and to drive the pumps and heating retorts. This oil-handling equipment is designed and constructed on permanent lines, so that the oil may be handled with a minimum of time, labor, expense and trouble. The latter item has been found to be a very important one, but its significance will be appreciated only by those who are familiar with the possibilities in this direction when handling heavy asphaltic oil if all conditions are not just right.

In addition to the central maintenance stations where road building materials, equipment and tools are stored, there are also structures known as "shelter houses,"

built on some of the longer stretches of highway where it is occasionally very convenient to have small tools near at hand.

With a subdivision of the system on this basis it is possible, for example, to get materials for repair work to the most remote portion of the 125 miles of highway surfaced from the Fresno station within less than four hours. The equipment for a "flying squadron," depending on motor trucks for rapid transportation, is kept in readiness for emergency service and has proved very effective and well worth the incidental cost.

Austin B. Fletcher is chief engineer of the California State Highway Commission and James W. Woodson is resident engineer of Division 6.

Literature

For the Civil Engineer and Contractor

New Publications

PROCEEDINGS OF THE TENTH ANNUAL CONVENTION OF THE SMOKE PREVENTION ASSOCIATION, 1915. Paper, 6 x 9 in.; 176 pages; illustrated. Chicago, 608 City Hall, Frank A. Chambers, secretary-treasurer.

DUST EXPLOSIONS AND FIRES IN GRAIN SEPARATORS IN THE PACIFIC NORTHWEST. By David J. Price, engineer in charge of grain dust explosion investigations, Bureau of Chemistry, and E. B. McCormick, chief, division of rural engineering, Office of Public Roads. Bulletin 379, U. S. Department of Agriculture. Paper, 6 x 9 in.; 22 pages; illustrated. Washington, Government Printing Office.

TRUST LAWS AND UNFAIR COMPETITION. By Joseph E. Davies, commissioner of corporations, U. S. Department of Commerce. Paper, 6 x 9 in.; 832 pages. Washington, Government Printing Office.

SUPPLEMENT TO MECHANICS' LIENS AND GENERAL CONTRACTING. By Thomas H. Ray, of the New York City Bar. Cloth, 6 x 9 in.; 819 pages. Albany, Matthew Bender & Company, Inc.

Contains the amendments to these laws up to the close of the New York legislative session of 1916, with all of the decisions since the date of the original work—July, 1914, to June 1, 1916.

CONCRETE SEWERS. Paper, 6 x 9 in.; 43 pages; illustrated. Chicago, Portland Cement Association.

Booklet for free distribution gives information on the merits of concrete in sewer construction, with history and examples of use.

Books Reviewed

Highway Engineers' Handbook

Authors, Wilson G. Harger, first assistant engineer, and Edmund A. Bonney, supervising engineer of the New York State Highway Department. Second edition, revised and enlarged. Flexible covers, 4¼ x 7 in.; 609 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $3 net.

The second edition of Harger and Bonney's "Highway Engineers' Handbook" contains about 100 pages of new material, and represents a revision of the first edition, published about four years ago and reviewed in the Engineering Record of September 28, 1912, page 363. The material on top courses has been brought up to date, and data on tests, designs, costs and maintenance and specifications have been added. The index also has been amplified, and rearranged systematically, although the general make-up of the book remains unchanged.

The book is divided into two parts, the first dealing with the principles of design and the second with the practice of design and construction. In Part 1 there are chapters on grade and alignment, sections, drainage, foundations for broken stone roads, top courses and their maintenance, minor points (including guard rails, retaining walls, curves, etc.) and materials. Part 2 opens with a chapter on surveys, which is followed by one on office practice. Succeeding chapters deal with cost data and estimates, notes on construction and specifications.

Since the publication of the first edition of the handbook many advances have been made in highway practice. The latest edition, therefore, brings the information up to date. Engineers will find this volume a compact and complete source of information ordinarily required in field and office practice of road-building.

Waterworks Handbook

Compiled by A. D. Flinn, deputy chief engineer, Board of Water Supply, New York City; R. S. Weston, professor of public health engineering, Massachusetts Institute of Technology, and C. L. Bogert, assistant engineer, Board of Water Supply, New York City. Flexible cloth, 6 x 9 in.; 824 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $6 net.

REVIEWED BY WESTON E. FULLER
Consulting Engineer, New York City

This book is a compilation of a large amount of valuable information on matters relating to the design, construction and operation of waterworks. The subject is treated under five parts, as follows: Part 1, Sources of Supply; Part 2, Collection and Work Therefor; Part 3, Transportation by Aqueducts, Pipe and Other Conduits; Part 4, Distribution, Hydrostatics and Hydraulics, Materials Much Used in Waterworks; Part 5, Character and Treatment of water.

This arrangement, while it leads to some repetition and to the separation of some subject matters closely related, is in general a satisfactory one.

The authors have included much data and information selected from a large variety of sources. Extracts from books, papers and periodicals have been used in many cases, with explanatory notes and comments. In other cases, a digest of the subject has been given. References are included quite generally, thus materially adding to the usefulness and value of the book.

As is inevitable in a work of this sort, much that is pertinent to the subject and which to others would appear of equal importance to that included is omitted. Generally, however, the matters presented are well balanced, and give the different viewpoints as fairly as can be expected within the limited space available.

It is noticeable that the authors have not limited the contents of the book to matters which are recognized as established practice, but have on the contrary laid particular stress on recent developments in the science, and have discussed matters that are under investigation and about which much difference of opinion now exists. In some cases the desire to give the latest information has perhaps led to a neglect of fundamentals which are of greater importance. In the main, however, the book presents an excellent idea of recent development.

The book is well illustrated, and is replete with tables and diagrams of value. Some of the data and tables would be useful to only a limited extent, as they are based on methods that would not be of general application. The book includes descriptions of special apparatus and appurtenances, with the names of some of the makers.

The book is written for those who are thoroughly familiar with the fundamentals of waterworks construction and who have a working knowledge of the mathematics, hydraulics and other natural sciences involved in waterworks problems. To these it will prove of the greatest value in the design, construction and operation of these works. The volume will also be of use to those whose connection with waterworks is less close, as it contains much general information.

The portion of the book relating to materials, to hydraulics, to dams and many other matters will prove of value to others than those interested in waterworks, as the information is equally useful for other works.

Location of Road Material Bases Help Contractors Bid

Successful Bidders Furnished Map of Bridges and Culverts, Size and Quantity of Material and Other Necessary Data

CONTRACTORS bidding on the recent road contracts in Vermilion County, Illinois, were furnished with complete detailed plans and in addition a map showing the location of approved material bases in the adjoining State of Indiana, whence most of the aggregate for the concrete will probably come. This map showed all the railroads and connections to points in Vermilion County.

Since the award of contracts the successful bidders have been furnished with all necessary and convenient data in blueprint form cut to the size of pocket notebook sheets. All bridges and culverts, together with the size and quantity of materials required, are noted.

P. C. McArdle is the superintending engineer in charge of this $1,500,000 bond-issue road construction. It will provide a complete system of 166.2 miles of hard roads which it is estimated will carry 80 per cent of the country road traffic.

Total of 1,175,000 Acres of Land Segregated to Wyoming Under Carey Act

Upon the recommendation of the Secretary of the Interior, President Wilson has approved a contract between the United States and the State of Wyoming, providing for the reclamation by the state under the Carey Act of 1680 acres of arid land. This act provides for the segregation of public lands therein to a state for a period of years, provided the state presents a feasible plan for their reclamation through irrigation. With the addition of this new allotment there are now approximately 1,175,000 acres of land segregated to Wyoming, of which more than 150,000 acres have been reclaimed.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

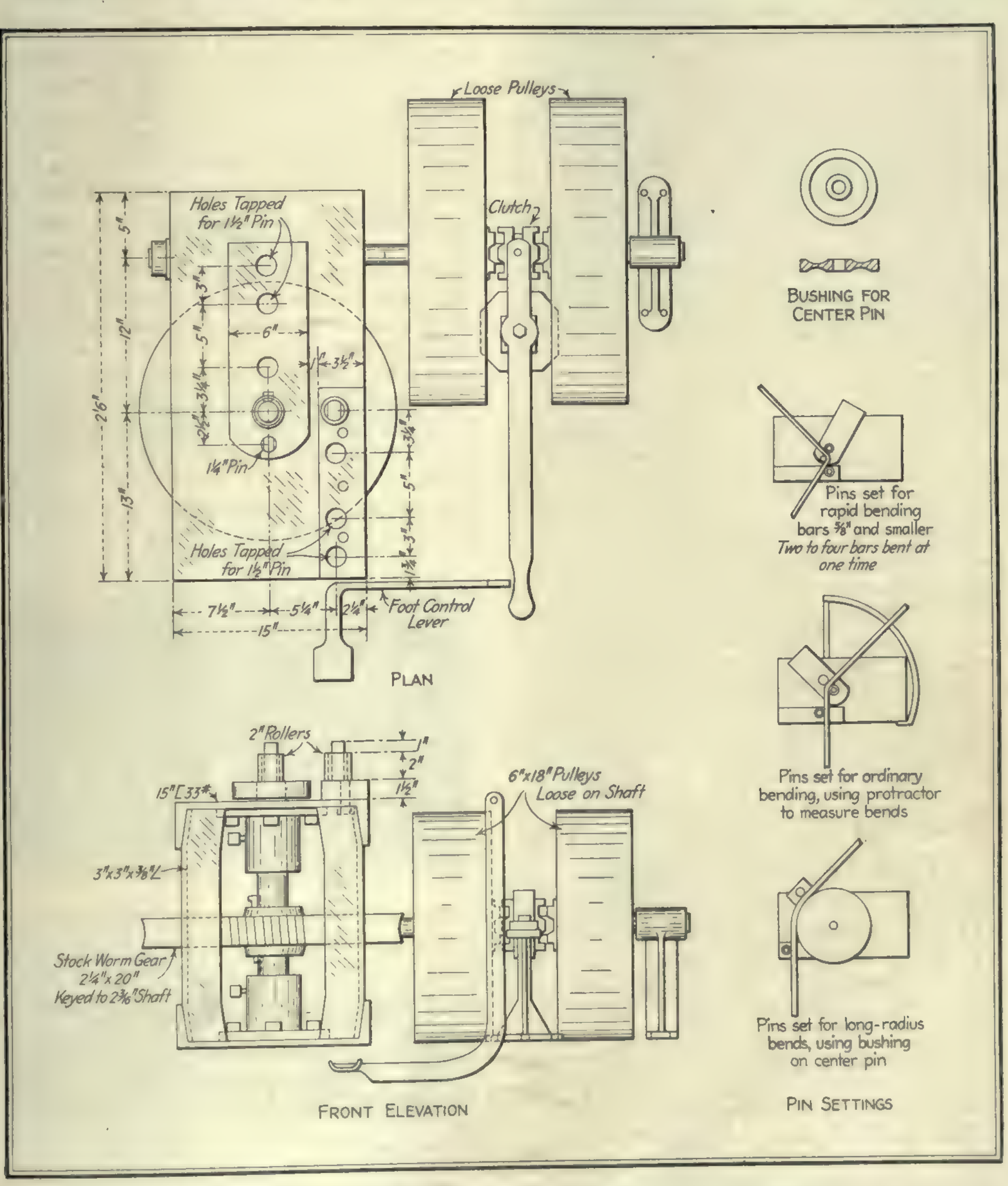
Power Machine Made on Job Bends Reinforcing Bars Around Disk

By HAROLD E. KETCHUM

Superintendent Hunkin-Conkey Construction Company, Cleveland, Ohio

A STEEL-BENDING MACHINE built on the work which is controlled by foot lever, leaving the hands free to handle the bars, is shown in the photograph and drawing. The machine is being used by the Hunkin-Conkey Construction Company on the Detroit-Superior bridge in Cleveland. It makes short bends, for which the end of the bar is caught by a projection on a revolving arm and bent around the spindle, and also long-radius bends for which a cast-iron disk, around which the bars are bent, is placed over the spindle. The machine is operated by a 3-hp. alternating-current motor, driving by belt in opposite directions two pulleys mounted loose on a shaft on each side of a clutch. The worm on the shaft drives the reversible head. The machine can make bends in 1½-in. square stock. Two ¾-in. or four ⅝-in. bars may be bent at the same time.

HANDLING FOUR FIVE-EIGHTHS INCH BARS AT ONCE—INSERT SHOWS OPERATING DEVICE BY WHICH HEAD IS STARTED OR REVERSED WITH FOOT, LEAVING HANDS FREE FOR BARS



MACHINE THAT BENDS ALL THE REINFORCING FOR THE DETROIT-SUPERIOR VIADUCT

Three men can handle the steel and make four bends per piece in 110 floor-slab bars ¾ in. by 17 ft. 6 in. in one hour. On this basis the cost of this class of bending amounts to about 50 cents per ton. The control is arranged so that when the operator steps on the foot treadle the horizontal clutch lever shown in the drawing and the insert photograph is pushed to the right, engaging the clutch with the left pulley and revolving the reversing head clockwise. To reverse, the hinged wooden dog, which would otherwise hold the clutch in neutral position when the operator takes his foot off the treadle, is lifted by the string shown. This allows the horizontal spring to pull the clutch lever to the left, engaging the right pulley and reversing the head. To stop the machine and take the bars out, the operator steps on the treadle, depressing it till the dog falls in place, and then releases it, which leaves the clutch locked free of both pulleys. The machine was built of standard channels, angles and gears at a cost of $200.

How Sheet Pile Structures Can Be Made Tight

SIR: Answering the questions in order as found on page 242 of Engineering Record for Aug. 19 last from the standpoint of experience with Lackawanna steel sheet piling:

1. Is there any difference between the watertightness of new and reused sheeting?

There is no appreciable difference where the re-used piling is in good condition, and

even where slightly bent trouble is seldom experienced from water leaking through. In general, if Lackawanna piling is usable at all it is sufficiently watertight for most purposes.

2. Should the sheeting be stretched tight from the inside of the cylinders by wedging against the bracing, or should they be tightened from the outside by putting a cable with a turnbuckle around them at the top, and by the outside water pressure when the cylinders have been pumped out?

It does no harm to stretch the piling tight, but it is seldom necessary. The pressure of the water against the piling automatically tends to seal the joints, and if the piling is driven in mud or sand the tortuous path through the joint and the three lines of contact soon seal the joint effectively.

3. Is it necessary to calk the joints? If so, is there any better method than the use of sand or sand and flour?

Almost everything has been used successfully for this purpose—rope, cinders, manure, coal dust, wood pulp, etc. Where the piling is to remain in place permanently, cement grout is generally used.

4. What is the best way to make a long straight line of sheeting watertight?

Drive to bed rock or to stiff soil and then take care of the leaks, if there are any. The methods have already been stated.

5. What type of pump has proved best for unwatering such cylinders?

On some jobs pulsometer type pumps are used for keeping the water level down during working periods. If the coffer fills overnight due to leaks under the piling, as is often the case, a centrifugal pump is used in the morning for emptying quickly.

N. G. NEAR.

New York City.

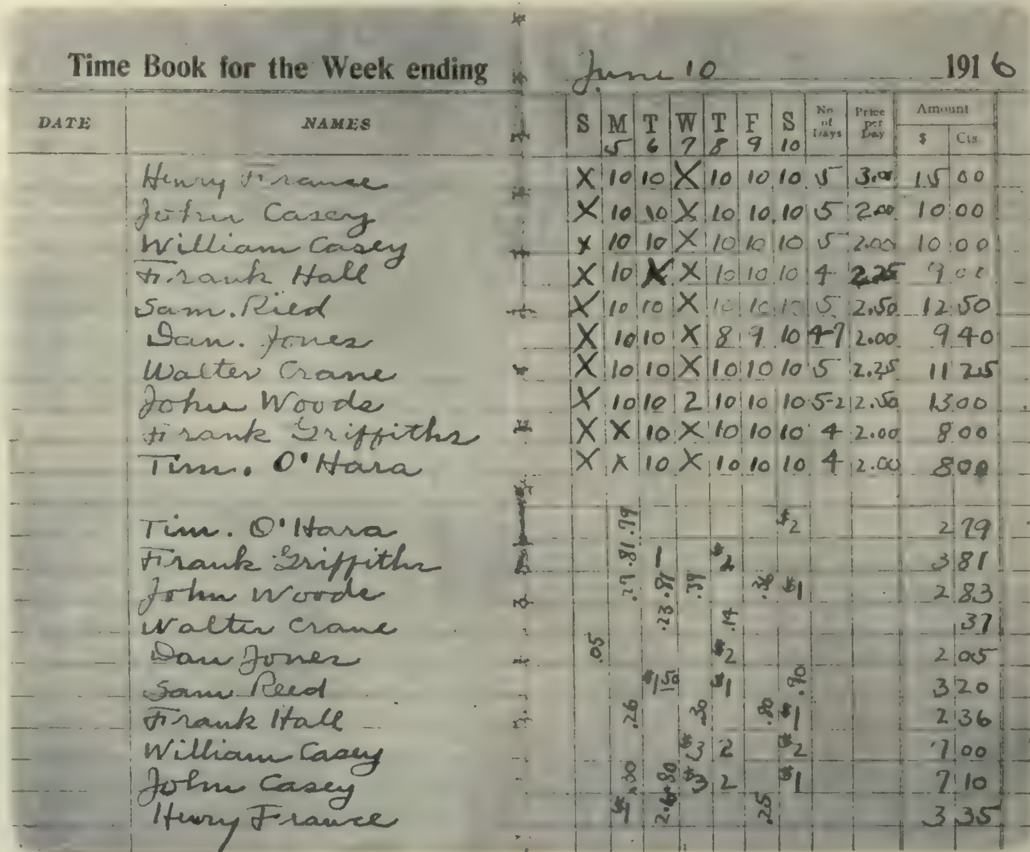
Foremen Keep Time and Deductions on Small Scattered Jobs

By F. D. BUFFUM
Pittsburgh, Pa.

IN THE writer's line of work in this section contractors advance their men money and commissary credit daily to the full extent of the man's earnings, and requests for advances come at all hours of the day. Many men draw their pay as fast as it is made.

The system shown by the accompanying pages taken from an ordinary time book was devised to make it possible to tell at a glance how much of an advance any man is entitled to receive. The time book is always handy in the foreman's pocket, and no office records have to be consulted before making or refusing an advance. But for this method, the practice referred to would make it necessary to have a bookkeeper on every small job. The system has been used for two years on jobs employing up to 40 men and might be made to answer on larger work.

When a man is given an advance, the amount is written under the date opposite the second entry of his name. If written right side up with a dollar sign, it means that he has been given cash. If written without the dollar sign, the entry represents coupon books or scrip. The figures lying on their sides show charges made for any other reason. At the same time, the foreman or timekeeper writes the man's name, the amount, purpose and form in which advanced, with the date, on a small


Time Book for the Week ending June 10 1916

DATE	NAMES	S	M 5	T 6	W 7	T 8	F 9	S 10	No. of Days	Price per Day	Amount $	Cts
	Henry France	X	10	10	X	10	10	10	5	3.00	15	00
	John Casey	X	10	10	X	10	10	10	5	2.00	10	00
	William Casey	X	10	10	X	10	10	10	5	2.00	10	00
	Frank Hall	X	10	X	X	10	10	10	4	2.25	9	00
	Sam. Ried	X	10	10	X	10	10	10	5	2.50	12	50
	Dan. Jones	X	10	10	X	8	9	10	4-7	2.00	9	40
	Walter Crane	X	10	10	X	10	10	10	5	2.25	11	25
	John Woods	X	10	10	2	10	10	10	5-2	2.50	13	00
	Frank Griffiths	X	X	10	X	10	10	10	4	2.00	8	00
	Tim. O'Hara	X	X	10	X	10	10	10	4	2.00	8	00
	Tim. O'Hara		.79					$2			2	79
	Frank Griffiths		.81	1		$2					3	81
	John Woods			.97	.39		.47	$1			2	83
	Walter Crane			.23		.14						37
	Dan Jones	.05				$2					2	05
	Sam Reed			$1.50		$1		.70			3	20
	Frank Hall		.26		.30		.80	$1			2	36
	William Casey				$3	2		$2			7	00
	John Casey		.30	.80	$3	2		$1			7	10
	Henry France		$[illegible]	2.60			.25				3	35

FIGURES WITH DOLLAR SIGN REPRESENT CASH THOSE WITHOUT THE DOLLAR SIGN COUPON BOOKS, THOSE ON THEIR SIDES OTHER FORMS OF CREDIT

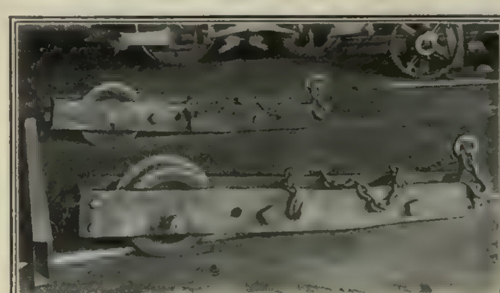
slip of paper torn from a pad which is carried with the time book. After being checked with the entry in the time book, this slip is hung on a spike file at the job for reference in case of dispute. Of course the memorandum slips may be itemized further, and some forms of coupon books have blank receipts to be signed and torn out which may be used instead of the slips. Many of the men who turn in time and deductions with this system could not be depended upon to keep accounts in the ordinary sense. Also, being able to tell a man at once the state of his credit produces a good effect.

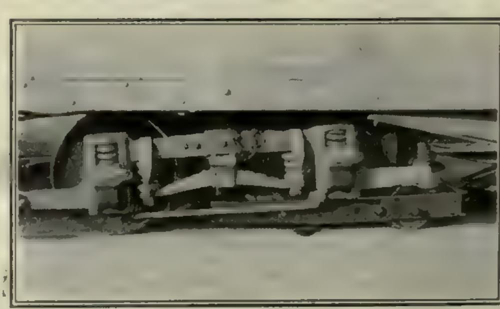
Writing some of the time figures on their sides has also made it easy for these men to separate time worked below the surface from time put in above ground. Private insurance companies on this class of work charged 5 per cent for underground workers and 2 per cent for those who worked above ground. The large difference in these rates made it profitable to keep the two classes of work accurately separated on the time books turned in to the office. Not only were the books kept this way, but the payrolls as well were made out in the same manner, making it unnecessary to have one payroll for surface and a second for underground workers in order to compute the insurance rates accurately.

When the Axle Breaks and You Have to Move the Car

MORE than one construction job has been held up by blocked tracks resulting from a broken axle or wheel on a dump car or crane. While the occurrence is so rare on some classes of work that provision against it would not be justified, on many railroad jobs, or even in some contractors' equipment yards, a device like that illustrated herewith would earn its salt.

This pull-in truck, described in a recent issue of the *Electric Railway Journal*, was made by E. Wright, master mechanic of the Fort Smith (Ark.) Light & Traction Company for bringing disabled trolley cars back to the barn. The emergency truck is made in three pieces, having a pair of bars with a small wheel to run on each rail and a channel to connect them. The disabled car truck is jacked up until the small wheels can be put under it, the rear ends of the bars of the emergency truck are chained up to the frame of the big truck so that they will not drag when the weight comes on them, and the jacks are released, allowing the car wheels to come down on the two pair of bolts, shown in one illustration to the right of the small wheels. In using the device with cars equipped with outside brake beams, it may be necessary to take these off to prevent the brakeshoes from interfering with the small wheels. The wheels on the truck shown have bronze bushings and compression cups for lubrication. When knocked down, the truck occupies but little room, and might be stowed away on a derrick car or a large crane.





THIS DEVICE, WHEN NEEDED, IS NEEDED BADLY

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Must Remove Dam in Colorado River by November 1

Irrigation District Given Permission to Build Temporary Structure — Salt Deposits Reason for No Permanent Dams

The Yuma (Ariz.) Water Users' Association has consented to the construction by the Imperial Valley Irrigation District of a temporary dam in the Colorado River at Hanlon's Heading to furnish water for about 400,000 acres of land. The dam has been built and the controversy that has been going on is temporarily ended. The courts ruled that the structure, which had been partly built, must be removed by Nov. 1 and the work of removal must commence not later than Oct. 1. A $100,000 bond was given by the Imperial Valley district to be forfeited if the terms of the agreement are not complied with. The question of building a permanent structure will probably be settled before next spring.

The reasons advanced by the Yuma Water Users' Association against the building of the dam are that "all of the lands are underlaid by a water table which is highly impregnated with deleterious soluble salts, which said water is dependent for its elevation on the relative height of the waters in the Colorado River; the said water table rising in elevation with the rise of the Colorado River and falling with the fall; that if the said water table should be raised in elevation beyond a certain limit of safety, all or practically all of said lands would become entirely uncultivable and valueless, because of an excess of deleterious soluble salts, to the great and irreparable damage of the plaintiffs and all the persons for whom they sue."

Another problem confronting the Imperial Valley Irrigation District is that of disposing of silt deposits which have been accumulating in large quantities. Dredging operations are said to have become more difficult and expensive and the beds of the canal and laterals have risen to an extent to reduce largely their water-carrying capacity.

Bridge Construction Abandoned Due to High Cost of Steel

The freight cutoff bridge to be built over the Delaware River near Trenton, N. J., by the Pennsylvania Railroad has been indefinitely abandoned. The reason for the action is given as the high cost of structural steel. The bridge was one of the Pennsylvania improvements planned for 1914. Work was started on the stone piers, but has not progressed further than that stage. With structural-steel prices so high there is said to be little chance for the structure's completion until conditions are again normal.

Postpone Hearing on Alleghany Bridges

The hearing on the question of raising bridges over the Alleghany River has been postponed from Aug. 31 to Nov. 15. The change was requested by officials of Pittsburgh and Alleghany County.

Irrigation Congress Will Meet When Elephant Butte Dam Is Dedicated

The twenty-third International Irrigation Congress will convene at El Paso, Tex., Oct. 14 and remain in session until Oct. 18. The meeting will coincide with the celebrations attending the dedication of the Elephant Butte dam.

Work of Pennsylvania Water Commission Outlined

Annual Report Summarizes 1915 Activities and Recommends Conservation of Water-Power Resources

In the annual report of the Pennsylvania State Water Supply Commission made public this week recommendations are made for comprehensive policies in administering the control and use of Pennsylvania streams; for the employment of an adequate engineering staff properly to supervise the construction and maintenance of dams; and that "water, the one remaining great natural resource over which the state has control, be conserved and developed for and in the interest of all the people of the commonwealth." The report covers in detail the various phases of the commission's work. Nine applications for the incorporation of companies to supply water for domestic purposes and three applications for water-power companies were approved. The report states that the number of applications shows a marked decrease.

Summary of Dam Construction

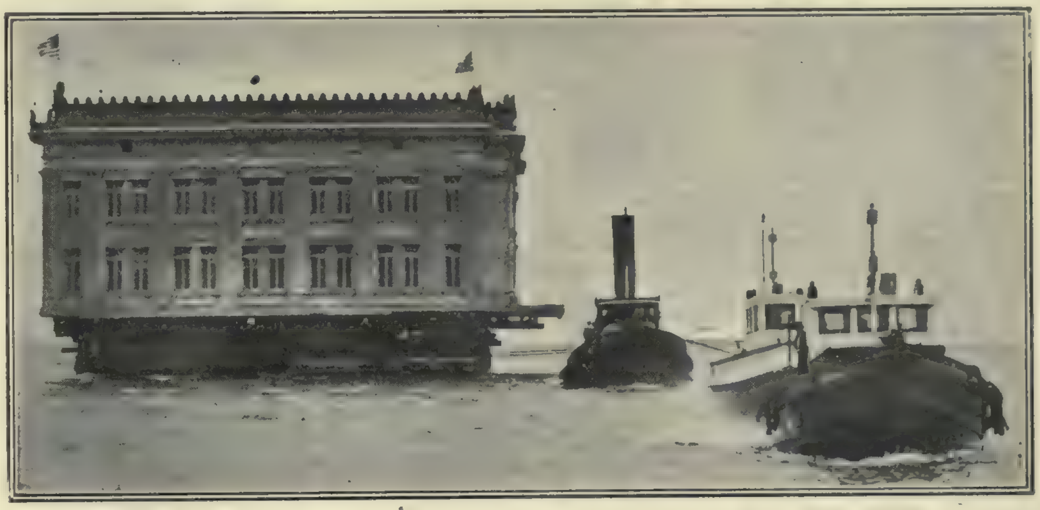
Fifty-one applications for the construction of new dams were considered and forty-three permits issued. Three of the proposed dams exceeded 40 ft. in height and the maximum was 68 ft. Twenty-nine applications to make changes or repairs to existing dams were received and twenty-three approved. The number of existing dams examined was 348, of which repairs and alterations were ordered on 121. The total number of field examinations of dams made was 626. The report, in discussing the dam supervision work, lays great stress on the need for an adequate staff to investigate and report on plans for new dams; to examine and report on all existing dams which by their failure may cause loss of life or property; to inspect dams in course of construction; and to examine from time to time such dams as require inspection to insure their being maintained in safe condition.

Stream encroachments, flood damage during 1915, stream gaging, flood warning, precipitation, inventory of water resources and the Pymatuning reservoir project in Crawford County are discussed in detail. The commission hopes that the general assembly at its next session will make liberal appropriations for hydraulic studies of all streams within the state to determine where stream encroachments are responsible for flood damage.

Move 1000-Ton Building Thirty-Two Miles

Ohio Building of Panama-Pacific Exposition Loaded on Barges and Taken to New Site at San Carlos, Cal.

Buildings have been moved from the Panama-Pacific exposition site to permanent locations in surrounding counties by loading them on barges. A white pine bungalow built by the Weed, Red River & McCloud Lumber Company at an approximate cost of $18,000 was one of the first to be moved in that way. It took a week to move the house from the south gardens of the exposition to the yacht harbor —a distance of less than 1 mile—for transfer to the barge. Loading on the barge was difficult owing to the rise and fall of the tide, which is about 9 ft. at that point, and necessitated quick work on the part of the movers to prevent damage to the 160-ton structure as it left the shore. After it was loaded the 15-mile journey across the bay to Santa Venetia, a suburb of San Rafael, was made in about six hours.



THE 1000-TON OHIO BUILDING WAS CARRIED THIRTY-TWO MILES ON BARGES

The largest and heaviest structure moved was the Ohio Building, which is 132.5 ft. long, 80 ft. wide and 43 ft. high. Its estimated weight is approximately 1000 tons. Two 600-ton barges were placed on ways so that they were entirely out of water at low tide and the building was moved onto them. They floated off at high tide. Owing to the choppy sea beyond the Marina, the barges were moored to the transport dock near by until the following morning and then towed about thirty-two miles down the bay to San Carlos. The building will be used as a home for the Peninsula Country Club. The George Washington home and the Wisconsin Building are to be moved in the same manner.

Herbert L. Hatch has the contract for moving the structures, which is done under the direct supervision of his foreman, A. W. Davis.

Municipal Men Can Attend Two Conventions in One Week

The annual convention of the Society for Street Cleaning and Refuse Disposal will be held Oct. 13 and 14 in the offices of the Department of Street Cleaning, New York City. The American Society of Municipal Improvements will convene Oct. 9-13 in Newark, N. J. The dates and places for the two meetings have been so selected that members of both societies can attend the conventions.

Prizes Offered for Best Papers on Plumbing Practice

Prizes amounting to $200 have been offered by the Cast-Iron Soil Pipe Makers' Advertising Association for papers on the practice or theory of plumbing. They are to be known as the Nelson prizes, in honor of N. O. Nelson, a manufacturer of plumbing supplies, and may be competed for by students or instructors in Harvard University, the Massachusetts Institute of Technology or by any one else who has had training or practical experience in house drainage. Each contestant should send his name, qualifications and the subject of his proposed paper to the committee in charge by Nov. 1, 1916. The chairman of the committee is George C. Whipple, professor of sanitary engineering, Harvard University, Cambridge, Mass. Notice of the approval of the qualifications and subject selected will be promptly returned by the committee. The completed papers must be in the hands of the committee by April 1, 1917. Papers submitted shall contain not more than 5000 words unless special written permission to submit a longer paper has been received from the committee.

The papers submitted may deal with the general arrangement or with selected details of waste, soil, drain, vent-pipe or rain-water conductor systems of buildings as installed under public regulations, or with fixture connections to the pipe system, or with materials used in any of the above-mentioned work either in common practice or to meet unusual conditions. The desire is especially to bring out defects of existing practice and feasible improvements therein. Special weight will be given to papers presenting original observations or experimental studies by the author or accompanied by figures or diagrams prepared by the author. All illustrations shall be bound with the paper that is submitted. Prizes will be awarded as soon as possible after April 1, 1917.

In addition to Professor Whipple, the committee in charge consists of Gifford Le Clear, of Densmore & Le Clear, engineers and architects, Boston, Mass.; Dwight Porter, professor of hydraulic and sanitary engineering, Massachusetts Institute of Technology, Cambridge, Mass., and Harry Y. Carson, Central Foundry Company, New York City.

Brick-Pavement Conference at Paris, Illinois, October 6

The National Paving Brick Manufacturers' Association will conduct a study and conference in brick-pavement construction Oct. 6 at Paris, Ill. Headquarters will be maintained at the Deming Hotel, Terre Haute, Ind., from which place those participating will go via the Interurban Railway to Paris—an hour's ride —where the construction demonstration will take place. The demonstration will consist largely of steps showing the economy of construction details in building a brick pavement by laying the brick in green mortar. An effort will be made to show how such a pavement can be built with the least possible cost and yet maintain all the essentials of worth.

All persons connected in any way officially or those deeply interested in the roads of this country will be made welcome at this conference. The announcement states that the conference is undertaken no less in behalf of the brick industry than in the sincere belief that the country itself is bound to be benefited by such an opportunity. It is pointed out that the money expenditure for roads is so great that a deep interest as to their economic value is manifest everywhere by chambers of commerce and automobile clubs, and that this occasion will afford bodies of this character an opportunity to make a careful investigation and examination of the merits of this kind of road that cannot be gained in an ordinary inspection trip.

All expecting to attend are requested to notify the secretary of the association, Will P. Blair, Cleveland.

Alteration of Engineering Societies' Building Started

Work has been started on the alteration of the Engineering Societies' Building in order to provide room for the American Society of Civil Engineers. A two and a half story addition is to be made to the present structure. The existing framework was designed for only the present loads and it is necessary, therefore, to carry four new columns through the entire thirteen stories. The loads will be carried to these columns by an ingenious truss system, from which the new stories will be hung.

Santa Monica, Cal., to Buy Waterworks

The Santa Monica Water Company has filed with the California Railroad Commission an application for authority to sell its system to the city of Santa Monica, Cal. The price is quoted as $402,500, for which sum bonds have been voted.

May Build $1,000,000 Bridge at Buffalo

The U. S. House of Representatives Aug. 29 granted permission to a committee of nine citizens of Buffalo, N. Y., to construct a toll bridge across the Niagara River in or near that city. The proposed structure will cost about $1,000,000.

Waterways Association Meets at Philadelphia in September

The ninth annual convention of the Atlantic Deeper Waterways Association will be held Sept. 12-15 at Philadelphia. In addition to the regular business an inspection trip will be made to the riverfront and local industrial plants.

Issue Bulletin of Lake Survey

The United States lake survey office at Detroit has just published Supplement 4, containing corrections and additions to Bulletin 25, showing results of surveys of northern and northwestern lakes. The information supplements that given on charts of the Great Lakes.

County Superintendents to Meet

The meeting of the New York State Association of County Superintendents of Highways will be held Sept. 13 and 14 at Syracuse and not Sept. 14 and 15 as stated in last week's issue.

Adds Architectural Engineering Course

The University of Arizona has added a four-year course in architectural engineering to its curriculum, effective this year. L. A. Waterbury, professor of civil engineering, has also been given the title of professor of architectural engineering.

Defer Power Dam Bill

Conferees of the U. S. Senate and House of Representatives working to reconcile differences in the Shields bill to permit construction of power dams in navigable streams by private companies, last week gave up all hope of agreement at this session of Congress. The question will again come up for discussion late in November.

Collects Figures on State Highway Tax

Anticipating the defeat of the Egan road bill in the referendum vote at the November election, the New Jersey commissioner of roads has begun collecting figures on a possible state tax for highways. The Egan bill provides for a $7,000,000 bond issue, but the state department's investigation showed that an outlay of more than $15,000,000 would be required to carry out the program it involves.

Decide Employing Road Engineer Is Economical Investment

The good-roads committee of the Chamber of Commerce of Oklahoma City, Okla., recently decided to employ an expert highway engineer to direct road construction in that vicinity. Parts of an editorial on the action in the *Daily Oklahoman* read as follows:

"It is recognized that building good roads is a matter of engineering and that different localities require different planning and constructing. A great deal of money has been lost in road-building simply because the work was not under trained direction.

"One of the simplest things in a good-roads movement anywhere is getting the money. Getting the best results for the money is quite another thing. A county over in Texas some two or three years ago happily hit upon that fact. It voted a tremendous good-roads bond issue, somewhere up among the millions. Profiting from the sad experiences of other enthusiastic communities it engaged a man who had made a distinguished record as a city street builder. It paid him a big salary, as of course it had to do, but that proved a wise investment. It got the results.

"The judgment of the Chamber of Commerce in getting a capable, experienced man for such a big job is sound. It is on the right road for good roads."

Engineering Society Activities

The San Francisco Association of Members of the American Society of Civil Engineers held its regular bimonthly meeting at the Palace Hotel, Aug. 15. George Lincoln Dillman briefly discussed the chief cause of trouble and the basic reason for human progress.

The Detroit Engineering Society conducted an inspection trip Aug. 16 to the plants of the Detroit Steel Products Company, the Michigan Smelting & Refining Company and the Aluminum Castings Company. The first fall meeting will be held Sept. 15.

The Connecticut Society of Civil Engineers gathered in New London Aug. 8 for the midsummer outing. More than 125 persons visited the new state pier, the submarine base and the work being done on the new Thames River bridge.

The Providence Engineering Society will occupy its new rooms at 29 Waterman Street, Providence, R. I., next September. The entire second floor of the building has been remodeled.

The Chicago Engineers' Club held a dinner Aug. 25 in honor of G. A. M. Liljencrantz, who is retiring from the engineering department of the U. S. War Department after forty-five years of service. Mr. Liljencrantz, as the club's invitation to the dinner read, will "return to his native Sweden to enjoy the evening of his days with his own people. We wish to show our appreciation of the man and to speed him on his way."

The Engineers' Club of Seattle recently entertained as its guest L. M. Grant, chief engineer of the Pacific Coast Pipe Company, who addressed the meeting on the uses of wood-stave pipe and its limitations.

The Engineers' Club of Seattle on Aug. 14 entertained at a luncheon at the Hotel Butler Director Manning, U. S. Bureau of Mines, who came to Seattle to consider the application of the University of Washington for the establishment of one of the ten mining stations of the bureau. Dr. Henry Suzzallo, president of the university, also addressed the meeting, which was presided over by Judge Thomas A. Burke of Seattle.

The Northwestern Branch of the American Society of Civil Engineers will meet Aug. 26 at Duluth. Inspection trips will be made to local points of engineering interest.

What Engineers and Contractors Are Doing

DR. WILLIAM MCCLELLAN, consulting engineer, of New York City, and former chief engineer for the New York Public Service Commission for the Second District, has been appointed dean of the Wharton School of Finance and Commerce of the University of Pennsylvania. Dr. McClellan was graduated from the arts department of Pennsylvania University in 1900. During his college course he received the Quaternions Prize, was elected a member of both Phi Beta Kappa and Sigma Xi honorary fraternities and received special honors in mathematics. Later he obtained the degree of doctor of philosophy in physics, mathematics and philosophy. For a time Dr. McClellan was engineer in charge of construction for the Philadelphia Rapid Transit Company. In 1905 he was appointed supervising engineer for Westinghouse Church Kerr & Company, and in 1907 became associated with H. T. Campion, consulting engineer, of Philadelphia. In 1911 he was appointed electrical engineer and chief of the division of light, heat and power of the Public Service Commission of the Second District of New York State. Dr. McClellan is a fellow and vice-president of the American Institute of Electrical engineers, a member of its executive committee and vice-chairman of its public-policy committee. He is one of the two representatives of the institute on the joint conference committee of engineering societies and is also president of the joint Pan-American engineering committee. He has always been interested in steam-railroad electrification and was for a number of years chairman of the electrification committee of the New York Railroad Club. As a member of the New York board of directors of the Naval Consulting Board he is also actively engaged in the work of national preparedness.

PIERCE J. LANDERS, who was recently made superintendent of the Indianapolis Union Railway, has been with that road since 1902. He entered railway service in 1888 as rodman for the Pennsylvania Railroad and was later promoted to superintendent's clerk, draftsman and assistant engineer. After ten years' service with the Pennsylvania Mr. Landers resigned to take a position as roadmaster of the Wisconsin Central Railway, from which position he was promoted in 1900 to become division engineer. His service with the Indianapolis Union Railway started in 1902, when he was appointed assistant engineer. He was promoted to engineer maintenance of way five years later, retaining the position until his recent appointment.

T. R. RATLIFF has been appointed engineer maintenance of way of the Indianapolis Union Railway, succeeding P. J. Landers, whose promotion is noted elsewhere in this issue.

C. E. GRUNSKY, of San Francisco, and GEORGE G. ANDERSON, of Los Angeles, have been chosen by the directors of the Imperial Valley Irrigation District to act with W. F. McClure, state engineer of California, as an advisory board to consider the various engineering problems of the district. Mr. Anderson has removed his office to the Consolidated Realty Building.

OLIVER F. STARR has resigned as president of the Green-Starr Engineering Company to open consulting offices at 1530 Chestnut Street, Philadelphia. He will specialize on sewerage and sewage-disposal problems.

BLUM, WELDIN & COMPANY, engineers, of Pittsburgh, have acquired all of the plans, notes and records belonging to Hudson F. Layton, civil engineer, of that city, who is retiring from practice. The addition of the data covering the practice of Mr. Layton and of the firm of Browne & Layton will greatly increase the facilities for service of Blum, Weldin & Company.

COL. S. W. ROESSLER, Corps of Engineers, U. S. A., who was placed on the retired list last year, has withdrawn from active engineering work. He is now at Bridgeport, Conn. Colonel Roessler was graduated from West Point in 1881 and was made colonel in 1909.

JOHN F. VAUGHAN has opened an office at 185 Devonshire Street, Boston, Mass., for the practice of consulting engineering. He has been retained by the Boston banking house of Estabrook & Company in connection with the re-development of a 20,000-kw. hydroelectric plant at the Sault Ste. Marie, Ont. Mr. Vaughan has been associated with the Stone & Webster Engineering Corporation of Boston for about fifteen years, prior to which he was engaged in pioneer electrification work on the New York, New Haven & Hartford Railroad under the late Col. N. H. Heft. He has been active in transmission and hydraulic work and has served as chairman of the hydraulic branch of the N. E. L. A. committee on prime movers. He is the inventor of the Vaughan hydraulic flow meter.

P. J. FREEMAN has resigned as assistant professor of applied mechanics in the Kansas State College to become associated with the Pittsburgh Testing Laboratories as engineer of tests.

F. N. GRAHAM, formerly assistant engineer for the Chicago & North Western Railway, has been appointed assistant engineer of construction on the new ore dock 6 at Duluth Minn., for the Duluth, Missabe & Northern Railway. Mr. Graham is a graduate of Rensselaer Polytechnic Institute, class of 1898, and was assistant engineer on the Chicago and North Western terminal in Chicago.

L. A. GRANGER resigned Sept. 1 as assistant city engineer of Fresno, Cal., to engage in private practice in that city. Prior to May, 1915, when he became assistant city engineer, Mr. Granger had served as a locating engineer in South America for an American mining syndicate. He has also been connected with a number of Eastern railroads as consulting engineer.

J. K. MCGRATH, formerly assistant engineer in charge of paving work in Baltimore, Md., has resigned from the city employ to become engineer in charge of new road work in Fayette County, West Virginia.

GEORGE F. WIEGHARDT, of the Pennsylvania Water Supply Commission, was appointed principal assistant engineer of the water department of Baltimore, Md., Sept. 1. He will have charge of the maintenance and construction division.

WILLIAM H. BOARDMAN, engineer for the New Jersey Water Supply Commission, has been appointed resident engineer on the survey for the proposed water supply from the Wanaque River watershed. The field party is now making a survey of the proposed site, with headquarters at Midvale. Mr. Boardman has been actively engaged in water-supply engineering in New Jersey since 1911, spending a year with Morris R. Sherrerd on reservoir work. He was graduated from the University of Maine in 1901 and from then until 1911 was employed on concrete dam and building construction.

FREDERICK HOLBROOK, president of the Holbrook, Cabot & Rollins Corporation, has been elected a vice-president of the American International Corporation and will, in a few days, make a tour of Russia as the representative of the latter firm. Hr. Holbrook will make a thorough investigation of a number of possibilities in Russia, including the financing and construction of new railroads, mines, power installations and other industrial projects.

Obituary Notes

THOMAS H. STRYKER, a retired civil engineer and business man, of Rome, N. Y., died last week in that city at the age of 69. Although he had not taken an active part in business since 1900, Mr. Stryker was interested in many of Rome's large industries, including the Rome Iron Works, the Rome Brass & Copper Company and the Rome Gas, Electric Light & Power Company. He was born in Rome in 1847 and was graduated from Hobart College in 1868. Immediately thereafter he studied abroad, returning to manage the affairs of his father, John Stryker, who was interested in the organization of several railroads, including the Lake Shore & Michigan Southern. Mr. Stryker was appointed city engineer of Rome in 1876 and was later active in the building of the Rome & Clinton Railroad. He was also chief engineer on the survey for the Boston, Rome & Oswego Railroad, assistant engineer on the Champlain canal and engineer under the state engineer in charge of improvement of the Hudson River. In 1881 he was made secretary and treasurer of the New York Locomotive Company and later elected to its presidency, in which office he continued until the firm passed out of existence. He retired from active business life in 1900.

ANTHONY WALSH, who was prominently identified with the construction of the Rock Island Southern Railway in Iowa, died Aug. 28 in San Francisco in his eighty-fourth year.

JOHN DEAN, a retired civil engineer and contractor, died Aug. 17 at his home in Chicago. He received his engineering education at Owens College, Manchester, England. Coming to the United States in 1885, he engaged in engineering work successively with the Chicago, Rock Island & Pacific Railway, the Frisco Lines and the Wabash Railroad. He was also engineer of parks for the City of St. Louis, Mo. As a contractor he did extensive work in grading and concrete bridge construction, first in the South and later for the Grand Trunk Railroad and the cities of St. Louis, Mo.; Manistee, Mich., and Des Moines, Iowa. He was for many years a member of the Engineers' Club of St. Louis and of the American Railway Engineering Association.

Civil Service Examinations

Minnesota — Unassembled examinations will be held Sept. 18 for sidewalk engineer and Sept. 22 for engineering assistant. Salary for each position is $100 to $125 a month. Resident requirements waived. Further information may be obtained by writing the civil service bureau at St. Paul.

United States—Examination will be held Oct. 3 for senior highway bridge engineer, salary $2,400 to $3,300. Another for highway bridge engineer, salary $1,800 to $2,100, will be held Oct. 4. Form 1312 should be filled in by applicants for these positions. Examinations will be held Oct. 4 for junior civil engineer, grades 1 and 2 (salaries $1,200 to $1,680 and $720 to $1,080) and for junior structural engineer at salary of $720 to $1,680. Form 2039 should be filled in by applicants.

Examinations Previously Announced

Date		See Eng. Record
Sept. 5.	Subinspector U. S. radio towers	Aug. 19
Sept. 6 and 7.	U. S. structural-steel draftsman	Aug. 19
Sept. 13.	Aid in Coast and Geodetic Survey	Aug. 5
Sept. 13 and 15.	Assistant examiner, patent office	Aug. 26
Sept. 19.	U. S. Mechanical draftsman	Aug. 26
Oct. 11.	U. S. junior civil engineer	Aug. 19

Simplifies Engineering and Contracting Computations

The diversity of engineering and contracting calculations and the great amount of mental effort wasted in arriving at accurate solutions have created a strong demand among engineers and contractors for relief through mechanical means. The Monroe calculating machine, which was placed on the market about four years ago, seems particularly fitted for the solution of their problems.

The machine has a standard flexible adding-machine keyboard for setting up the numbers to be added, subtracted, multiplied or divided; a crank for performing the operations and a carriage holding the dials which show the results and the proof of the operations as they are performed.

The use of the machine requires no special training. Every operation carries a constantly

COMPUTING MACHINE USEFUL TO ENGINEERS

visible check on the accuracy of the work. An error can be immediately detected and corrected by either a forward or a reverse turn of the operating lever.

To illustrate the adaptability of the Monroe to engineering work, suppose the length of the hypotenuse of a right-angle triangle whose sides are 21 and 28 ft. long is to be found. This calculation is performed by setting up 21 on the keyboard, squaring, adding the square of 28 and extracting the square root of the total (1225). The whole operation only requires 8 sec. and no mental effort is involved.

The following concrete-girder computations can be done on the Monroe with a check as to accuracy in 40 to 50 sec., whereas to solve them with pencil and paper would require four or five times as long and then there would be no proof of accuracy:

$$K = \sqrt{(2 \times 0.00769 \times 15 + [0.00769 \times 15]^2)} - 0.00769 \times 15 = 0.379$$

The machine, of course, is equally adaptable to the simpler computations, such as the making out of payrolls, the figuring of percentages, the computation of costs, billing, etc.

Beside being used extensively by large industrial companies the following engineering firms, among others, have installed the machine: Henry L. Doherty & Company, Bing & Bing, W. J. Wilgus, Viele, Blackwell & Buck. Henry L. Doherty & Company state that the machine is especially useful in computations where unit figures are to be found. "For multiplying and dividing," they say, "we find it the best machine we have ever used."

The machine is manufactured by the Monroe Calculating Machine Company, with offices in the Woolworth Building, New York City.

Welding and Cutting Handbook

Lessons in use of equipment and operations necessary to oxyacetylene welding and cutting. Compiled by Imperial Brass Manufacturing Company, Chicago. Fifty-six pages; illustrated; paper binding. $1 net.

Preceding the detailed description of the proper use of oxyacetylene-welding tools are a few pages outlining the principles of welding and the care of equipment. The effects of expansion and contraction are discussed and the chemical action and mechanical effects of the flame explained. Pages 21 to 42 inclusive are devoted to details of welding operations and also contain lists of metals that cannot be welded.

Two pages suggest a cost-keeping method, following which the oxyacetylene-cutting process is described. The oxyhydrogen process is also mentioned. The equipment manufactured by the publishers is described and its operation explained.

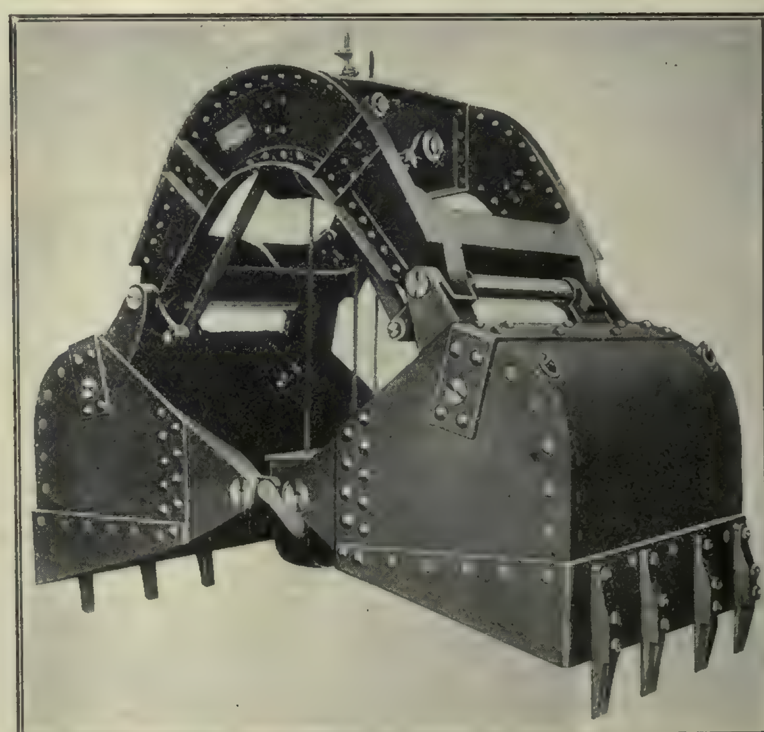
New Clamshell Bucket Has Steel Arch Yoke

A radical deviation from the usual design of clamshell buckets has been made by the Buffalo (N. Y.) Contractors' Plant Corporation. The design and construction of the Buffalo bucket, as the new device is called, embodies many new features, the most prominent of which is the steel arch yoke. The arch construction gives a maximum rigidity and compactness and a closing power that surprises even the manufacturers. When open the bucket forms a continuous arch of such strength that it may be dropped from great heights to gain entrance into hard material.

The height of the Buffalo bucket is about 20 per cent less than usual. The bowls are joined to central pivots and closing is effected by means of ropes and sheaves without drums or chains. The distance of the closing links from the central bowl pivot is enough, the manufacturers say, to make the closing power unusually great. The design also takes care of tension between the center bowl pivot and the link connection to the bowl (caused by closing) by placing the metal of the bowl directly in the line of that stress.

According to the manufacturers, the Buffalo bucket has given most satisfactory results when tested. They also say that the unusual strength of the device offers new opportunities for contractors in excavating when the ground is hard.

WHEN BUCKET IS OPEN IT FORMS A CONTINUOUS ARCH, AND WORKING PARTS ARE CLEAR OF THE MATERIAL TO BE DUG

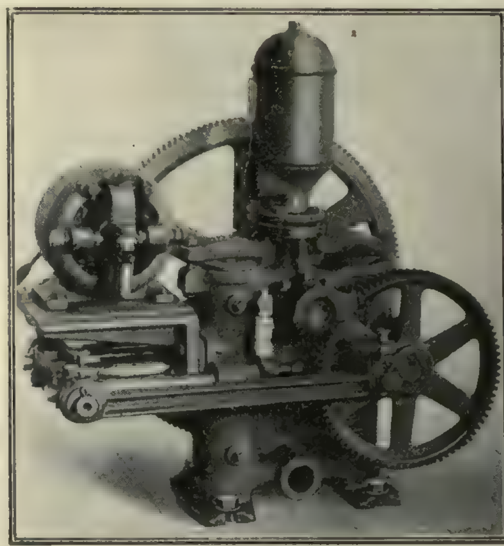


C. W. Nash Heads Motor Company

C. W. Nash, formerly president of the General Motors Company, is now at the head of the Thomas B. Jeffery Company, Kenosha, Wis. Mr. Nash announces plans for a big increase in the production of the company he now heads.

Double-Acting Piston Pump Used with Elevated Water Tank

The rapid extension of electric power circuits has made it possible and desirable to have power-pumping equipment for general water supply, fire protection and various other services. To meet such demands the Goulds Manufacturing Company of Seneca Falls, N. Y., has developed a line of single-cylinder double-acting piston pumps, of which the one illustrated is typical. The pump shown is the 2½ x 4 in. size, having a capacity of 6 gal. per minute against elevations up to 100 ft. It is operated by a ½-hp. Westinghouse motor mounted on a bracket attached to the pump to make a compact outfit.



DOUBLE-ACTING PISTON PUMP

The "Pyramid" pump has large and easy waterways and few parts. The base, cylinders, bearings and one cylinder head are cast in one, thus keeping the gearing in line and decreasing wear. The cylinder is lined with brass and provided with large suction valves which are easily accessible through two hand holes. The discharge valves are above the cylinder and reached through handholes at either side of the air chamber.

The outfit illustrated is especially adapted for elevated tank water-supply systems. It can be used for pneumatic tank water-supply systems by employing a separate air pump. Fitted with special valves and gaskets it can be used for pumping gasoline, for which service it has been approved by the National Board of Fire Underwriters.

Truck Company Increases Capitalization

The United States Motor Truck Company of Cincinnati, Ohio, recently increased its capital stock from $300,000 to $1,000,000. The firm was established seven years ago. When it was reorganized in 1914 R. C. Stewart was made president and the capital stock increased to $300,000.

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For the Waterworks Man

TO mark the meeting of the New England Waterworks Association in Portland next week this issue of the Engineering Record contains more than the usual number of waterworks articles. The aim has been to select subjects of general importance and applicability, rather than the spectacular works with which the average waterworks engineer and superintendent never has to deal. Meter testing, moss removal, new filtration-plant devices, department organization, a traveling laboratory are the subjects discussed. The articles contain many valuable suggestions for the improvement of the service which the waterworks men render the public.

Tribute to an Engineer

ONE cannot read without a thrill the letter from L. F. Heuperman on page 330 of this issue, telling about the recognition which was given C. R. Broughton, engineer for the Southern Pacific Company, on the completion of his work. The incident is most gratifying. Too often the engineer's position is radically reversed between the construction period and the dedicatory ceremony. While the dirt is flying and results are demanded, while difficulties are being met in "putting the work through," the engineer is a most important factor. To him come all hands when trouble is brewing. He must save the day if there are difficulties with labor or materials or if the elements threaten destruction. But when the work is completed he is too often relegated to the background. The financier, the public official, the prominent citizen bask in the limelight and pat each other's backs upon the successful issue of the work. Happily at North Bend such was not the case. First credit was given to the engineer, and those in attendance indicated by their thundering applause that the credit was deserved.

Reconstruction of Europe

IN THE LEADING ARTICLE in this issue W. S. Kies, vice-president of the National City Bank, New York City, and of the American International Corporation, expresses his views regarding American opportunity in the rehabilitation of Europe after the war. His words should be weighed carefully by engineers and contractors who have been considering Europe as a possible field for future activities.

Technical men in active practice are prone to regard such an immense task as the reconstruction in Europe will present as primarily an engineering problem, without giving due consideration to the question of finance. Mr. Kies' position in the banking world entitles his opinions on such subjects to the greatest respect. His viewpoint, of course, is different from that of the engineer. He sees the need for organization, and engineering and constructional skill, but his broad experience leads him further to the conclusion that financing is of first importance in the conduct of work under the conditions that will obtain in Europe. It remains for engineers, contractors and manufacturers of equipment to act upon Mr. Kies' suggestion for the establishment of an American engineering bureau abroad. Such an organization, he points out, would be the first logical step in the securing of foreign business. Certainly no large scale operations can be conducted without a painstaking survey of conditions and the co-operation of construction, manufacturing and financial interests. It may be possible for individual companies to secure small contracts of various sorts without special preparation. In doing so, however, the really big opportunity would be lost. Mr. Kies would plan a construction campaign involving not merely the rebuilding of one industry or one city, but hundreds of industries and hundreds of cities. News reports indicate that plans for such reconstruction work are already under consideration in France. It is imperative, therefore, if the United States is to share in this reconstruction, that steps be taken immediately toward formulating a broad plan.

Exchange of Information

AN exchange of information among engineers engaged in the same field of work is always decidedly helpful in promoting knowledge. Certain kinds of committee work, for example, depend to a large extent upon the co-operation of members of the profession in replying to lists of specific questions sent out in large numbers. Individual engineers, too, frequently give one another the benefit of their experiences through the medium of correspondence. Within certain limits these forms of exchanging information are highly beneficial to all concerned, but the seeker after information may develop into a public nuisance unless he is possessed of a certain consideration for the other fellow. An engineer in a city which has recently completed large-scale investigations of sewerage and sewage treatment informed one of the editors of this journal recently that if he attempted to answer all of the inquiries he received regarding his work he would have practically no time left for anything else. This engineer was recently appointed chairman of a committee of an engineering society which was instructed to collect information by means of a questionnaire. He decided to make his inquiries a model of their kind, framing them so as to call for a minimum of time required for replies. They were printed and space was left on the sheet for the answers. Each question was definite and could be answered merely by a yes or no, by giving a dimension, or by a single brief descriptive sentence. Every time-saving device he could think of was employed. He wrote on each list of questions the name of the engineer to whom it was sent so as to save the latter the trouble of signing his own name. He forwarded with each list a stamped and self-addressed envelope. These are only a few of the time-saving kinks he resorted to. By his foresight in preparing the questionnaire the work of sending in a reply to his queries had been made almost automatic. His efforts were rewarded. A remarkably high percentage of returns were received only a few days after the questions had been mailed, and the information contained in the answers was in a form which could be readily assembled and interpreted. When engineers are seeking information gratis they should keep constantly in mind that their informant should be called upon for the minimum effort in making a reply.

Replies from Engineers

APROPOS of the preceding note the experience of the New York State Bureau of Municipal Information, which collects and disseminates data for city officials, is of interest. This organization reports that it has found that the records of city engineers are more complete and easily obtainable than are those of most other city departments. The bureau recently issued a questionnaire concerning the method of assessing the cost of sidewalks and curbing to all New York State city engineers. In the return mail were received twenty-one replies and within a week all except three in the state had answered. The experience of the bureau in sending a questionnaire to city officials in general leads to the conclusion that replies may be expected from two-thirds within a period of from one to three weeks, depending upon the length of the list of questions. A second request, it is said, elicits replies from about one-third of the remainder. One of the greatest difficulties which the bureau reports in connection with engineering records is that a lack of standard units makes an accurate and intelligent comparison of data well-nigh impossible. This condition has long been realized, but it cannot be emphasized too often. At the present time, however, the American Society of Municipal Improvements has a committee at work in an effort to standardize units of reporting municipal work. This movement deserves the hearty support of engineers throughout the country.

Pure Water and Water Rates

IT is a sound principle in waterworks finance that in order to prevent complaints as to the cost of water it is necessary to furnish water of good quality and maintain a satisfactory service. When the water supply is muddy or colored or has a bad smell, or when the pressure fails, or when something or other goes wrong, the consumers ask the question, "Why are we paying so much for water?" It is the consumers' way of expressing dissatisfaction.

The reason for this is that the cost of a public water supply to the ordinary householder is low when compared with what he pays for other services—light, heat, ice, or telephone—and as long as the water supply is satisfactory he finds no fault with the bill. Indeed, he does not object to an increase in his bill if he believes that additional expense is necessary to improve the service or to filter the water. Nine times out of ten when the consumers of a city object to the cost of water, it is not the cost, but the service, which displeases them.

Not long ago there was hostility between the consumers in a Connecticut town and the private company which supplied the water. It was claimed that the rates were too high and the quality of the water too low. The case was taken to the Public Service Commission, which wisely ordered the company to filter the water and to raise, not lower, the rates. This was done, to the satisfaction of both sides. The people got what they really wanted, good water, and the company got what it wanted, adequate receipts.

Several things follow from the adoption of this principle. The first is that no city should refuse to install a needed filtration plant because of the effect on the water rates. Such refusal is sometimes made by city governments for fear that the increase in rates will injure the standing of the political party in power by adding to the financial burden of the rate payer. In this the politicians are wrong. They do not appreciate that people value pure water above all money considerations, and they do not appreciate that adequate filtration of water seldom adds more than 10 per cent to the cost of the water.

Another corollary to the principle is that water rates should not be determined until the cost of good service is known. The city of Cambridge, Mass., has recently changed its rates for water sold by meter from a sliding scale, which varied from 15 cents per 100 cu. ft. for small quantities to 7½ cents for large quantities, to a flat rate of 10 cents per 100 cu. ft.

Some good reasons for this change were given. The bonds were maturing, interest charges decreasing, and a surplus accumulating. It was thought that the citizens should have the benefit of this condition, and it was known that the surplus was looked upon with covetous eyes by some who hoped to apply it to the general expenses of the city and thus relieve the already high tax rate. Another reason, and a valid one, was that it would encourage the use of meters by the small consumers and tend to reduce the water consumption.

On the other hand, the water supply needs filtration, the distribution reservoir needs to have its leakage stopped, and there are other projects which will soon have to be considered. The cost of these is not known with certainty, but the expense will be considerable. Cambridge is within the natural limits of the metropolitan water system, and it is manifest destiny that at some not distant day metropolitan water will be cheaper for Cambridge than its own supply. Yet in the face of these needs, and before the cost is known, the city so modifies its rates as to make a material reduction in the receipts. It is another instance of considering rates before service, and whatever may be said in favor of substituting a flat rate for a sliding scale, it is a curious case of putting the cart before the horse.

In comparing low rates and the cost of filtration it should be noted also that while low rates tend to attract manufacturers, it is the quality of the water which is considered by persons seeking desirable homes. In these days of city planning, this matter deserves consideration. Looked at from any angle it seems obvious that pure water pays, and that where pure water is furnished the rate question becomes secondary.

Some Aspects of the Railroad Wage Controversy

"THE WORLD is at a crisis just now, and our statesmen do not know this fact; great masses of radical groups are working within our boundaries for a weaker government; only an obsession of crass ignorance can assure us that our relative comfort will last; we cannot get together enough men to catch a border bandit; we have dangerous enemies everywhere; yet our statesmen are interested in fences, pork, the baseball score, poliomyelitis, and sharks on the Jersey coast. Our leaders do not think; they do not know enough to think; they have lost the capacity of appreciating an abstract argument. We talk of the English muddling along; we muddle and stand still."

These words of Dr. Austin O'Malley, a New York physician of keen mind and trenchant pen, would have been read by most Americans with much doubting when they were written only three weeks ago. But how great the change in three weeks! In that time we have seen the Congress of the United States pass, under duress, a law favoring four-tenths of one per cent of our people at the expense of all the other ninety-nine and six-tenths. The popular theory is that the members of Congress lacked the courage of their convictions. There have been happenings in our national life in the last two years that would give color to that explanation, but men who thought clearly on the fundamentals of our government and on the industrial history of this country and of Europe would not have abandoned principle and shirked a fight. The fundamental weakness was clarity of thinking. The yielding to party dictation, to supposed necessity, to the demands of wielders of a compact group of votes, flowed naturally from the muddling of thought.

Is the Stream Deep?

The newspapers of the country quite generally see but the superficial side of the recent conflict. They devote their editorial columns to raillery at the cowardice of Congress or to justification of its course. Most of them discuss the probability of the early revival of the dispute, deplore the methods used by the brotherhoods and contemplate with anxiety the likelihood of the other railroad employees going to Congress with wage-increase demands. The thought is on the public facts of the controversy and its immediate consequences. The careful observer probes beneath the surface. He asks whether as incidents in Congressional history the controversy and its method of settlement have little or much significance; whether as events in the chronicles of American labor they carry any special message to our industrial leaders.

Regulation of Wages

As an event in our legislative history the outstanding feature for the economist is not that Congress for the first time has been openly and brazenly forced to pass class-favoring legislation, even though that fact mark a distinct epoch in the decadence of American statesmanship. The outstanding feature is that the Congress of the United States has assumed the right to fix wages. Unconsciously and under duress it has carried to a logical conclusion the policy of regulating public-utility corporations. Hitherto it has not seen, or has been unwilling to admit, its responsibility in the matter of forced utility expenditures. It limited income some years ago by controlling rates. Then the public stepped in and insisted on arbitration of wage disputes. Congress, too, reflecting the popular demand, became a party to the arbitration program by establishing the federal board of mediation and conciliation. Now it has taken the final step—the step that carries out the logic of the regulation theory. Public-utility regulation was undertaken in order to protect a dependent public from the high-handedness of utility owners. It has been equally apparent for years that the public could suffer from the high-handedness of employees, yet no move was made, other than to establish a powerless board of mediation, to protect the public. If our leaders had thought—had thought clearly—the needed legislation would have been passed long since. There has been ample warning. Three years ago the situation was so acute that an amendment (the Newlands bill) to the Erdman act was hastily passed to avert a strike of the railway firemen. Even a few months back there was time to remedy the neglect. The national chamber of commerce recommended then that wage regulation be made part of the duty of the Interstate Commerce Commission. Congress did not see fit to act. The measure passed in haste and under pressure is entirely inadequate. It does, however, close up the gap in our regulation practice.

Industrial Slavery

The President in asking Congress for legislation recommended a law that would prevent strikes and lockouts during the pendency of an investigation. Discussing this recommendation before the Senate committee on interstate commerce, the brotherhoods' representatives declared that it would be industrial slavery to force men to work against their will. That position indicates an utter failure to understand the rights of the public in utility operation. Compulsory service would be industrial slavery if applied without exception to private industries whose operation has only a remote effect on the welfare of the whole people. This is precisely the theory of the limitation of the interstate commerce laws and of the utility-regulating acts of the states—that the management of private corporations is almost wholly a private affair, but that the conduct of the public-utility corporation, charged as it is with a public interest, is a matter for government supervision. The government's function of conserving the interests of the whole people would justify it in forcing public-utility servants to work pending an investigation. To characterize service under these conditions as "industrial slavery," merely stamps the brotherhood chief using the term as unfit to represent his side in the triple-interest controversy. The rights of the public must be respected.

Abuse of Power Is Loss of Power

Apropos of the last comment, the brotherhood leaders elected the very course most certain to bring about the enactment of stringent supervisory laws. The country has seen and felt their power, and as a result that power will be shorn from them. The reaction has already come. The brotherhoods have been unmercifully lashed by the press. There is a demand for measures that will prevent a repetition of the legislative "hold-up." Undoubtedly the Interstate Commerce Commission will be given authority over wages, while the men will be restrained from striking pending the investigation of disputes. The debate in the Senate and the hearings before the senatorial committee indicate that without the shadow of a doubt. The abuse of power inevitably leads to its loss.

The Social Significance

From the social aspect the demand of the brotherhoods is not an isolated event; nor is it merely an incident in the struggle of the railroad employees for higher compensation. It holds an important place in the development of the labor movement. It is a warning of what is coming, unless we rightly appraise the gravity of the situation and, as a people, adopt a comprehensive solution of the problem.

He is blind who does not see that labor has made remarkable strides in recent years toward getting that "proper share" of the product of its labor for which its leaders have been fighting. The evidences are many. Taking a leaf from the book of capital, labor has entered the political arena. It has not forgotten the things that Congress "put across" for the insiders in the days when the Senate and House were trust and railroad controlled. And so labor has had itself exempted from the Sherman act, and has had efficiency studies ruled out of government establishments. Of commendable measures, it has had the workmen's compensation acts, child and women's labor laws passed. Special legislation enforces precautions where occupational diseases threaten. Hours are shorter, wages higher, working conditions better, and still labor is unsatisfied. Its clamors are louder than ever. Its victories have given it power and it is constantly forcing still further concessions.

And when shall be the end? The Engineering Record, without hesitation, answers, only when the workman has full confidence that he is getting all that the industry can afford to pay him. This confidence cannot come from a vote of the board of directors. It cannot be developed overnight. It is of slow growth, born of fair dealing, of an interest in the worker's welfare, of a plan by which the workers, each according to his performance, get a full reward for their industry. There are companies that have won this confidence, that laugh when others tremble at the prospect of strikes, that earn constantly increasing profits because a basically sound plan stimulates the men to give of their best, confident that their proper share will find its way into their pay envelopes and not into the pockets of the owners.

But where there is one corporation in that enviable position there are a hundred that try to get the most work for the least pay, that allow the judgment and tyranny of foremen, rather than a square-deal company policy, to determine the character of their labor force, that care nothing for the welfare of the men so long as they (the corporations) get production. Backward employers do as little for their men as they dare; they are forced—by the law or by their employees—into every improvement.

The farsighted employers, with a touch of human kindness that, happily, pays dividends, anticipate both the law and their employees' demands. Sanitary and working conditions, hours, wages, the future of their men, have all had consideration, and each has been determined on a basis of justice to the men and in a fashion to bring out the best that is in them. Some companies, confident that there can be no industrial peace unless the workers are partners in the business, allow the men to choose from their fellows one or more directors of the company. The employees thus have means of learning exactly the financial standing of the company and its ability to grant higher compensation, shorter hours or any other concession which may be under discussion.

But here again new methods cannot be installed by fiat. An industry is an organism; it is reformed only by gradual process. One fundamental of the transformation is that each step shall conduce to higher efficiency. An ill-considered profit-sharing scheme that does not result in better or more work is doomed to failure. A shortening of hours that has no compensating advantage may lead to the destruction of the business through inability to meet competition. And so through the whole gamut of possible industrial improvements.

Often it is hard to see whence the new profits will come. A pension plan, for example, shows little or no immediate returns. But here the manager with vision is a necessity. In other words, the managements as well as the men need to be remade if the labor question is to be solved.

When employment is on a proper basis the whole character of an industry changes. One feels it in going through the Procter & Gamble soap works, the National Cash Register plant and many smaller industries where the paternal attitude of the founders still persists. Employment in such plants is an honor, is sought for and is not lightly thrown away. The men know that they are not mere tools, to be used and scrapped as the management wills. They know that the interest of the management is not in holding down the payroll, but in increasing it whenever an employee's work has added to the success and profits of the company.

Until at least a majority of our industries are on this basis, the labor problem will be with us. May we not have a right to expect that the clash of last week will awaken our industrial leaders to a realization of the seriousness of our labor situation, and to a determination to take the steps—no matter how abhorrent to the ideas of the military, one-man-power management—to put our industries on the sure basis of justice and a regard for the feelings and aspirations of the workers?

The Engineer's Opportunity

And if the future industrial peace of this country depends on a new relation between employer and employee, how necessary is it for the engineer to learn the fundamentals of that relation! Industry is his creation. It moves and grows through the laws he has formulated, the processes he has developed, the tools he has built. On an ever-increasing scale the direction of these enterprises lies in his hands. Miss Frances A. Kellor, in her article on the "Engineer and the New Nationalism" (Engineering Record, July 4, 1916), predicted for him the pivotal position in the America of the future. Dr. Frank Crane, the writer of syndicated editorials which appear in newspapers throughout the country, says that "the time will come when the President of the United States will be chosen as the man who has the greatest talent and skill in organizing public works. There will be no more politics in his selection than there is now in choosing the master mechanic of a railway or factory." When others see this future for him, shall the engineer pitch his ambitions lower? Shall he by lack of a sound and broad preparation fail to take the position which others would gladly accord him, and feel he must inevitably hold? If our statesmen can be rightfully accused of "being unable to think," shall the engineer lay himself open to the same charge?

Rehabilitation of Europe Offers Opportunity If American Interests Co-operate—W. S. Kies

Vice-President of National City Bank of New York City and the American International Corporation, in Engineering Record Interview, Discusses Relation of Engineering Construction, Manufacturing and Finance

By ROBERT K. TOMLIN, JR.
Managing Editor of the Engineering Record

IN the rehabilitation of Europe after the war engineering will face the most colossal task in its history. From ruins which scar the face of an entire continent must spring new industries and new cities—not singly but in quantities of hundreds and thousands. Any attempt to state in definite terms the amount of work to be done would lead into the realm of mere guesswork; but certain it is that a declaration of peace will herald the dawn of a reconstruction era such as the world has never before witnessed. Coupled with the demand for vast supplies of machinery, structural steel, cement and building materials of all kinds will come a call for engineering and constructional skill of the highest order. Will American interests be a factor in this work of the physical resurrection of nations and, if so, how can they best equip themselves to render adequate service? These are the questions which William S. Kies, vice-president of the National City Bank of New York City and of the American International Corporation, answered for the Engineering Record in an interview at his office in New York City last week.

Sound Financing Essential

"In the rebuilding of Europe," said Mr. Kies, "the opportunity for American contractors, engineers and manufacturers will be what they make it. It will depend primarily upon their ability to develop a close-knit organization for the solution of a great economic problem. If they fail to keep this fact in mind and content themselves merely with a scramble for little contracts here and there the big chance will be lost. What American contractors, engineers and manufacturers must realize, at the outset, is that the task of restoring European industries and cities is not one solely of design and construction on an immense scale. Of course these are essential elements in the problem, but the vital factor is sound financing. It is certain that any work of reconstruction undertaken by American interests must be carried through largely on credit. Payment may take the form of foreign bonds or other securities. Thus it would be folly for any concern to consider work in Europe without a thorough appreciation of the extreme improbability of cash payments. No matter how valuable American machinery, construction methods and engineering skill would be, they will count for little without the backing of American capital.

Foreign Investment

"This country's participation in the rebuilding of Europe can be made effective on a large scale only if groups of American engineering, construction and supply interests form some sort of co-operative association under the auspices of responsible banking and investment-manager corporations. With the right kind of organization developed I believe that the reconstruction work in Europe will warrant the solid support of American investors. We must not forget the axiom: "Trade follows foreign investment." When a nation invests systematically in large volume in foreign countries the capital invariably goes out largely in the form of machinery, construction materials, tools and general supplies for construction forces. Afterward the enterprises upon which these materials are used continue to buy supplies for maintenance, repairs and renewals. This business induces other importations from the lending countries. Even such foreign investments as loans to governments or to municipalities are recognized as being of immense assistance in the building up of foreign commerce. It has been a part of the program of the National City Bank of New York to assist in the organization of facilities for foreign investments on a safe and effective basis."

American International Corporation Will Co-operate by Supplying Capital

The American International Corporation has been studying the possibilities of American participation in European reconstruction and, according to Mr. Kies, stands ready to lend its financial backing to well-considered projects. In fact this is the very object for which it was created. "There has been some popular misconception regarding the work of the American International Corporation," said Mr. Kies. "The main purpose of this organization is to co-operate with existing engineering and contracting concerns. Under special conditions, however, the necessity may arise for the American International Corporation to organize subsidiary construction companies, but its functions are chiefly supervisory. It has on its staff engineers qualified to examine and report upon any construction program submitted to it. In other words, the corporation was established as an agency through which individual American investors could employ their funds in a way to make them most effective as part of a systematic American development of foreign investments, interlocking closely with American export expansion and the extension of direct American banking representation; but the corporation does not intend to waste time on schemes which have not been studied carefully enough to indicate their practicability."

Advocates American Engineering Bureau Abroad

It was suggested to Mr. Kies that even if groups of American interests could pool their resources in a co-operative association such as he mentioned they would still be a long way from actually securing foreign work. "First-hand knowledge of local requirements, in France or Belgium for example, would be necessary," replied Mr. Kies, "before plans for any comprehensive construction program could be financed. I think it is time now for American firms interested in this work to get together and establish in Europe an engineering bureau. Its personnel should be recruited from only the highest grade of men, representing the best brains in the engineering, construction and manufacturing fields. Such a bureau could at once begin a study of the problem of reconstruction on a big scale and formulate working plans for the restoration of entire cities or even groups of cities.

Work Will Be Organized

"We must recognize the probability that the early stages of the reconstruction of industry in Europe may be in accordance with some big organized plan under government auspices. The success with which both the Allies and the Teutonic Powers have placed national business activities on a controlled basis—mobilized them—will make sure the national organization of rehabilitation. Nevertheless, we may be sure of the fact that Europe has obtained too clear a view of the fundamentals of industry to stop anywhere short of the quickest, most effective restoration, even at a measure of national expense. Surveys of destruction in France and Belgium, already in progress under national auspices, show that important plans are now in process of formation. If, as a result of the work of an American engineering bureau abroad such as I have suggested, we can show Europe that America is ready with an absolutely certain supply of materials and machinery, an absolutely certain supply of capital, and an organization which can be depended upon for first-class, speedy construction on an enormous scale, the prospects of American participation in the restoration work in Europe will be particularly bright. In other words, if Europe knows that we can be depended upon to do a large amount of reconstruction cheaper than she can do it for herself, Europe will prefer to begin at once getting her labor forces back into the permanent alignment of normal productivity and give us the opportunity of using our surplus capacity in doing as much as we can of this rebuilding."

Signs of Activity

As indicating the need for the immediate organization of American resources, if any large European contracts are to be secured, Mr. Kies called attention to the fact that press reports, a week or so ago, stated that France had made preparations for the reconstruction of about 3000 towns and villages, destroyed or seriously damaged by the German invasion. Another significant news item mentioned the fact that an ex-

position is now being held at which great building and contracting corporations of France have presented models of new towns and villages which they will undertake to erect in a given number of days for a fixed sum. A certain quantity of quick construction work will probably be needed, according to this report, even in towns only partly destroyed, as the refugees are said to be anxious to return to the sites of their homes at the earliest possible moment. In the realization of this hope, according to Mr. Kies, the extensive use of American construction plant, capable of a maximum output of finished work with a minimum input of labor, should have an important influence. Even with the comparatively high cost of common labor which obtains in the United States American contractors, it is believed, are able to do work at lower prices than could be attained with cheaper labor in foreign countries. Modernized, highly developed construction plant and methods are held responsible, in large measure, for such results.

Another indication of approaching activity in foreign rebuilding is the sailing to France, last month, of an American industrial commission organized by the American Manufacturers' Export Association. On this commission prominent contractors and engineers as well as bankers and manufacturers are represented. Another straw in the wind is the recent decision by the American International Corporation to send investigators upon a tour of Russia and to establish a permanent office in Russia.

In the course of the interview, mention also was made of a conference held in Chicago Aug. 21, at which were present representatives of the federal government and of the lumber industry. The object of the meeting was to inquire into the possibilities of the export market. At this meeting it was stated that the Southern Pine Association had a representative in Paris investigating the possibilities of distributing large quantities of timber for reconstruction work in France.

"The immensity of the task confronting the European nations," continued Mr. Kies, "forces upon us an entirely new conception of a working organization for the rebuilding. It is safe to assume that when the armies are disbanded the men from the ranks will immediately be put to work on reconstructing towns and the industries in them. I believe that no provision for the importation of labor from the United States, at least, need be considered. What we would be called upon to supply, in the event of securing a large foreign reconstruction contract, would be an organization more or less supervisory in character, made up of office and field engineers, construction superintendents, etc., adequately financed with American capital, and supplied with the necessary high-speed construction plant of American design.

"I have already mentioned the desirability of establishing an American engineering bureau abroad. This organization should concern itself not merely with preliminary surveys, estimates and designs but should be, in addition, a business-getting agency. The remarkable speed records made by American contractors in the construction of big additions to munitions plants in this country would serve as arguments for swinging work our way. The American manner of mixing and placing concrete in huge quantities and in an incredibly short time, for example, justifies a very careful consideration by European commissions intrusted with the work of reconstruction. The same may be said of our accomplishments in the fabrication and erection of steel structures—buildings and bridges. There is no doubt about our ability to carry on construction work on a large scale and in a minimum time, provided we organize for it and make the necessary arrangements as to its financing."

The first reconstruction to be undertaken abroad, Mr. Kies believes, will undoubtedly be in France and Belgium. Our primary efforts, he thinks, should be directed toward these nations. Next will come Russia—an industrial giant, asleep. Her awakening will signalize an unprecedented opportunity for American enterprise.

Closely linked with matters of engineering and construction abroad is the problem of using, to best advantage, the manufacturing facilities in the United States that have been acquired and paid for out of extraordinary profits during the last year and a half of enormously remunerative war business. "The nation's industries," Mr. Kies pointed out, "are now confronted with the problem of finding a way to use this splendid manufacturing equipment for all it is worth without over-production and, if possible, without 'scrapping' the plant and machinery acquired for temporary use but fully paid for and available if some new use can be found for it. The superabundance of productive facilities necessitates a broadening of our markets. With the right kind of co-operative effort between labor, capital and our government it will be an impossible undertaking for America to make a foreign market big enough to absorb every dollar's worth of our manufacturing output. If the manufacturing and investment public will rise to the opportunity we cannot only draw a permanently increased income from what we gained so cheaply, but we can push the national productive ability to a still higher level.

New Law Needed

"We need a new law," Mr. Kies concluded, "permitting freedom of combination of concerns in foreign trade. If we get it, our national industries will be able to make effective, to a remarkable degree, machinery we already have for co-ordinating on a very large scale the right kind of manufacturing and construction enterprise. With such a law we would be able to carry out in complete detail any contracts for furnishing fully equipped factory plants or even factory towns and at the same time finance the enterprise over a term of years."

Vice-President of National City Bank of New York and American International Corporation, Who Sees in Europe's Rehabilitation an Opportunity for United States Interests

WILLIAM S. KIES

$12,000,000 Invested During Past Six Months in Manufacturing Industries

A report recently compiled by the industrial commissioner of the Los Angeles Chamber of Commerce states that the number of factories constructed or in course of construction in territory tributary to Los Angeles for the first half of 1916 exceeds the total for the entire year of 1915. Up to July 1, according to the report, there had been thirty-seven important factories under construction, contracted for, or occupied since January 1. The cash expenditure for the first six months of this year is given as $12,063,000.

Notched Steel Brackets Aid Placing of Hoop Reinforcement for Concrete Reservoir

Duluth's 5,000,000-Gallon Circular Basin Concreted During Freezing Weather—Costs of Construction Are Given

By E. W. KELLY
Engineer, Water and Light Department, Duluth, Minn.

FLAT, notched steel-plate brackets, riveted to vertical 3-in. channels, spaced 7½ ft. on centers, demonstrated their value as supports of the hoop reinforcement used in the construction of the 5,240,000-gal. circular concrete reservoir which serves as a distributing basin for the second pressure zone of the water-supply system of Duluth, Minn. The reinforcing bars were furnished in lengths of about 66 ft. It was found unnecessary to curve them before placing, as the rigidly held notched brackets and clamped laps held them to the exact circle desired. Because of the narrow clearance between the steel and the outside form, the latter was carried up in advance of the steel, and the channels strongly braced thereto at intervals, to enable them to support the great weight of hoop steel. The "spring" of the bars against the notches of the brackets held them so tightly in place that wiring was unnecessary. The bulk of the concrete for this structure was placed during freezing weather.

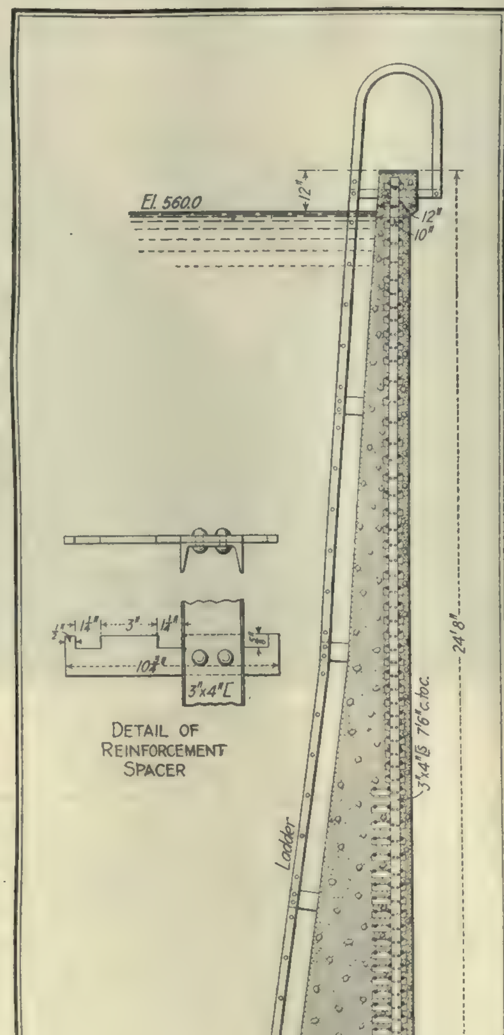
Choice of Site

The choice of a site was narrowed by the size and location of the district to be supplied, which is on the slope of the rocky ridge upon which the city is built; by the desired elevation, which was between El. 550 and 570 above the lake; and by the nature of the soil between these contours. A level site free from rock was not available in the neighborhood indicated by the first two considerations, but a site was available which was not unreasonably rough, and which contained a comparatively small amount of ledge. This site was selected for a reservoir some years ago. Two 12-in. mains were laid thereto, and wooden tanks of a combined capacity of 360,000 gal. were erected upon it for temporary service at that time. The presence of these mains at this point and the large expense of laying similar mains to any other available place were deciding factors in the final selection of this site when, in the spring of 1913, the building of the reservoir was definitely decided upon.

The soil on this property consists of gravel of various degrees of coarseness, loam and hardpan, lying in the irregular layers and masses characteristic of glacial deposits, the gravel being in greater quantity than the other two soils. The presence of several layers or streaks of nearly pure coarse gravel, which would have made watertightness difficult to secure, and the position of the reservoir about 500 ft. higher than the "congested value" district and on the slope directly above it, decided the writer against the earth-embankment type of reservoir, and the circular reinforced-concrete reservoir was therefore selected. The reservoir is built on the rather steep slope of the ridge. This necessitated an unusually large amount of excavation for a reservoir of this size, and it appeared best for only the upper 10 ft. of wall to be above ground, the uphill portion of the reservoir being embedded in the slope and the excavated material forming an embankment on the down-hill side. The elevation selected left the wall footings above the ground surface at some points, while the highest ground within the limits of the structure proper was of the same height as the top of the wall.

Design Assumptions

To keep fluctuations in pressure within what were considered reasonable limits a total available depth of 27 ft. was selected. This fixed the diameter for the desired capacity of about 5,000,000 gal. at about 185 ft. On account of the large diameter it was felt that a unit stress in steel greater than about 12,000 lb. was not permissible. Because of probable inequalities in the pressure exerted by the backfilled earth no deduction from hoop tension was made for external earth pressure, this being regarded simply as an added element of safety. Steel sufficient to take the entire hoop tension at 12,000 lb. per square inch was therefore provided for.



HOOP REINFORCEMENT FOR RESERVOIR WALL WAS SUPPORTED BY NOTCHED STEEL PLATE BRACKETS RIVETED TO VERTICAL CHANNELS

The completed plans were submitted to Dean F. E. Turneaure, as consulting engineer. By his advice the bottom half of the wall was thickened so as not to exceed a unit stress of 240 lb. per square inch in the concrete, assuming steel and concrete both to take tension and in the ratio of 10 to 1. The reinforcement of connections between wall and floor also was increased. At the instance of D. A. Reed, manager of the Duluth waterworks, the allowed unit stress in steel for the upper portion of the wall was progressively reduced toward the top, beginning at a point 11 ft. below the overflow. This was adopted as a precaution against possible ice pressure.

In final form the wall section of the reservoir is shown in the accompanying drawing. Hoop reinforcement is supported on flat notched steel plate brackets riveted to vertical 3-in. channels which are spaced on about 7½-ft. centers. The floor is reinforced with ½-in. square bars, laid at right angles on 1-ft. centers both ways. The margin next the walls is further strengthened by four concentric rings of similar bars on 1-ft. centers. The wall and floor are tied together with ¾-in. square bars 7 ft. long on 2-ft. centers. One-half of the length of these ties is embedded in the floor, the end in the wall being turned upward as shown. A steel ladder was provided for, to give access to the interior of the reservoir.

Materials

Sand for concrete making consisted of a mixture of coarse lake sand, pit sand and rock screenings proportioned to meet the following requirements: Passing ¼-in. mesh, 100 per cent; passing No. 20 screen, not less than 65 nor more than 85 per cent; passing No. 100 screen, not over 5 per cent. Coarse aggregate consisted of crusher-run traprock from the excavation. That for the floor and wall was screened to pass a 1-in. ring and be retained on a ¼-in. mesh. For non-waterproof concrete larger aggregate was permitted. For walls and floor a 1:2:3½ mix was specified, but the contractor, wishing to take a little more precaution to insure watertightness, used a 1:2:3 mix. At points where filling was required to bring the ground surface to grade a 1:3:6 concrete was used as filling, and a similar quality concrete was used to fill around pipes under the reservoir floor. The specifications provided that the contractor should waterproof walls if, after construction, leakage should occur or damp spots appear on the exterior of walls.

Construction

Earth was excavated by means of wheeled scrapers. Most of the soil was loosened by plowing, but portions, resembling alluvial silt, required no loosening, while some bodies of hardpan and cemented gravel necessitated blasting. Ledge was encountered over about one-fourth of the floor area. This was a seamy red "trap" that broke in small cuboidal pieces excellent for crushing. Rock was excavated 1 ft. below subgrade and backfilled to grade with material from the remainder of the excavation, well compacted.

All wall reinforcement was placed before concreting was begun. A substantial hub was driven to exact grade for each vertical channel. The channels were secured and braced on these, accurately centered, and

DULUTH CONCRETE RESERVOIR HAS A CAPACITY OF OVER 5,000,000 GALLONS, A DIAMETER OF 185 FEET AND A DEPTH OF ABOUT 24 FEET

exactly vertical. To insure that steel and forms were placed on the exact circle required, a temporary but rigid tower was erected over the center hub of reservoir and a steel tape swung from exact center at various levels as required. The hoop reinforcement was then placed in position in the notches of brackets. The bars were lapped 36 diameters and secured with three Crosby wire rope clamps at each joint, all joints being carefully staggered.

The forms consisted of 1-in. shiplap sheathing on 4 x 4-in. studding wired through the walls. The outside form was completed to the top before commencing concreting, while the inner sheathing was carried up 2 or 3 ft. in advance of the concrete.

Concreting in Freezing Weather

An ample supply of rock taken from the excavation was crushed, screened and stockpiled on the high ground above the reservoir, and about one day's supply of pit and lake sand and of cement were provided before concreting commenced. While concreting was in progress, cement and sand were hauled from the pier by teams and a 5-ton Kissel truck. The latter gave particularly valuable service. The difficulty of transportation will be appreciated upon mention of the fact that the horizontal distance of about 1 mile from the pier involves a rise of 560 ft.

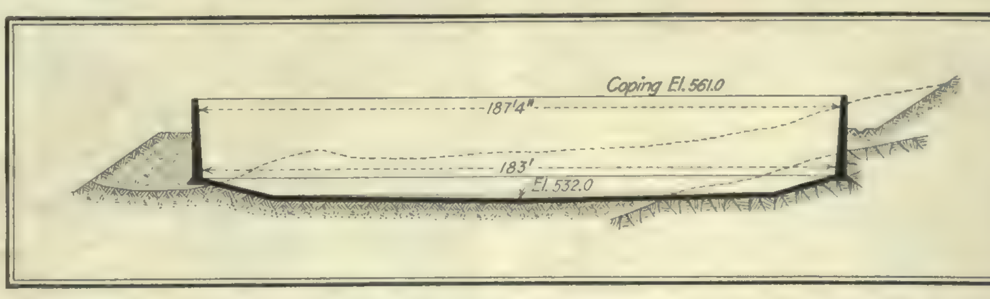
Mixing was by a ½-yd. gasoline-engine-driven Smith mixer, with side loader. A similar but smaller machine was set up alongside this as a reserve. Water was supplied by a small steam pump drawing from wooden tanks previously mentioned. As the temperature was below freezing nearly throughout the job, it was necessary to heat the sand and water. Steam for this purpose was supplied from a 40-hp. boiler near the stock pile to the water tank on the mixer by steam pipe and perforated points attached to steam hose to the sand piles. By this means a temperature of about 90 deg. Fahr. was obtained in the batches as they left the mixer. No trouble from freezing or slow setting was encountered, except as hereafter noted.

Distribution of concrete was accomplished by hopper-bottom cars propelled by two men each on a circular track at the top of the forms. This track was built independent of the forms so as to avoid vibration of the latter. The cars were dumped into hopper-top telescoping steel spouts, four of which were provided, two being in use and the other two in process of being shifted at all times. Cars made a complete circuit of the reservoir at each trip.

Concreting was continued night and day after commencement, in the attempt to produce a true monolith, but this intention was frustrated by weather conditions. The tail end of the terrific gale of Nov. 6, 1913, which caused extensive disasters on the lower Great Lakes, struck this locality when the wall had been brought up to about 10 ft. from the top of the coping. The wind was of such strength as to tear off the runway boards which were nailed to the ties of the track, and it was, of course, humanly impossible to continue. A dam of 23-gage galvanized steel, 8 in. in width, in 6-ft. lengths, had been provided for this contingency, and this was embedded for half its width in the green concrete when work had to be discontinued. Before resuming concreting, the surface of the joint was scrubbed with wire brushes and water under pressure until the aggregate was well exposed. The surface was wetted and covered with creamy grout well scrubbed in, just in advance of new concrete.

While pouring the last round at the top a sudden drop of temperature to well below zero, accompanied by a high wind, started freezing the top of the concrete as it was deposited, and thus again interrupted the work. This also occurred in the early evening. The next morning the top concrete appeared to be frozen to some extent. Hot manure was placed about it, being secured to the sides of the form by strips nailed outside the studding. Under this treatment the frozen concrete quickly thawed and set, and the following day the final pouring was done. It was felt that Providence should not be further tempted by trying to construct the floor, and concreting was therefore discontinued. An opportune thaw made possible the stripping of forms and construction of most of the embankment at this time. The inner toe of wall was also protected from possible heaving by frost by banking with manure.

Work was recommenced in the following June, after the ground had dried and well compacted after the frozen ground had thawed. The wires, extending through the wall, which had secured the form studding, were cut off at least 2 in. below the surface, and the cavities so left were plastered carefully with 1:2 mortar. All reinforcing was placed and wired as the first step in constructing the floor.



THE RESERVOIR IS BUILT ON A RATHER STEEP SLOPE, NECESSITATING AN UNUSUALLY LARGE AMOUNT OF EXCAVATION FOR A RESERVOIR OF THIS SIZE

Concrete was dumped directly from the mixer into a chute, and thence into hopper cars, which were used for transporting to the point of deposit. The track upon which these cars ran was supported on horses which were moved, and the track swung, to follow the progress of concreting. Spreading was done with shovels only, and the surface purposely left rough. Continuous concreting of the bottom was not attempted, dependence for securing waterproofness being placed in making all joints on a long scarf, and wetting, scrubbing and grouting all old surfaces previous to placing new concrete against them. Joints in the mortar finish were also kept away from joints in the base concrete.

Applying Finish Coat

It was found nearly impossible to deposit the mortar for the finish coat while the concrete was green, and the attempt was abandoned. To obtain a bond, scrubbing with steel brushes and water was resorted to. This was followed by a sprinkling of cement, and that in turn by a sprinkling with water. The resulting cement cream was thoroughly scrubbed into the hard concrete, and lastly, the mortar coat of a ½-in. minimum thickness was deposited, and, after the proper interval of time, troweled to a sidewalk finish. Upon the suggestion of the writer, the concrete was sprinkled after initial set had taken place to remove laitance and so reduce the amount of scrubbing required. This proved to be a very successful expedient, as the particles of aggregate were left exposed and clean, embedded firmly in the concrete matrix, just as is the case where concrete has been rained upon before it is hard.

Springs, discharging about 20 gal. per minute, were encountered in the excavation. These were conducted by tile drains to the blow-off sump. When the walls of the latter were concreted, wrought-iron pipes were left to carry off this drainage. Upon capping these, it was found that the head thereon was too small to be injurious to the floor, and flow was accordingly shut off.

Watertightness

As soon as the last section of facing had hardened the bottom was flooded to the foot of the outer slope to facilitate curing. After a one week's wait, filling proceeded at the rate of between 1 and 2 ft. per day. No appreciable leakage was apparent, but dampness appeared along about two-thirds the length of the joint in the wall heretofore referred to, and at a few points where pockets of coarse aggregate had formed. The latter were all in the upper portion of the wall, where the section was thin, and where the spouts, on account of their construction and the position of the track, had delivered their contents obliquely against the outer forms instead of directly downward as in the lower wall. Vigilance had been exercised, during concreting, to spade the aggregate into uniformity at such points, but a few spots had escaped treatment, probably during the hours of darkness. After a few weeks most of this seepage had disappeared, but still persisted in parts of the horizontal joint. Accordingly, a coat of bituminous waterproofing was applied to the upper 12 ft. of the interior of the walls. Since this application no signs of dampness have appeared on the exterior. The outside of the exposed portion of the wall was painted with neat cement grout to improve its appearance. A cement gutter was constructed on the uphill berm to carry off storm water from the slope above. The berm and slopes were manured, and seeded with clover and timothy.

The costs to the department of this structure and appurtenances, complete, is given in the table.

In the reservoir proper there are about 197 tons of steel and 1850 cu. yd. of 1:2:3 concrete.

Temperature Crack at Concrete Joint

An observation as to the horizontal joint produced by interruption of concreting will no doubt be of interest. At the conclusion of work in November, and also about the first of the following June, the union of the layers at this point appeared to be complete. Before the reservoir was filled, however, a hair crack was visible following this joint for about two-thirds of its length. The writer believes this crack to have occurred on account of differences in temperature in the portions of the wall below and above the joint. The joint happened to be almost exactly at the level of the top of the earth embankment. This left the upper portion of the wall exposed to the hot sun, while that below was protected by the earth. The resulting stresses naturally produced cleavage at the plane of weakness caused by the joint at the critical point.

The points of interest which the writer has noted for subsequent practice are: A renewed sense of the difficulty of joining old to new concrete; the necessity for extreme care in arrangement of spouts when the same are to be used for depositing concrete; the thorough satisfaction given by the notched brackets used as a support for the horizontal wall reinforcement; and the feasibility of producing excellent concrete in below-zero weather, in an exposed situation, and with no protection other than the forms.

COSTS OF DULUTH CONCRETE RESERVOIR

	Unit Cost	Total
11,559.0 cu. yd. earth excav.......	$0.529	$6,079.50
875.9 cu. yd. earth in trench....	0.75	656.93
1,331.9 cu. yd. rock excav.........	6.00	7,991.40
299.7 cu. yd. gravel fill over rock	1.00	299.70
196 ft. 16-in. pipe laying.......	0.20	39.20
1,286.5 ft. 12-in. pipe laying.......	0.15	192.98
706 ft. 8-in. pipe taken up......	0.10	70.60
93.8 cu. yd. class C concrete (filling)	3.00	281.40
335 lin. ft. cement gutter.......	0.50	167.50
1 valve chamber		100.00
1 blow-off pier		50.00
Reservoir proper, including ladder and steel		28,755.30
48.6 tons pipe........................	25.90	1,259.09
10,337 lb. specials................		402.31
Valves		351.40
Pipe hauling		54.22
Electric overflow alarm and conduit		59.28
Painting exterior with cement....		45.87
Inspection, including inspection of steel and cement................		358.57
Miscellaneous labor and material, including seeding		100.54
Total, exclusive of engineering and overhead		$47,315.79

New Dam Increases Salt Lake City Water Supply

High Altitude of Dam Site Makes Short Construction Season—Only Proper Consistency of Concrete Will Flow Down Chutes

A NEW arched rubble dam forming the Twin Lakes reservoir at the head of Big Cottonwood Cañon adds 306,000,000 gal. storage capacity to the water supply of Salt Lake City. A short construction season, experience in getting proper moisture consistency of the concrete and the plant layout are the chief features of the construction.

The dam is 29 miles from Salt Lake, and the water runs down the natural bed for 15 miles before reaching the headgates at the mouth of Big Cottonwood Cañon, where it enters a reinforced-concrete conduit leading to the city. The crest is at an elevation of 9459 ft. above sea level, and the water surface with reservoir full is at El. 9456. The height is 56 ft. above stream bed and 69 ft. above bedrock. The maximum base width is 44 ft. and the top width is 6 ft. The arch has a radius of 670 ft. and a length of 650 ft. It is thrown across the outlet of the lower Twin Lake, a small basin of glacial formation near the top of the Wasatch Range. The topography of the country is such—as in practically all of the watersheds draining into the Salt Lake Valley—that there are no large sites available for the storage of water; but the pre-

ARCHED RUBBLE DAM WHICH WILL INCREASE SALT LAKE CITY WATER SUPPLY

cipitation at this altitude for the locality is very heavy, particularly during the winter months. For the ten-month period beginning June 9, 1915, it was 37.36 in. As the dam has been under contemplation for some years, most of the excavation, relatively small in amount, had been done by city forces before the contractor began operations June 9, 1915. Work can only be prosecuted in this altitude from this time on to November. The work of laying bare the bedrock was completed July 15, so that concreting could begin. The entire work was finished Nov. 7, 1915.

Cyclopean Concrete Used

The specifications for the rubble concrete provided for a 1:3:5 mixture of concrete in which granite stones in sizes from 6 in. to 4 ft. in dimensions were to be embedded, with spaces between stones of not less than 2½ in. The maximum size of stones actually placed did not exceed 2½ ft., and most of the rock did not exceed 2 cu. ft. Approximately 25 per cent of rubble was placed in the mass.

The rubble was obtained by stripping the bedrock and by quarrying from the hillside, 600 ft. distant. The sand and stone for the concrete were crushed from granite from the quarry, 400 ft. distant. A belt conveyor transmitted the sand and stone from the crushers, one gyratory and two jaw crushers, about 200 ft. to hoppers over the ¾-yd. Smith mixer at the foot of a distributing tower and to a stockpile. The rubble was transported to the forms in 1-yd. cars over a trestle built along the upstream face. The average amount of concrete placed was 74 cu. yd. per day of 10 hours, and the limiting features were the capacity of the mixer and the rate of furnishing the large stone.

In mixing and placing the concrete it was found that a slight excess of water caused the grout to separate from the aggregate to such an extent that it was practically impossible to handle the concrete satisfactorily. The best results were obtained by adding just sufficient water to make the concrete plastic. This mixture required steeper chutes. However, tests on 6-in. concrete cubes made of the plastic concrete showed higher strength than those made of the wet concrete. During the progress of the work 6-in. concrete cubes, made and tested in compression after 7 days and after 30 days, crushed under loads of 887 and 1992 lb. per square inch respectively.

Quantities and Costs

The total quantity of rubble concrete was 9985 cu. yd., for which the contract price was $7.20 per cubic yard. For loose material and solid rock the prices were $2.25 and $3.50 per cubic yard respectively. Cement at Park City, the nearest railroad point, 7 miles from the site, was $2.17 per barrel.

The freighting of cement and other supplies to the dam site over the 7 miles of rough cañon road cost $5.90 per ton. This was accomplished by four-horse teams requiring 4 hours to make the trip up and 3 hours down. The estimated cost of crushed sand and stone was $2 per cubic yard and of rubble 50 to 60 cents. The dam proper costs $74,980, and the excavation $5,880.

James Stewart & Company were the contractors. The work was carried out under the direction of Sylvester Q. Cannon, city engineer.

Equipment Devised for Testing Water Meters Quickly in the Field

Methods Systematized for Checking Accuracy Without Removing Meters from the Property of the Water Consumers Who Own Them

By W. T. McCLENAHAN
Monmouth, Illinois

While superintendent of a small water plant in Pennsylvania where there were about 3000 meters in use, the writer inaugurated a campaign of systematic testing of all meters already in service, as well as of all new and repaired meters going into service. As no record had been kept of tests in the past, and as some of the meters had been in service from six to ten years, it was necessary to test all meters. The testing was done largely by the regular shop force whenever other work did not require their attention. During a year's time the methods of making and recording the tests were greatly improved, and a description of them is given below.

We began making our tests by removing the meters and taking them to the shop for test on a calibrated tank. A short piece of pipe was substituted for the meter, so in the running position of the meter when it is tested in the shop. There is some truth in this contention, but from our experience with this method and with the test meter method described in the following paragraphs the writer would hesitate to say that the test meter is the more accurate. While it overcomes some of these faults, it introduces others that may be just as serious. Our experience showed that particles of sediment are likely to get into the test meter and interfere with its proper working. However, with proper care taken to watch the regularity and smoothness of the action of the test meter during the tests and a frequent checking up of the test meter on the tank, reliable results can be obtained.

There is usually less objection to making tests on the property without the removal of the meter, and there is also a psychologi-

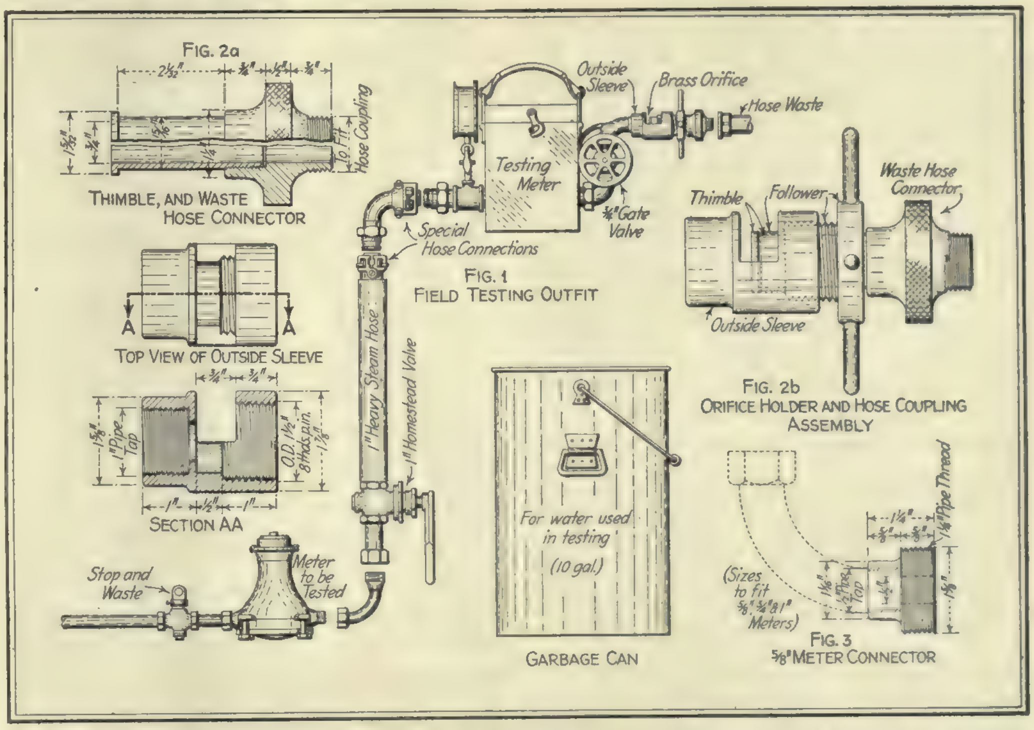


FIG. 1—DETAILS OF FIELD TESTING OUTFIT FOR METERS RANGING FROM FIVE-EIGHTS TO THREE-QUARTERS AND ONE INCH. FIGS. 2A AND 2B—DETAILS OF SPECIAL BRASS ATTACHMENTS FOR METER-TESTING OUTFIT. FIG. 3—CONNECTOR FOR FIVE-EIGHTHS-INCH METER

that the consumer was not without water while the test was being run. It took three men to run tests efficiently in this way—one man to remove the meters, one man to test them and one man to reset them. Generally the man who removed the meters to be tested brought in his load of meters to be tested and took out a load to be reset, but often one of the men was inexperienced and so was put to setting meters only.

As the meters were owned by the property owner this method of testing meters very often caused trouble, for the property owner was likely to feel that we were taking liberties with that which belonged to him. A question also arose as to the accuracy of such tests made under conditions different from those which prevailed in the house. The basis of the contention is that there is a difference of pressure, a disturbance of sediment in the meter and a change

cal effect on the consumer which favors the test meter. The consumer seems to be favorably impressed in most cases when he sees an array of equipment brought to his cellar and sees the test made, even though he may not fully understand it. Our men were instructed to explain the test whenever the property owner wanted to know about it.

From our experience it would seem that there is very little difference in the cost of making the tests by the two methods. Present practice is to test with the test meter where it can conveniently be used, but to remove the meter and test at the shop if the test meter cannot be easily connected in. With this modification in method the test meter method is a little cheaper.

Two men are required to make tests with the test meter. One man should be an intelligent, resourceful laborer who knows

	Date of Test	Reason for Test	Tested By	Tested On	Tested For	Folio	Meter Number	Meter Size	Meter Kind	Meter Reading	Record of Test: Size Orifice	Pressure	Test Meter or Gage: From	To	Correction Test Meter: Fast / Slow	Percentage: Fast	Percentage: Slow
0										Beginning							
										Finish							
1	7/11/16	New	W.T.Mc	Tank	Ellwood Bros.	3076	567 976	5/8	Key	B 0	1/16		0	1.01	—		1%
										F 6	5/32		1.00	2.02	—		2%
											1/2		1.00	2.00	—		O.K.
2	7/12/16	P.S.	W.T.Mc	T.M.	John Smith	2685	31 056	5/8	Trid.	B 4675	1/16	118	1.76	2.75	1% F	O.K.	
										F 4682	5/32	110	2.75	3.74	O.K.	1%	
											1/2	[illegible]	3.74	4.74	1% F		1%
3	7/12/16	Repaired	W.T.Mc	Tank	Sam Jones	392	365 871	5/8	Key	B 0	1/16		0	1.01			1%
										F 5	5/32		1.00	2.02			2%
											1/2		1.00	2.02			2%
4										B							
										F							

FIG. 5—REPORT CARD IS COMPILED BY MAN TESTING THE METER

how to figure percentages and can keep a clean, reliable record. The other man is a helper and can be an ordinary cheap laborer.

The heart of the testing apparatus used by us is the test meter. Other meter companies make test meters, but the one we happened to use was a ¾-in. split-case Neptune meter. It is inclosed in a neat wooden carrying case and is provided with a special dial with two hands, the smaller reading to feet up to 10 cu. ft. and the larger reading to hundredths of feet up to 1 cu. ft. If the meter to be tested records 1 cu. ft. for every revolution of the hand showing the smallest unit of consumption, then the test meter will record directly in percentage fast or slow, according as the test meter shows hundredths of feet less or more than 1 cu. ft. for every revolution of the small digit hand on the tested meter. Meters to be tested which do not record 1 cu. ft. for every revolution of the small digit hand are tested in the same way, but the percentage fast or slow must be calculated. Where most of the meters read in gallons, no doubt the meter companies could furnish a dial suitable to give results in percentages.

HOLE IN DISK GOVERNS RATE OF FLOW

The rate of flow is governed by the size of the hole in a round, flat brass disk which was formerly inserted in a coupling on the discharge side of the test meter. The meter is connected up in series with the meter to be tested so that all the water going through one meter will go through the other. The lid of the carrying case is made to hold the orifice disks not in use. This was the outfit purchased from the meter company.

In testing meters we ran three tests. The first test was always the highest rate of flow and was intended to correspond as nearly as possible to the rated capacity of the meter being tested. The next test corresponded as nearly as possible to that specified for test by the Public Service Commission of Pennsylvania. The last test run was on a very small flow which was supposed to correspond to a leak and was usually about one-thirtieth of the rated capacity of the meter. It was the writer's observation that most of the time spent in making tests was consumed in setting up the apparatus and in changing the orifice disks. He therefore designed an orifice holder to shorten the time required in making the changes of disks and connecting equipment between the two meters to speed up the work of setting up and disconnecting the apparatus.

Instead of the clumsy coupling into which the orifice disk was inserted and then screwed onto the discharge end of the test meter, the writer had the special orifice holder shown in Figs. 2a and 2b, made of brass and permanently screwed to the discharge end of the test meter. It consists of three distinct parts—an outside sleeve which fits on the end of the test meter, a follower which screws into the outer end of the outside sleeve and fits snugly around the thimble and a hose piece. The follower pushes the end of the thimble piece against the orifice disk which is inserted in the slot in the top of the outside sleeve. A hose is attached to the other end of this thimble piece to take care of the waste water, which is run either into a handy sink or sewer or into the garbage can which is carried for the purpose. Three lengths of hose are carried—3 ft., 10 ft. and 20 ft. To attach the hose the follower is loosened up and then the milled wheel is turned.

This orifice holder was very successful and was well worth the cost.

CONNECTION BETWEEN METERS

The connection between meters consisted of a set of three ordinary curved meter connections to fit the three sizes of meters ordinarily tested, a quick-closing valve and two short pieces of heavy steam hose with special hose connections and two curved hose connections. In order to make convenient the changes which are necessary in testing the different sizes of meters, special brass male ends, shown in Fig. 3, were made to fit the ends of the curved meter connections, and these were all made to fit into a standard 1-in. meter connection screwed into the end of the 1-in. Homestead valve. The Homestead valve was chosen because it is quick-closing, is well made and will stand the wear. It is used in stopping the test when the small digit hand on

DATE OFF 5/6/16
REMOVED BY M. Kabler
READING 57874 G.C.F.
DATE TESTED 5/8/16
TESTED BY Geo. Kleiman
RESULT UNREPAIRED METER TEST

ORIFICE	1/16	5/32	1/2
PERCENTAGE	N.R.	10% S	4% S

RESULT REPAIRED METER TEST

ORIFICE	1/16	5/32	1/2
PERCENTAGE	% S	2% S	2% S

DATE REPAIR TEST 7/12/16
TESTED BY W.T. McClanahan
DATE RESET 7/15/16
RESET BY M. Kabler
READING 5 G. C.F.

RECORD OF TESTS

DATE OFF 5/6/16 REMOVED BY M. Kabler
READING 57874 GAL. ~~CU.FT.~~ REASON FOR FIRST TEST ~~NEW~~ PUBLIC SERVICE ~~BILL~~

DATE TESTED	TESTED BY	TEST NO.
5/8/16	Geo. Kleiman	3043
6/2/16	do	3052
7/12/16	W.T. McClanahan	3063

DATE RESET 7/15/16 RESET BY M. Kabler
READING 5 ~~GAL.~~ CU.FT.

METER NO. 365 871 SIZE 5/8 KIND Key
FOLIO 392 REPAIR NO. 765
DATE SHIPPED 5/10/16
OWNER Sam Jones
560 5th ST. AVE.
LOT 27 BLOCK 2
[illegible] BORO

FOLIO 392
METER NO. 365 871
SIZE 5/8 KIND Key
REPAIR NO. 765
DATE SHIPPED 5/10/16
DATE ACCEPTANCE [illegible]/12/16
REPAIRED BY [illegible]
CHARGES $2.10
FRT. ~~EXP.~~ .10
LOCAL LABOR .25
TOTAL CHARGES $2.45

FIG. 4—FILING AND REVERSE SIDES OF CARD FOR METER-TEST RECORDS

the meter being tested has made exactly one revolution. It must be placed near this meter. The slow-opening gate valve at the test meter is used to start the tests, as it was found that there was a certain amount of error introduced because of inertia of parts when water was allowed suddenly to start through a meter.

The special hose connections were made by the W. J. Clark Company of Salem, Ohio, and are what are known as "Quick as Wink" couplings. They are made up by simply pushing the one into the other. They are taken apart by inserting a key into the jaws of the clamp which holds the coupling together and turning it through 90 deg. They were very quickly handled and never gave trouble or leaked. They were indeed so satisfactory that the writer believes they could be used to advantage on the discharge hose also. The two pieces of short hose and the two curved hose couplings are found very useful in making certain connections.

GAGE RECORDS PRESSURE

A small gage was placed permanently next the test meter so that a record of the pressure obtained at each house during each test could be noted. Such information is of value not only in calculating the exact rate of flow during each test but furnishes valuable information that is useful for other purposes.

A special wrench was made to fit the two most common sized meter nuts—the ⅝-in. and the ¾-in. meter.

Other equipment carried is listed in the table. A specially designed cart was made to carry everything in its place, so no time was lost in collecting the equipment and nothing was forgotten. That cart did service for testing only, and the equipment was not to be taken from it.

It had a cover which could be locked to keep out thieves when it was left out on the street. In winter a lantern was carried in the cart to prevent freezing of the equipment.

MISCELLANEOUS EQUIPMENT

1 10-in. pipe wrench.
1 12-in. monkey wrench.
1 screwdriver.
1 flash light.
1 meter sealing iron.
1 pair wire cutters.
1 spool copper sealing wire.
Supply:
  ½-in. lead seals.
  Seal bolts.
  Seal screws.
  Meter nut seals.
  Candles
  Leather washers for ⅝, ¾ and 1-in. meters.
Assorted lot bushings, nipples, etc.

RECORD SYSTEM

In handling meter tests and repairs our local office made certain reports to the general office in Pittsburgh. The property owners usually delivered the meters needing repair to us, and we would then send them to the factory, where they would be repaired and the charges billed to us for collection. These two facts explain the form and the reason for some of the information appearing on the meter card shown in Fig. 4. The card as here shown is not exactly as used at the time the writer was connected with the company but is the improved form we intended to use as soon as our supply of old cards was used up.

The meter card is made in two parts and is printed on both sides. The upper part of Fig. 4 shows the face of the card and the

lower part shows the reverse side. When a test is desired on a meter, or a meter damaged by frost or other agency is to be repaired, the face of the card is filled out in the office and the card given to the shop man, who tests the meter or removes it, as the case may require. On the back of the card the shop man is told the reason for the test, whether new, a routine test as required by the Public Service Commission or a test desired by the consumer because of an excess bill. If all these reasons are crossed out the shop man understands that the meter is to be removed and repaired.

The left-hand part of the face of the card is a standard 3 x 5-in. filing card, and remains in our local office. The stub goes to the general office and gives the information it wants. An ordinary pair of shears or a coupon machine can be used to clip the stub from the card. It was found that this style of card has advantages over a system using two cards or a card and a slip report, for the latter system is cumbersome, and the two parts are likely to become separated and one part lost or overlooked. Where the two parts are attached till the report is completed this cannot happen, and the shop man does most of the work of filling out the blanks, thus saving the office force a lot of work.

The card is either attached to the meter or slipped under the lid while it is being handled in our shop, but is removed when the meter is shipped to the factory.

The cards are filed in the office according to meter number, and for that reason the meter number appears at the top. The folio is the account number in our register. Repair number is a number given consecutively to the repair orders, and is useful in handling repairs, and indicates the number of repairs done in a given time. Date shipped shows when the meter left for the factory, and date accepted indicates when the meter passed our tests after it was repaired. The time that a meter is away at the factory is sometimes interesting information. The charges are those billed by the meter company, and the total charges are those charges plus the freight and local labor charge.

On the back of the card appears the history of the test and the time off for repair. The first test listed is always the unrepaired meter test, unless all the reasons for test are marked out, which would indicate that the meter was damaged and no unrepaired meter test run.

If this matter has been overlooked, the test card described later will give the reason for test. Extra lines are provided in the test-record table for extra tests made on repaired meter when it failed to pass our requirements. The last test shown indicates the test when the meter was finally accepted. All these blanks on the back of the card are filled out by shop men.

The man testing the meter also makes out a test card, shown in Fig. 5. Both the meter card and the test card are original records and are filed in standard filing cabinets. The test card is filed by the page number appearing in the upper right-hand corner. The test number indicates the page and line in the test record where the test can be found. For instance, test number 3062 refers to test page 306, as shown by the figure in the upper right-hand corner of the test card and line 2 as given in the left-hand margin. It would refer to a test on meter 31056 owned by John Smith. The number also indicates that there have been 3062 tests run since the system was started.

Most of the columns in the test record are self-explanatory, but perhaps some of them need a little explanation. Under the column entitled "Reading" appears a division of the test line into two parts. The upper part is labeled "Beginning" and refers to the reading of the meter to be tested before any water is used in testing. The lower part is labeled "Finish" and refers to the reading of the meter after the test is completed. Consumers often complain that water is wasted for them during the test, and if these figures are recorded they are generally satisfied that the amount is insignificant, or if it really does amount to something the amount is exactly known.

Pressure is that shown by the gage while each test is being run and is of value in determining the rate of flow through the orifice and for other obvious reasons. Usually the rate is not calculated and is assumed to be the same as determined at the shop, but the data are furnished so that the rate can be calculated if occasion arises.

Correction of test meter is the amount the test meter has been shown to be fast or slow when tested on the tank in the shop. These corrections should be applied before setting down the percentage fast or slow in the last two columns.

It may be said by some that the system is complicated and asks for too much information, but it calls for information only on points that have arisen in actual practice. Most of the clerical work is done by the field men, and if these men make use of their spare moments it costs no more to get the information complete than it does to get it incomplete. The system is intended to obviate the necessity of duplicating work and records. Of course it would be modified where the meters are repaired by the shop men or where different information is wanted by the main office.

Wire Rope Removes Moss from Lake Water Supply

Reduction in Algæ Growth Is Effected and Screen Washing Is Cut Down—Two Gangs Keep Shallows Near Five-Mile Shore Line Clean

LONG, tangled strands of green moss, which grows prolifically in the shallow portions of Marston Lake, a 6,000,000,000-gal. storage reservoir supplying Denver, are cut loose from the bottom and partly removed by a 1000-ft. length of ⅜-in. wire cable. The portion not dragged to shore by the cable, 50 per cent, floats, and is blown to the shore in a short time.

The water-company engineers have a theory that the more of this moss that can be removed the less trouble they will have with algæ growths. In fact, during the 1916 season, when more care than ever was taken to remove the moss, it was not necessary to give the lake its usual treatment with copper sulphate. This treatment is not given until anabæna reaches 500 standard units per cubic centimeter, or other odor-producing organisms reach corresponding objectionable counts. It has been found that algæ are extremely sensitive to changing conditions, so that it will require several seasons' operation to make sure that the algæ have died out owing to the lack of moss, and not just encountered a natural death. The present high cost of copper sulphate makes the proposition an economical one, to say nothing of the very much improved condition of the shallows near the shore line, which is skirted by

Removing Moss from Denver Water Supply

CENTER—BOAT PAYS OUT CABLE IN A LOOP

LEFT—TWISTING WIRE ROPE PULLS LARGE MASSES ASHORE

RIGHT—CUTTING TWISTED MOSS FREE FROM CABLE AT BLOCK

an automobile road much traveled by consumers. The decaying moss causes trouble in the screens, the washings increasing from 10 to 100 per day. The filters are also clogged unduly, because it is not possible to screen out all of the fibers in the decaying stage.

Six men, one team, and a boat with a reel in the stern form the outfit to cut the moss with the 1000-ft. cable. The procedure is to anchor one end on shore, and, with the rope wound on the reel, to row straight out from shore about 400 ft. and return in a loop to the shore, about 100 ft. away from the starting point. The team is then hitched to one end of the cable and pulls it ashore. For flexibility, a 1½-in. manila rope, 50 ft. long, is attached to each end of the 18-strand wire cable. The cable runs through a large block, which four men anchor to the ground by a bar and rope, to collect the moss at a point about 50 ft. from the water's edge. One man, with a sharp spade, makes a cut along the cable to free it from the moss which is wound around the cable in a thick rope, and gathers other portions at intervals 1 to 2 ft. in diameter. The team makes two pulls of 500 ft. each. There are five swivels in the cable to permit as much twisting as possible, for it is the twisting that increases the amount of moss entangled. Formerly, barbed wire was used, but the team broke it. It was intended to wrap the cable with barbed wire to entangle the moss, but it was not found necessary.

Moss Is Piled

Final disposal of the moss is made by collecting it in large piles about a mile apart. Two wagons and a gang of eight men gather the floating moss and load the piles pulled in by the cable. They wade into the shallows with rakes and pitchforks. The moss is 95 per cent water, and is burned after it dries out. It is not thrown around promiscuously, for it kills vegetation, and the shores above the high-water line are sown to wheat or rye. These cutting and collecting crews work continuously during July and August on about 5 miles of shore line, 1 mile of which is riprapped with stone.

Care of the banks of all the Denver reservoirs above water has received much attention. The steep outsides of fills are covered with alfalfa, which has extremely long roots. The inside slopes are planted to some small grain crop, so that the straw can practically all be removed. Below the high-water line to the existing shore line the area is disk-harrowed at sufficient intervals to keep all vegetation from growing.

The care of the Denver Union Water Company reservoirs is in charge of the engineering department, of which D. G. Thomas is chief engineer.

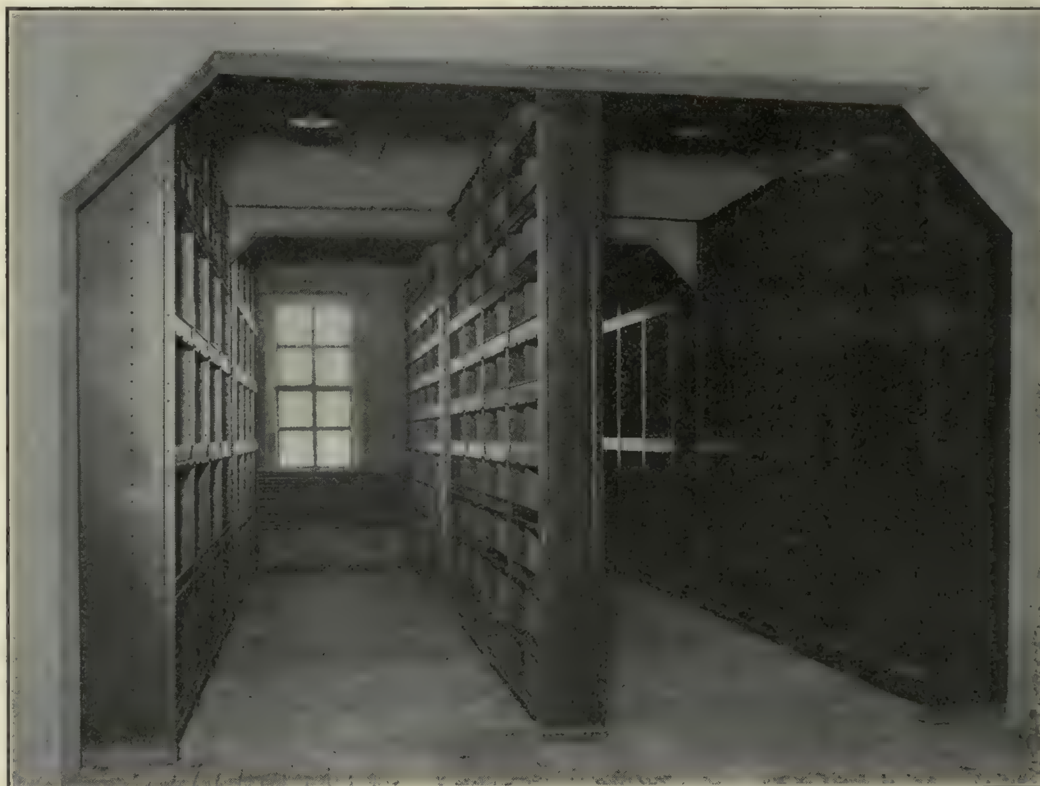
Panama Traffic in Five Months Compares Well with That of 1915

Despite the closing of the Panama Canal from the middle of last September to the middle of April, leaving only five months of operation in the year ended June 30, the net tonnage carried through the canal was 2,479,761, or 64.5 per cent of that of the previous year, according to figures presented in the *Canal Record.* The tolls were $2,399,830.62, as compared with $4,343,383.69 in 1915. The total number of vessels passed were 1088 in 1915 and 787 in 1916.

Blower System Ventilates Railway Blacksmith Shop

Other Features of Bessemer & Lake Erie Shops Include "First-Aid" Room and Two-Story Reinforced-Concrete Storehouse

AMONG the features to which the engineering and motive-power departments of the Bessemer & Lake Erie Railroad call the attention of the visitor to the railroad's main shops at Greenville, Pa.—shops that have mostly grown up in the last ten years—are the blower and exhaust system in the blacksmith shop, as a result of which it is facetiously stated that men go into and not out of the shop for fresh air; a "first-aid" hospital in one of the shop buildings where prompt treatment of injuries saves much lost time and discomfort to the men; and a two-story reinforced-concrete storehouse with an elevator and an orderly system of steel shelving, replacing a one-story frame building such as is found in many a railroad yard.



STEEL SHELVING AND AMPLE WINDOWS MAKE FOR ORDER IN STOREHOUSE

In the blacksmith shop the officials of the company believe they have gone as far in promoting the comfort and efficiency of the workmen as has been done anywhere. Under the floor of the shop are two independent pipe systems for ventilation, a blower system and an exhaust system. In one corner of the shop are the three fans—two blower fans and an exhaust fan. The blower system starts with two 15-in. lines, which branch off and taper down to smaller sizes to reach each machine. The exhaust line reaches a diameter of 36 in. at the fan. A separate blower outlet and exhaust inlet reach each forge, and in addition a blower outlet reaches every other machine. Thus all dust and gases are sucked away from these forges, and are replaced by fresh air.

A plan is maintained showing the exact location and size of every part of the system, and when new machines are placed they are fitted to the system.

Further contributions to the comforts of the workmen are the white paint with which the interior walls of the shop have been coated and the light window shades to shut out the strong sunlight. As a commentary on the cleanliness of the place, it is pointed out that the paint, though not quite so light as when applied eighteen months ago, is still cleaner than would be expected on the exteriors of buildings in that vicinity. The "lace curtains" have also retained most of their freshness.

The first-aid hospital is equipped to minister to the numerous minor injuries that would otherwise send the victims home, and to provide temporary relief to those more seriously injured, who must be taken afterward to the city hospital. A large number of the cases treated are caused by filings or other foreign matter entering the eye, and in these cases, both because the treatment is prompt and because the hospital is specially equipped for such relief, the advantage of the first-aid hospital is apparent.

Only half of the concrete storehouse has been built up to this time. Part of the old frame structure was torn down to make room for it, and when the transfer of stores to the new building has been completed the old storehouse will be used for storing frogs, switches, heavy castings, etc., until some future time when requirements necessitate an extension to the new concrete building.

The new storehouse is something more than a mere shelter from the elements, dark and dingy, expected to take any junk thrown into it. The new building, besides minimizing the fire risk, is designed to facilitate classification as well as storage. A feature is the rows of steel shelves, which, as the photograph shows, are of various sizes, and adjustable. Shelving of this type was thoroughly tested before the equipment for the building was ordered.

As the new storehouse has two floors, a large elevator will handle material. On the second floor is also a commodious lavatory.

These shop improvements have been carried out under the general direction of H. T. Porter, chief engineer, and G. M. Gray, superintendent of motive power.

Local Water Tested by Laboratory on Wheels

Railroad Car Equipped with Chemical and Bacteriological Apparatus to Control Water Supplies

By J. H. O'NEILL
Sanitary Engineer, Louisiana State Board of Health

IN ORDER to increase the efficiency of its control of water supplies and to be able to send a laboratory to any point in the state to aid in fighting epidemics which might occur, the Louisiana State Board of Health has equipped and put into service what is probably the first car of its kind in the country. A railroad car, formerly used as a private car, was purchased and remodeled to a design prepared by the board's president and technical staff. Space is provided for a laboratory for chemical and bacteriological work, a power plant, two toilet rooms with shower baths, one section with four berths, a dark-room for photographic work, two large lockers, office, and garage for a small automobile.

The power plant consists of a two-cylinder gasoline engine direct-connected to a $1\frac{3}{4}$-kw. dynamo, which furnishes current for lights, fans, an electrically heated incubator with electric thermostat control, and an air pump. A 20-gal. gasoline tank is suspended beneath the car. A 3-gal. tank hung on the wall of the lavatory next to the engine room supplies the carbureter of the engine by gravity flow. Gasoline is forced from the storage tank to the small tank by compressed air as needed. A vacuum system was first used to supply the engine directly from the storage tank, but proved unsatisfactory. An electrically driven air pump keeps up pressure in air-storage tanks. The engine room has an exhaust fan in the ceiling.

LABORATORY EQUIPMENT

The bacteriological laboratory is equipped with sterilizers, autoclave, centrifuge, microscope, etc., for the making of media and practically all kinds of bacteriological analyses and diagnostic work. Supplies of antityphoid vaccine and culture tubes for throat swabs are carried.

At present the chemical laboratory is equipped for the analysis of milk and water. An exhaust fan and three ceiling fans provide ventilation. In one corner of the laboratory is a fume chamber with acid-proof light and exhaust fan. Glassware, such as beakers, burettes, pipettes, etc., is carried in racks specially designed for each type and size. Flasks and delicate glassware are carried in compartments lined with cotton batting. Heat for autoclave, stills, etc., is furnished by alcohol stoves of various sizes. The scale beam and pans of the balance are dismounted and carried in racks when the car is moved.

THE REAR END OF THE RAILROAD CAR SERVES AS A GARAGE FOR A SMALL AUTOMOBILE

Three water storage tanks suspended beneath the car have a capacity of 500 gal. Compressed air is used to lift water into the car. The car is equipped with a gravity hot-water system, which comprises a heater, two tanks each of 80 gal. capacity suspended from the ceiling of the engine room, and a circuit supplying laboratory and toilet rooms.

The section containing the berths is for the porters. The laboratory staff and inspectors are provided for by another car.

The dark-room, though small, is fully equipped, one interesting point being that the wash sink is supplied with ice water from a coil in the refrigerator. This is a great convenience when it is necessary to wash films or plates in hot weather.

The office has two bookcases and typewriter desks.

The garage is large enough to carry a small automobile and a motorcycle. These are loaded and unloaded on skids built up of channel irons. Along each side of this room are benches which let down against the wall when not in use. On the wall at one end are two small tables similarly hung. This room is used as a demonstration room or for conferences with local authorities.

The car has recently completed a tour of all the railroad lines in the state. The use of the automobile makes it possible to cover a much larger area and also decrease the number of stops of the car, the usual practice being to collect samples along the shorter branch lines and at places between the stops of the laboratory car.

Follow This Advice in Cold-Weather Concreting

Portland Cement Association Outlines Precautions Which Will Insure Sound Work During Winter Months

TO INSURE the integrity of concrete placed during cold weather the Portland Cement Association, of Chicago, is calling attention to a number of precautions which should be taken by contractors and engineers in charge of winter work. This timely advice will soon be published in pamphlet form by the association. The substance of an advance copy, which will bear the title "How to Do Concrete Work in Cold Weather," follows:

HEAT SAND AND STONE

Concrete work can be carried on successfully in cold weather. All that is necessary is to heat the sand and pebbles or broken stone and mixing water so that the concrete mixture will have a certain minimum temperature, then place the concrete quickly and maintain the heat until early hardening has been completed. This does not mean that there are no limitations to the practicability of doing concrete work in cold weather, but that if a few simple precautions and protective measures are used, winter concrete work will be as successful as that done in warm weather.

Many contractors have found their working season profitably lengthened by using these precautions and protective measures. Men and equipment can be kept employed almost regardless of season. In this way the contractor can keep his efficient organization together. The resulting advantages are far greater than the seeming disadvantages—principal among which is that the application of the necessary precautions slightly increases the cost of cold-weather work. This, however, is usually offset by the builder's willingness to pay for the privilege of having the use of his building

A PRIVATE RAILROAD CAR HAS BEEN CONVERTED INTO A LABORATORY COMPLETELY EQUIPPED WITH CHEMICAL AND BACTERIOLOGICAL APPARATUS FOR MAKING ANALYSES

or structure earlier than would be possible if work were postponed until warm weather.

During the first few days following the placing of concrete, alternate freezing and thawing at comparatively short intervals will damage it. It is necessary, therefore, to mix, place and protect the concrete so that early hardening will be complete before the work is exposed to freezing temperatures. To do this: (1) Sand and pebbles or broken stone used must be free from frost or lumps of frozen material. (2) If these materials contain frost or frozen lumps, thaw them out before using. (3) As cement forms but a relatively small bulk of the materials in any batch of concrete, it need not be heated. (4) Mixing water should always be heated.

DANGER IN SALT

Although adding common salt to mixing water will prevent freezing of concrete that has not hardened, there is a limit to the quantity of salt which may be added if the final strength of the concrete is not to be affected. Salt simply lowers the freezing point of the mixing water; it does not supply what is most needed—heat and warmth. It delays, instead of hastening, the hardening of the concrete. Sand and pebbles or broken stone and mixing water must be heated so that the concrete when placed shall have a temperature of from 75 to 80 deg. Some sands are injured by too much heat. The same applies to certain varieties of pebbles and broken stone. A temperature not exceeding 150 deg. Fahr. will generally prove most satisfactory.

Place concrete immediately after mixing, so that none of the heat will be lost before placing in the forms. Warm the metal forms and reinforcing before placing concrete. Be careful to remove ice and snow and frozen concrete remaining on the forms from preceding work. Forms can be warmed by turning a jet of steam against them or by wetting with hot water.

PROTECT FINISHED WORK

Even though materials have been heated and the concrete placed immediately after mixing, it will lose much of its heat if not protected from low temperatures. Protect the concrete immediately after placing. Canvas covering, sheathing, housing in the work, or hay or straw properly applied will furnish the required protection for some work. In addition to these means, small oil or coke-burning stoves or salamanders may be used in inclosed structures.

Temperatures which may not be low enough to freeze the concrete may, nevertheless, delay its hardening for a considerable time. Do not expect concrete placed when the temperature is low and remains low for some time afterward to be safe for use as soon as that placed during warmer weather. If concreting is unavoidably delayed or interrupted the work should be covered until concreting is resumed. Cover and protect any sections of the work as soon as completed. In severe cold weather continue this protection for at least five days.

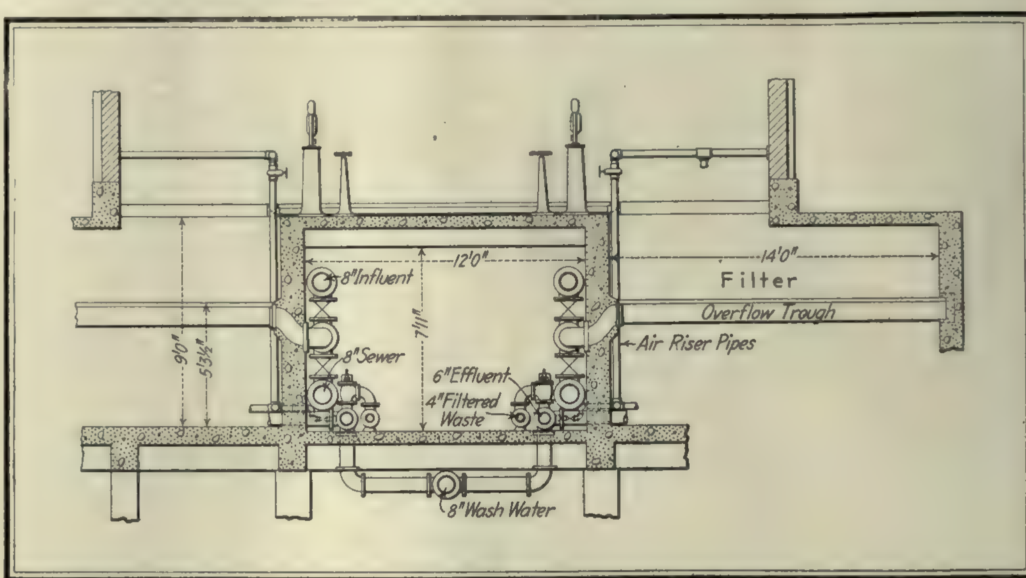
Forms must not be removed from the concrete work too early. This applies to any concrete work, regardless of season, but is particularly important with work done during cold weather. Frozen concrete sometimes very closely resembles concrete that has thoroughly hardened. When frozen concrete is struck with a hammer it will often ring like properly hardened concrete.

Special Devices Installed to Improve Operation of New Mechanical Filters

At Chillicothe, Mo., Chemical Feed for Coagulation Is Automatically Proportioned to Flow—Rate Controllers Regulate According to City's Demand for Water

By E. E. HARPER
Consulting Engineer, Kansas City, Mo.

A CIRCULAR coagulating basin, automatic proportional chemical feed devices, an unobstructed pipe gallery, draft tubes for washwater, supplemental coagulation at each filter unit and rate controllers which regulate the flow automatically in accordance with the demand for water in the city—these are a few of the features at the mechanical filtration plant which has recently been completed for the city of Chillicothe, Mo., which has a population of 10,000 and obtains its supply from the Grand River. The river water is pumped by De Laval centrifugal units a distance of 2 miles to a 1,800,000-gal. rectangular, concrete-lined settling basin, 120 x 200 ft. in plan. Thence it passes through the coagulating basin to the filter.



THE PIPE GALLERY IS DESIGNED TO AFFORD UNOBSTRUCTED PASSAGE

The coagulating basin, of reinforced concrete, is circular, 42 ft. inside diameter, 11 ft. deep, and has side walls 12 in. thick. So far as the writer is aware, this is the first circular coagulating basin built in this part of the country. The baffle walls are also circular, and the whole construction is such that all sharp turns and dead spaces are eliminated, as the raw water, after being treated with the proper dose of coagulant, enters at the center of the basin and flows in an ever-widening circle until it is ready for the filters. A basin of this type costs only about two-thirds as much as a rectangular basin of the same capacity, and is, the writer believes, more efficient.

The mixing chamber is a triangular space in a small compartment in that part of the basin which extends underneath, and is inclosed by, the filter house. Here the raw water is discharged through an orifice plate of such size that 700 gal. per minute produces a jet about 9 in. high, and the chemicals are discharged in a stream at this point and thoroughly mixed with the stream as it falls from the orifice. The treated water then passes a series of wooden baffles and flows through the pipe leading to the center of the basin.

Coagulants, lime and alum are mixed in circular concrete tanks and discharged through chemical feed devices which automatically proportion the flow of coagulants to the amount of raw water pumped to the coagulating basin. Each device consists essentially of a small tank, called the tilting tank, cylindrical in form, about 10 in. in diameter and 15 in. long, open on one side, with closed ends, and fitted to rotate 30 deg. about its major axis and approximate center of gravity. Attached to one side of this tank is a spout or piece of pipe about 18 in. long, the end of which is fitted with an adjustable orifice. This tank is kept filled to a uniform height with the chemical solution, regulated by a float valve, as in the usual type of orifice box.

The tilting tank is actuated by means of a cable fastened to the end of the spout thereon, running over suitable pulleys, and attached to a large float, which in turn is moved up or down by changes in the water level of a small tank that is connected, by means of piping, to the pipe through which raw water is discharged into the coagulating basin. In operation, the coagulant is therefore discharged from the tilting tank, through the orifice on the end of the attached spout, under the same head as the raw water is discharged through its orifice into the coagulating basin. The chemical feed is always in exact proportion to the amount of raw water entering the coagulating basin, and the quantity of water entering the coagulating basin is regulated by the demands of the filters, and is controlled by a float-operated butterfly valve in the coagulating basin.

PIPE GALLERY

The pipe gallery is 12 ft. wide, 8 ft. high in the clear, with the floor on the same level as the bottom of the filters, and the piping is so arranged that there are no pipes overhead or on the bottom of the gallery, where they would interfere with walking. There is a clear space in the center of the pipe gallery 6 ft. wide.

The pipe gallery really contains the most important parts of the filter plant, but as a rule pipe galleries are so arranged that they are hard to get at, poorly lighted and ventilated, and are generally avoided as much as possible when the superintendent is showing visitors around the plant. The writer has always insisted that more attention should be paid to this part of a filter plant, and feels well repaid for the efforts that were made in this case to secure a pipe gallery that would be just as accessible as any other part of the plant, and which would not invite neglect on the part of the operators at the plant.

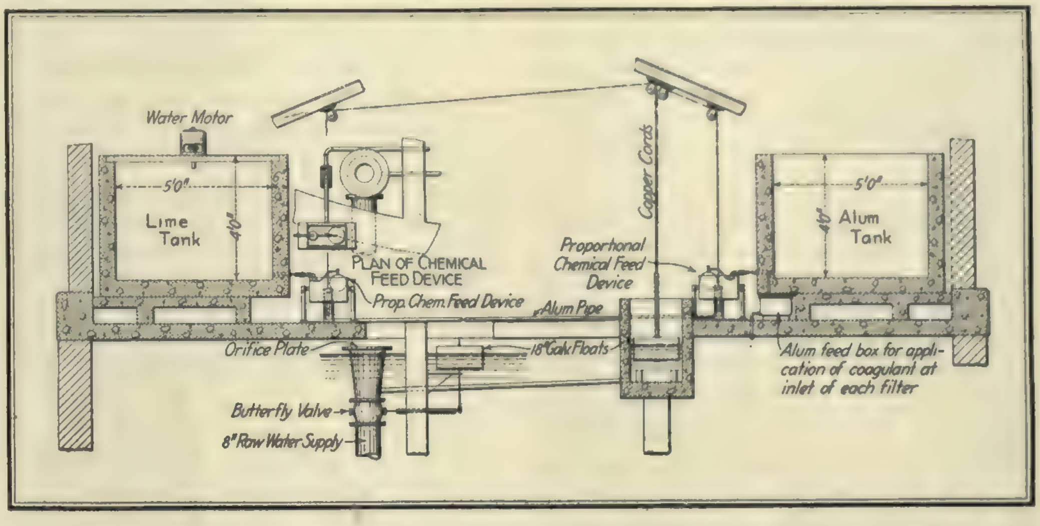
Filter Units

Space is provided for six filter units, each 11 x 14 ft., but only three units have been equipped. As constructed, the weir wall and small compartment usually built in one end of each unit on filters of this size to receive the washwater discharged from the wash troughs were omitted, and the wash troughs were carried the full length of the filter unit. They discharge through special castings set in the front wall of each filter unit and connect to the sewer. This is the first instance in which the writer has used the principle of the draft tube to facilitate the discharge of washwater from the troughs in a filter, but it worked well and has since been used on other plants with equal success.

This form of construction, by which the small compartment at the end of the filter unit was omitted, allowed the capacity of each filter unit to be increased 15 per cent over the usual form of construction without increasing the space required for the filter unit, and the cost of the few extra laterals, strainers, and extra sand was insignificant.

Supplemental Coagulation

To insure a high bacterial efficiency of the filters soon after washing the writer worked out a plan which is very simple, and which he believes will be widely used when the importance of this matter becomes more generally known. No rapid sand filter will give good bacterial efficiency until sufficient coagulant has been deposited on the sand bed to form a good mat, and if the water as it comes to the filter carries sufficient floc to make a good coating in less than an hour, the period between washings of the filter will be too frequent. Very few operators filter to waste for more than 5 minutes, and as a result most filters are operated in such a manner that the bacterial efficiency for the first hour or two after washing, or at least 10 per cent of the time, is very low, and the much-talked-about "98 per cent removal of bacteria," which is the basis of most filter-plant guarantees, is, after all, a delusion.



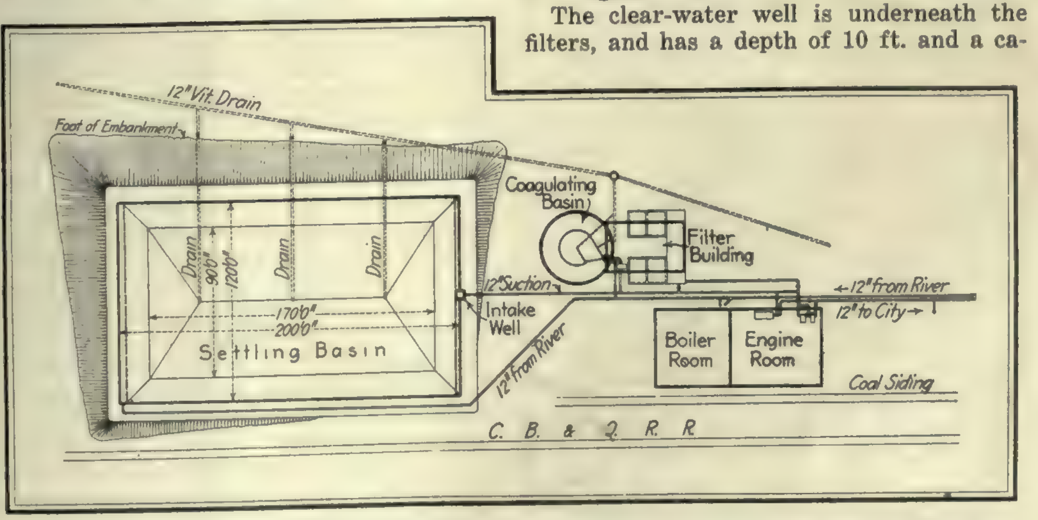
THIS DEVICE, INVOLVING A TILTING TANK AND GALVANIZED FLOATS, REGULATES THE FEED OF COAGULANT IN PROPORTION TO THE FLOW OF WATER

How many companies furnishing filter equipment would be willing to guarantee 98 per cent removal of all harmful bacteria, if the tests were to be made within 1 hour after the filter was washed, and at the same time guarantee such low percentages of washwater as are now guaranteed?

At the Chillicothe plant a small porcelain-lined tank, holding about 5 gal., is placed on the operating floor beside the alum solution tank. It can be filled to a predetermined level by opening a valve on a pipe leading to the alum tank. Leading from this small tank are three lead pipes, with a valve on each pipe, and these pipes are connected into the raw-water inlet to each filter, so that after a filter is washed the raw water for that particular filter can be given an extra dose of coagulant. This is done while the filter is being filled again after being washed, and the raw water and coagulant are thoroughly mixed as they flow into the filter.

The filter is then allowed to stand for a few minutes, during which time the coagulant forms and settles on the sand bed, thus affording ideal conditions under which to begin filtering with high efficiency. The first water is filtered to waste in the usual manner, except that the water thus wasted does not go to the sewer, but flows back to the large settling basin, and is later filtered over again.

The clear-water well is underneath the filters, and has a depth of 10 ft. and a capacity of 100,000 gal. From this well the water is pumped direct to the city by either of two motor-driven centrifugal pumps, located in the engine room in the electric light plant, and operating under a minimum suction lift of 15 ft.



WATER FROM THE GREEN RIVER IS PUMPED TO A SETTLING BASIN AND PASSES THENCE THROUGH A CIRCULAR COAGULATING BASIN TO A FILTER PLANT OF THE MECHANICAL TYPE

The discharge from each filter unit is controlled by a rate controller located in the pipe gallery, but with a handwheel connection extending to the operating floor, so that the rate of flow of each filter can, if desired, be regulated by the attendant from the operating floor.

Under all normal conditions the controllers are set for the normal capacity of each filter, and they automatically maintain this capacity until the filter requires washing, or until the clear-water well is nearly filled with water, when they gradually throttle the discharge of their respective filters, but never shut off the flow completely unless the pumps are shut down, in which event the throttling of each filter is so gradual that the flow is not completely stopped for perhaps an hour.

Prevent Flooding of Pipe Gallery

With these controllers it is impossible to flood the pipe gallery, yet the clear well is always kept well filled with water ready for emergency. In case of fire they can quickly be set to give twice the normal flow, and yet perform all their automatic features.

These controllers operate on the principle of maintaining a constant head of water through a variable orifice, the size of the orifice being regulated by a cone-shaped plug, actuated by a handwheel from the operating floor to change the rate of discharge through the orifice. They have proved to be especially well adapted to the conditions at Chillicothe, where the city uses the direct pressure system, and has several customers who use water in large quantities at irregular periods, for the clear well is always well filled, yet never overflows.

It is the custom in many plants, both large and small, to meet the varying demands for filtered water during the day by shutting down or starting up one or more filter units, and this practice results from the fact that very few filter plants are equipped with controlling devices which will automatically perform this function by varying the rate of all the filters instead of starting or stopping one or more units.

Whenever a filter is shut down, even for a very brief interval, small bubbles of air or gas which tend to collect in the sand

during filtration will rise to the surface, and in so doing they break the mat which has formed on the sand and when the filter is started again the rate of filtration through these broken places is very rapid, and the bacterial efficiency of the filter is very low.

The writer believes that if a filter is kept in continuous operation from the time it is started until it is washed, that the results therefrom will be much better, even if the rate of filtration is very small at times. It does no harm to change the rate of filtration while the filter is in operation, provided that the change is made slowly.

Air and water are used for washing the filters, the air being supplied through a separate system of pipes so that the flow of washwater can be started before the air is turned off. A novel feature in connection with the air wash is that the air is carried to the different filters through a wrought iron pipe, so arranged as to form a hand-rail around the filters.

All loss of head gages, clear well gages, etc., are of the vacuum type, with mercury columns. All valves are hand-operated, and all valve stands are on line, instead of being spotted all over the operating floor.

The plant was designed and installed under the supervision of the writer as consulting engineer. The mechanical equipment was furnished and installed by the Pittsburgh Filter Manufacturing Company of Pittsburgh, Pa.

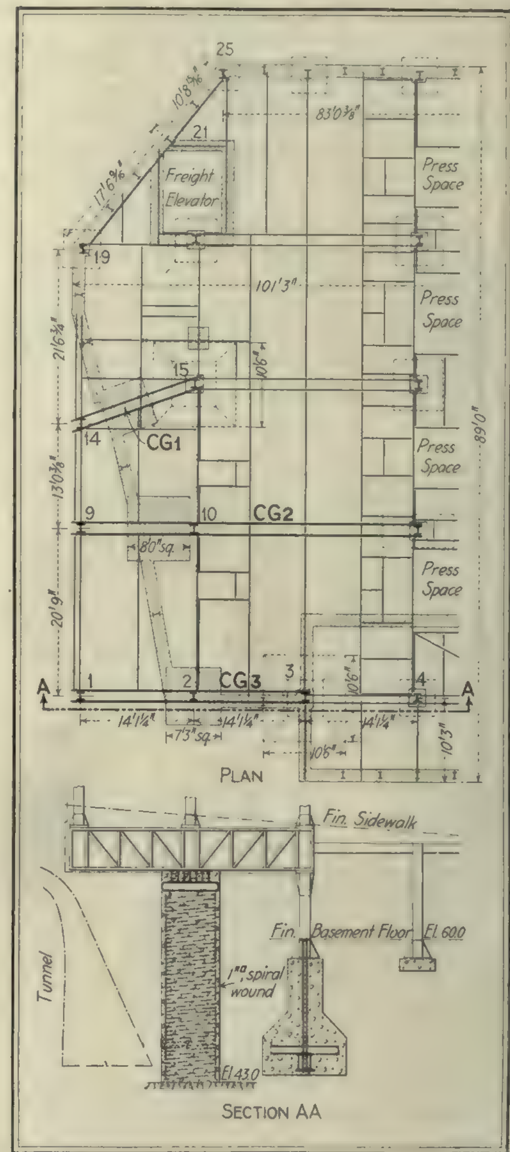
Cantilevers Carry Building Columns Above Tunnel

Foundations of Gazette-Telegraph Building, Pittsburgh, Contain Steel Girders with Diagonal Stiffener Angles

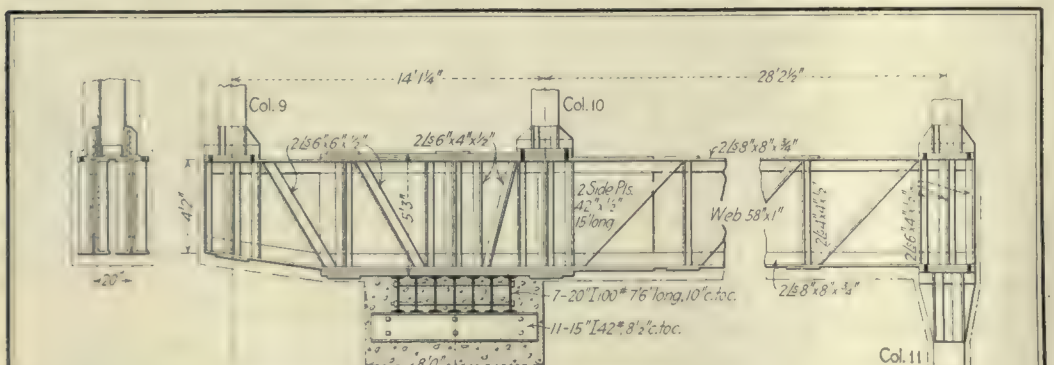
STEEL cantilever girders with diagonal stiffener angles form a special feature in the design of the foundations for the new Gazette-Telegraph Building, Pittsburgh, an eight-story building in course of erection. It was impossible to construct the usual concrete foundations for the columns at one corner of the building, because under this corner passes the large tunnel used by the Panhandle Division of the Pennsylvania Lines West of Pittsburgh. It was therefore necessary to support three outside columns upon cantilever girders. The inner ends carry interior columns, and in two cases are anchored by rods to grillages in the foundation concrete to prevent the possibility of uplift resulting from unbalanced live loadings.

Details of Cantilever Girders

As is indicated on the part plan and section of the basement of the building, three outside columns are carried by double cantilever girders, CG1, CG2 and CG3, the details of which are shown on the other accompanying drawing. Clearance between tunnel and the foundation work of the building was provided by retaining walls of steel and concrete and by the hooped concrete columns, carried down to solid rock, upon which the cantilever girders are supported. The tunnel runs diagonally across the site. The length of the cantilever ends of the girders varies from a maximum of 14 ft. at the corner column to only 6 ft. for the third column along Pentland Street. Diagonal stiffener angles are used to aid in resisting the high diagonal compressive stresses in the webs. The heavy vertical loads are transmitted to the hooped concrete piers by steel I-beam grillages.



PART PLAN AND ELEVATION SHOW LOCATION OF CANTILEVER GIRDERS



DETAILS OF CANTILEVER GIRDERS WITH DIAGONAL STIFFENERS—STEEL ANCHORAGE EMBEDDED IN CONCRETE

Interior Columns Anchored

As the difference in total load on the columns at the two ends of the cantilever girders CG1 and CG3 was relatively small, it was decided to anchor the interior columns in each case by the use of two 2¾-in. rods attached to I-beam grillages in the piers under these columns, these piers being carried down for this purpose to sufficient depth to provide the necessary uplift. Any condition of live load on the outer bays unaccompanied by loads on the interior bays would thus be fully provided for. It was unnecessary to anchor the inner end of the cantilever CG2 because of the unequal lengths of the cantilever and anchor arms, the latter being nearly twice as long as the former.

The building was designed for the architects, Lee & Piper, of Pittsburgh, by C. O. Gilbert, engineer. The steelwork was fabricated by the Fort Pitt Bridge Company of Pittsburgh.

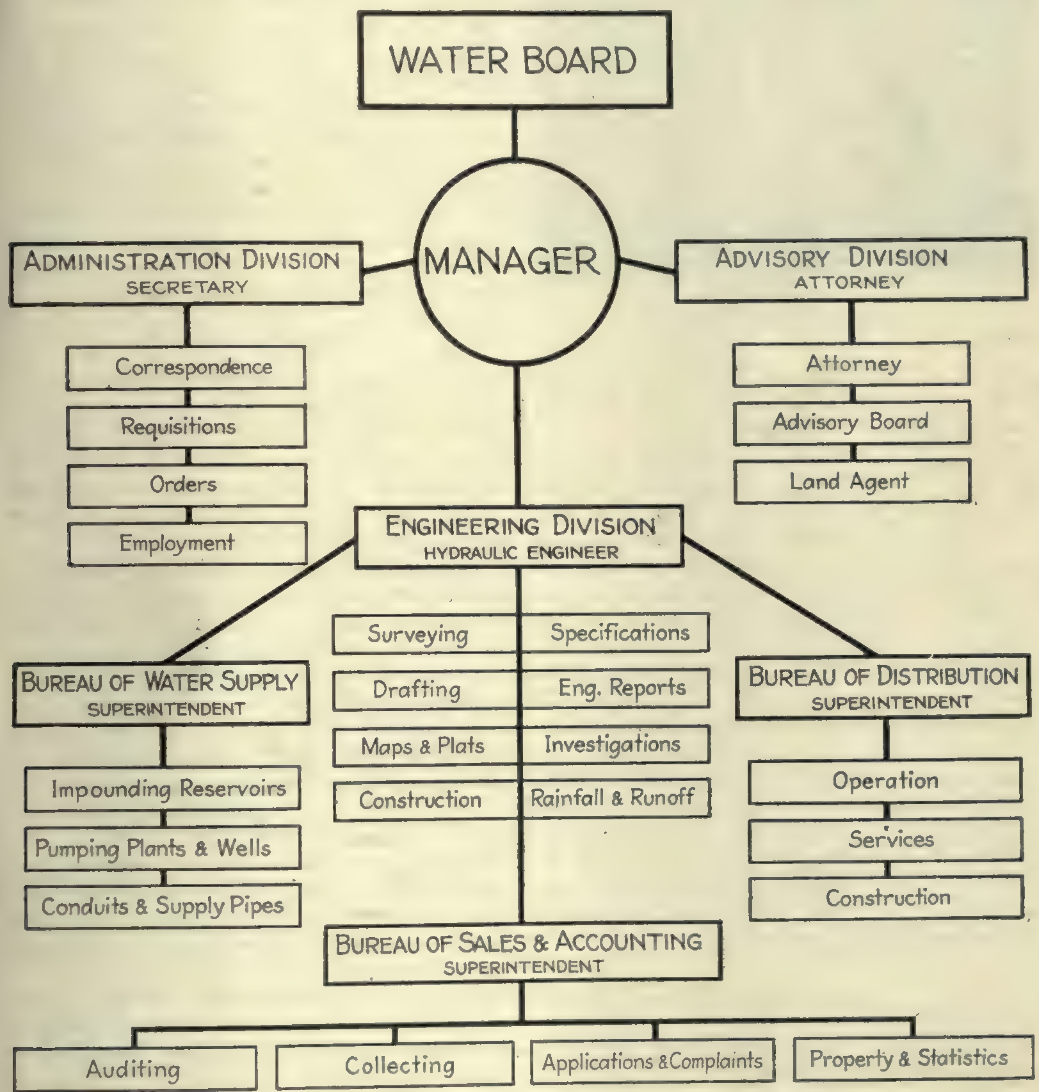
Ideal Organization for Waterworks Described

H. A. Whitney Outlines Scheme for a Department in a City Having 100,000 Population

THE problem of just how to go about organizing a department for handling a newly acquired municipal water system has been faced by many of the rapidly growing cities of the West, and in order to collect some data on the subject and bring out discussion thereon the San Francisco Association of members of the American Society of Civil Engineers assigned this as a paper topic to H. A. Whitney of the hydraulic department of the California Railroad Commission. In his discussion of the subject, from which the following has been taken, Mr. Whitney presented the accompanying diagram to show graphically the general nature and relation of an organization required in a city of 100,000 population.

When the management and operation of a water system come under the control of the city government, provision should first of all be made, said Mr. Whitney, to safeguard from political interference the department which is to handle it. Then to organize the work a governing board, or water board, should be established. This board should consist of three to five citizens, chosen by the mayor and approved by the council, and picked with a view to their breadth of vision and understanding of men. The board should select and appoint a manager for the new department, who must have, in addition to a foreknowledge of such work, resourcefulness in a high degree and initiative and ability.

The water board, according to Mr. Whitney, should hold regular monthly meetings to receive and discuss the report of the manager. In order to facilitate a clear presentation of the status of the work, as well as to control it to better advantage, the manager should arrange to administer the affairs of the department through the three divisions—administration, advisory and engineering—and handle all operating matters through the three bureaus—water supply, sales and accounting, and distribution—as shown in the accompanying diagram. This arrangement is suited particularly to a city of 100,000, Mr. Whitney explained, but the plan may be modified for smaller cities by combining some of the offices and thus reducing the size of staff.



ORGANIZATION DIAGRAM FOR WATER DEPARTMENT IN CITY OF 100,000 POPULATION

Investigate Utilization of Lumber Waste in Wisconsin

The U. S. Forest Products Laboratory at Madison, Wis., according to the National Lumber Manufacturers' Association, is experimenting in converting sawdust and other lumber waste into valuable articles of commerce. The "sawdust laboratory" is working on producing from lumber waste such things as baking powder, artificial silk, binding twine, rope, woven furniture, milk bottles, woven-matting rugs, paper, grain alcohol and several acids. The Forest Products Laboratory is also experimenting in methods of treating wood to make it non-inflammable.

Riparian Rights Settled by Arbitration After Suit

Engineering Board Determines Amount of Damages Sustained by Small Mill Owner Through Loss of Spring Water

By FRANK P. McKIBBEN
Professor of Civil Engineering, Lehigh University

THIS is a case where a mill owner claimed damages because a county, by taking water from a large spring, diminished the water power available for operating his grist mill. The case can be divided into two parts. The first consists of a suit by which the mill owner, in the Court of Common Pleas of Lehigh County, Pennsylvania, established his uninterrupted right to the spring's flow. The second part was an arbitration in which the mill owner claimed and received damages for water taken by the county and in which the amount of damages was fixed by a board of arbitration.

ARBITRATION PROCEEDINGS

Some time after the first suit the mill owner brought another action against the county for damages. Since it was necessary to secure some information regarding the spring, the amount of water consumed by the county and the value of the water power, it was agreed to submit the question to a board of three arbitrators. This board was chosen June 9, 1915, and its report was submitted to the parties concerned July 12, 1915.

The arbitrators determined the capacity of the spring from which the county home is taking water; the amount of water taken from the spring by the county home; the amount of water returned as purified sewage to the stream from the sewage-disposal plant; the loss in water power to which the mill owner is at present subjected, and, finally, the loss in water power to which the mill owner would be subjected and the compensation due him in case the county home were to take all of the flow of the spring and return none of it to the stream.

CAPACITY OF SPRING

Two methods were used for determining the flow of the spring. First, as a small weir had previously been inserted in the overflow of the spring, Ftely and Stearn's formula for the discharge of a weir with a broad crest was applied. This formula is:

$$Q = 2.75bH^{\frac{3}{2}} + 0.007b$$

where Q = discharge in cubic feet per second; b = breadth of weir in feet; H = head on weir in feet. The application of this formula gave a flow of 407,000 gal. per 24 hours. The Francis formula, applicable to weirs with sharp crests, but not suitable in this case, gave 485,000 gal. per 24 hours.

The second method of determining the flow of the spring consists in pumping the water from the reservoir surrounding the spring until the surface of the water is a few inches below the crest of the weir, then by noting the rise in inches of the water in the reservoir, the corresponding time, and by knowing the area of the water surface, the inflow of the spring is determined. This method gave 435,000 gal. per 24 hours.

Taking the average of 407,000 gal. per 24 hours as determined by Ftely and Stearn's formula, and 435,000 gal. per 24 hours as determined by the rise of the water in the spring, the average flow of the

spring is found to be 421,000 gal. per 24 hours.

Determining Amount of Water Pumped from Spring

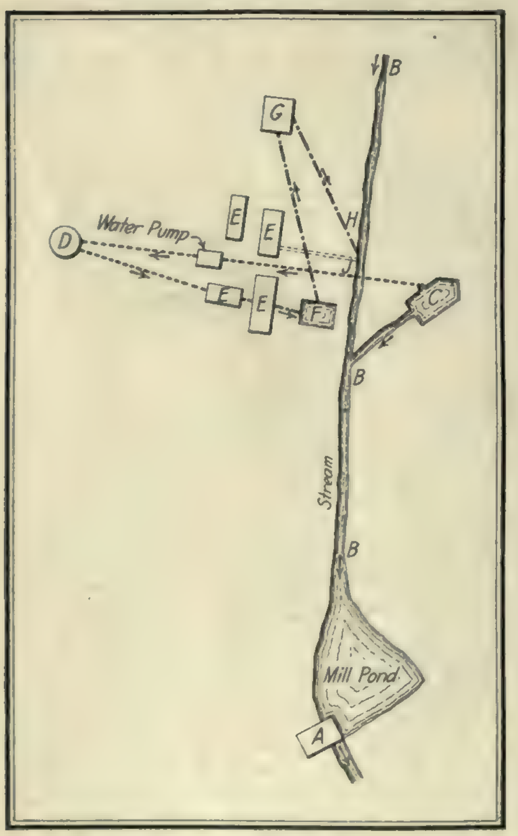
The amount of water pumped from the spring was determined in two ways—first, by computing the discharge from the pump, making a reasonable allowance for slippage, and, second, by determining the amount of water flowing from a tank to the buildings, the elevation of the surface of the water in the tank being determined by direct measurements. By these methods it was found that 84,000 gal. per 24 hours was pumped from the spring and supplied to the institution. Clearly, not all of this water was consumed, because a very large part of it was returned to the stream and, after being purified, reached the mill.

The amount of sewage reaching the sewage well, and thence pumped to the filtration plant, from which it was returned to the stream above the mill, was determined by measurement at the sewage well; and while this could not be determined exactly, the amount of 67,500 gal. per 24 hours is sufficiently accurate.

The total flow of the spring, 421,000 gal. per 24 hours, reduced to power at the mill amounts to 1.3 hp.

Summary of Results

From the foregoing it appears that the flow of the spring is 421,000 gal. per 24 hours; that the amount of water pumped by the county home from the spring is 84,000 gal. per 24 hours, or one-fifth of the spring's daily flow; that of the 84,000 gal. pumped daily from the spring, 67,500 gal. are purified and returned to the stream every 24 hours, leaving a net amount of water removed by the county home of 16,500 gal. per 24 hours, or approximately one-twenty-fifth of the daily flow of the spring; that if the county were to take



RELATION OF SPRING TO PUMP

A, grist mill; *B*, stream; *C*, spring; *D*, tank; *E*, buildings of the Lehigh County Home; *F*, sewage well; *G*, purification plant; *H*, brook; *I*, concrete conduit, which empties into brook at *J*.

FORMS FOR JOIST AND SLAB FLOOR

421,000 gal. per day, all of the spring's flow, and return none of it to the stream, the mill owner would lose 1.3 hp.

The question involved, therefore, is simply this: If the county should take the entire flow of the spring, thus depriving the mill owner of 1.3 hp., what is the cost to the mill owner of producing the equivalent of the 1.3 hp. of which he would be deprived by the county? This loss in water power must needs be made up by the mill owner by means of an auxiliary gas engine operated with producer gas. Taking a unit cost of $55 per horsepower per year, the cost to the mill owner would be $71.50 per year to produce this 1.3 hp. If the county should purchase the right to the entire flow of the spring it should pay the mill owner a sum of money which, if capitalized at 5½ per cent, would produce for him an income of $71.50 per year. Approximately the sum of $1,300 would be required to do this.

The unit cost per horsepower-year of $55 was intended to include the interest on investment, depreciation charges, repairs, insurance, cost of labor and cost of fuel or its equivalent.

Settlement Made

The board of arbitrators therefore recommended that, as the county home will continue to increase in size and will have need for more water as time goes on, the county purchase the right to use and consume the entire flow of the spring, paying the mill owner $1,300 therefor, in return for which the mill owner relinquishes all rights to the spring, thus enabling the county to divert and consume any part or all of the spring's flow, as the county's requirements may demand. A settlement was finally made by the payment of $2,500 to the mill owner.

This case, although involving small values, is of interest not only because it is so typical of many actions based on the law of riparian rights, but also because of the recognition that it is largely an engineering problem.

The arbitration board consisted of Freeman Hawk, Milton U. Reinhard and the writer, all of whom are citizens of Lehigh County.

Slab-and-Beam Floor Without Shear Stirrups

Building for Firestone Tire Company Contains Flared Joists and Shallow Drop Beams of Special Construction—Economy Claimed

By J. H. BYRD
Structural Engineer, Smith, Rea & Lovitt, Kansas City, Mo.

SPECIAL REQUIREMENTS for clear headroom, lighting facilities, appearance, and placing of future partitions led to the adoption of shallow reinforced-concrete joist-and-beam design for the floor of the Firestone Tire & Rubber Company, Kansas City, Mo. The unusual floor details here illustrated include the flared sides for the joists and drop beams at the columns to furnish greater shear resistance and avoid the use of shear stirrups for economy, and heavy T-beams only 15 in. deep carrying the joist loads to the columns. This design is claimed to be more economical than a flat slab designed according to the Chicago building ordinance.

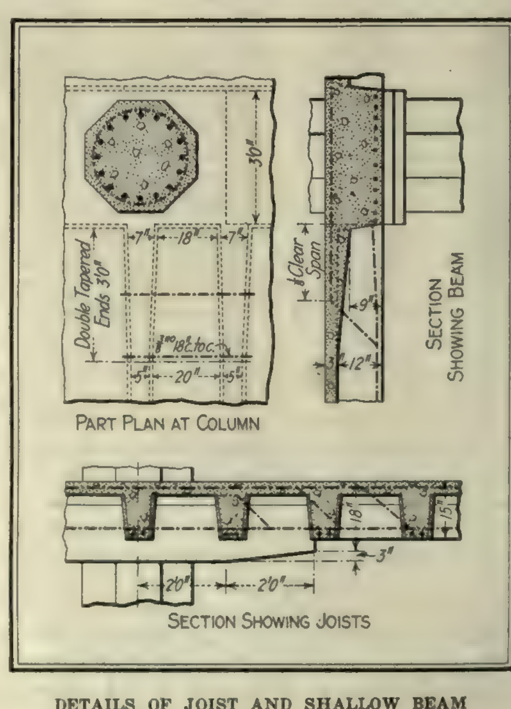
General Features

The building is 74 x 116 ft. in plan, eight stories high, with basement, and a concrete tower 40 ft. above the roof. A clear height from floor to ceiling of 12 ft. was required by the owners. The foundations are caissons built to solid rock 30 ft. below the basement floor.

For various reasons, such as headroom, lighting, appearance, and placing of future partitions, some sort of flat-slab design was desirable; but the required openings for elevators and stairs to a large extent made impracticable the use of the standard flat-slab design. The ceilings for any design had to be suspended metal lath, to hide the steam, sprinkler and plumbing pipes.

Comparative Designs Made

An assumed live load of 200 lb. per square foot was adopted, with 20 per cent deducted for the beam loading and the usual amounts for the columns at the various stories. Several arrangements of beams and slabs were tried for the panels of 24 ft. 6 in. to compare with the adopted design of joists on about 2-ft. centers with shallow end girders as shown in the accom-



DETAILS OF JOIST AND SHALLOW BEAM

panying drawing. All were found to be more expensive, owing to the increased yardage of concrete and the cost of forms for beams.

Features of Adopted Design

A typical wall panel of the adopted beam-and-joist design, including all concrete and steel except the column shaft within the area of 24 ft. 6 in. square, weighs 100 lb. per square foot and contains 0.025 cu. yd. of concrete and 5 lb. of reinforcing bars per square foot of floor area. Comparing this with the flat slab or mushroom system, designed according to the Chicago building ordinance, the slab would be 9½ in. thick with a 4-in. drop panel 10 x 10 ft. at the columns with flared heads. The units per square foot were: Weight, 135 lb.; concrete, 0.034 cu. yd.; reinforcing bars, 4.5 lb.

For the adopted design, the usual bending-moment factors were applied, all joist and beams being considered fixed at the end, and the clear span being used. The joists were tapered or flared at the ends for a length of 36 in., as shown, and no shear stirrups were used. The end beams between the columns were also flared downward to allow the T-beam action gradually to develop without producing excessive horizontal shear.

Design of Shallow Beams

How much T-beam action is developed for these shallow beams is difficult to determine. In this case the flange was assumed to be 108 in. in width at the end of the flared beam, counting 36 in. width of slab tapered as shown on each side of the stem, which is 36 in. wide. The total depth is only 15 in. from the top of the rough concrete to the bottom of the beam.

With these assumptions the factors kd and jd were obtained and the proper reinforcement provided, the rods being spaced 3 in. apart on centers. For negative moment over the columns sufficient compressive resistance was obtained by the additional depth of the beam and the use of the straight bars in compression. No shear bars were used, the bending up of the main reinforcing providing the necessary shear reinforcement, as shown in the detail drawing.

Test Load Applied

A test load was applied to the third floor on March 27 at the age of 91 days, sand being placed in 1-ft. layers and deflection readings taken after each foot of sand was in place. The loading was thus carried to a depth of 4 ft., or 400 lb. per square foot. The maximum center deflection under this load was 9/32 in. with a permanent deflection of 1/32 in. in one panel only after the load was removed. No shear cracks appeared in joist or beam, water being applied and a magnifying glass used for inspection.

The adopted design was economical in form lumber, on account of the similarity of the floors and the use of 2-in. lumber, securely cleated, for soffits, and 2 x 6-in. pieces for the joist soffits, making all floor forms easily removable, to be used again on the floors above.

Smith, Rea & Lovitt, of Kansas City, Mo., were the architects, and the author, associated with this firm as structural engineer, designed the building. The Swenson Construction Company, of the same city, was the contractor.

Steel Cofferdam of Pocket Type Successful for Lock on Cape Fear River

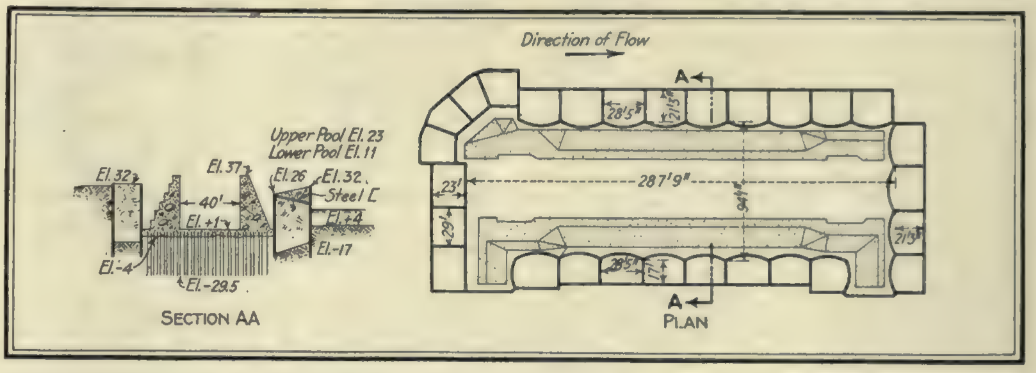
Horizontal Channel Ties Bolted to Cross-Wall Sheeting Overloaded at One Point—Long Sheeting for Outside, Shorter for Inside Walls

GOVERNMENT lock No. 2 on the Cape Fear River, 72 miles above Wilmington, N. C., has been built inside a steel pocket cofferdam designed to withstand a 30-ft. head. To the web walls of these pockets were bolted steel channels, inclined slightly away from the inside, which were designed to prevent the web-wall piling from leaning by slipping of the interlocks and to make the pockets resist pressure as a unit. These ties failed on one point on the land side, before the coffer was pumped out, by shearing of the bolts, but movement of the wall was successfully stopped by wire-rope anchorages and by relieving the earth and water pressure behind it. A type of land driver with two-way motion, carrying the hammer in a cage in front of the leads, used successfully on the work will be described in a later issue.

tempt pumping. As the concrete lock floor was laid before pumping out, the inclosure had a total depth of 31 ft.

For this construction piles 49 ft. in length were required for the outside wall. All the piling in the land wall was of this length, but that used for the side of the river wall next the inclosure was 6 ft. shorter. By sloping the tops of the pockets in this manner the dredge operating inside the inclosure at low-water stages was enabled to fill them much more readily. All of the piles in the inner walls were spliced just above the elevation of the lock floor, the lower sections remaining in place as part of the permanent construction.

The steel for the land wall was driven well back in the river bank where the ground surface was as high as the top of the sheeting. Consequently, these pockets



INSIDE SHEETING OF RIVER POCKETS LOWER TO ALLOW EASY FILLING

The lock will have a 12-ft. lift. Together with the 8-ft. lift provided by lock No. 1, 39 miles above Wilmington, and the dredging work being carried on by the government, this dam will provide an 8-ft. navigable channel to Fayetteville, N. C., a distance of 115 miles. The entire project, which is nearing completion, will cost about $1,000,000.

Two Types of Pockets Employed

From the accompanying drawing showing the general arrangement of the cofferdam it will be seen that two types of pocket were used. Those at the upper end of the dam had parallel inside and outside walls tied together by steel cables and rods fastened to walings. The other pockets were without ties, the inside wall being curved to reduce distortion in the steel piling from the weight of the fill. Two single-wall panels were required in the upper and lower wings, which were held by cables to wooden pile anchorages. Because of its greater transverse strength, Lackawanna arch-web piling was used in the straight wall pockets and on the outside of the river pockets. The remainder of the sheeting was the straight-web type. The total length of cofferdam was 878 ft.

Profiting by experience gained at the first lock, the top of the steel was carried to an elevation 23.4 ft. above the mean low-water level existing before a pool was created by the completion of the lower dam. This elevation, about 28 ft. above the river bed, provided against all except maximum floods, during which it was not desirable to at-

required no filling. The flat on which the tracks for the land drivers was laid was excavated out of the bank. Piles were delivered to the drivers from stock piles by hand cars running on a track in front of the machines. Jets at 75 and 80 lb. pressure were freely used both in the land and the river driving. The penetration of the piles in the land walls varied from 39 to 48 ft. in clay, clay and sand, and marl. Driving to grade was difficult, and in several instances of absolute refusal the tops of the piles were cut off with an oxy-acetylene flame to permit the drivers to proceed. While the land driving was under way, sufficient dredging was done at the upper and lower ends to enable a floating driver to continue the coffer walls out into the river.

As the penetration in the river was only 18 to 21 ft., the two floating drivers were able to place an average of 37½ piles per 16-hour day, as compared to 34½ piles driven by the same single-action steam hammers when used on the land rigs.

The curved panels of the river wall were driven to a template floating on the convex side, which was held in place by adjustable bracing to wood guide piles located inside the cofferdam in line with the cross-walls. The closures of all the pockets were made by the larger steam hammer. Its ram weighed 3000 lb. as compared with 1800 lb. for the other hammer. It was found difficult to keep the piling vertical, as a leaning tendency frequently developed in the direction of driving. In four instances, especially fabricated, wedge-shaped

piles had to be used for making a closure. All of the pockets were closed on the outside wall. Driving was carried on alternately on the rear and cross-walls of a pocket until only the four piles nearest a corner remained. These last four piles were then entered at once and driven successively a few feet at a time to grade.

Diagonal Wales Fail in Four Pockets

Diagonal steel channel walings were bolted to all the cross-walls. The holes for the bolts were burned in the piling after driving with an oxyacetylene flame. These wales were designed to prevent the sliding of one interlock on another, due to the overturning moment on the pockets. In this they were successful except at four of the pockets near the upstream end of the land wall. Although the earth back of these pockets had not been disturbed in any way and was not surcharged, as dredging proceeded in front of them they began to lean toward the excavation. The maximum movement at the top amounted to 7 ft. 6 in., and an examination of the walings on the cross-walls of these pockets showed that all of the fastening bolts had sheared off. As it was not practicable to put enough bolts in the waling to withstand the stress, the pressure was partly relieved by excavation and drainage of the soil back of the pockets, and further movement prevented by anchoring them to trees by means of heavy wire cables. This solution of the difficulty proved satisfactory, and no further movement was detected even when the cofferdam was pumped out. At the lower end of the land wall no similar movement occurred, although there were 2500 wooden piles stacked immediately back of the steel at this point.

A gap was left at the lower end of the cofferdam for the passage of the dredge and a floating driver. The inclosure was excavated by the U. S. engineer dredge "Ajax" with a 5-yd. clamshell bucket. About half of the sand and clay removed was used to fill the pockets of the cofferdam at an average cost of 26½ cents per cubic yard. However, considerable material next the steel sheeting could not be touched by this bucket, and had to be loosened by jetting and removed with a ½-yd. orange-peel bucket. A small shelf of marl encountered in the lower wing also required some blasting. Further, the shoaling of the bottom during pile driving exceeded expectations, and additional dredging by siphon in a considerable area where piles had been driven was necessary. These operations increased the total unit cost of the material removed to 46½ cents per yard.

LAND WALL COMPLETED AND TWO DRIVERS AT WORK ON RIVER POCKETS

After all the foundation piles had been driven with the floating drivers, the gap left at the lower end of the cofferdam was closed and the bottom sealed with a 5-ft. layer of concrete deposited through a tremie. After this concrete had set a month, the cofferdam was unwatered with a 12-in. centrifugal pump mounted on a raft. After the raft had grounded, unwatering was finished with a 10-in. submerged centrifugal pump. The pumping was purposely extended over two days in order to watch the behavior of the cofferdam walls. The only movement detected, however, was the slight inclination of the river wall, which brought its top 1½ in. in toward the lock pit. The maximum head under which work was carried on in the cofferdam was 26 ft., and leakage at ordinary stages of the river amounted to about 200 gal. per minute. A 24-in. pipe through one of the pockets 12 ft. below the top of the dam was provided for flooding. It was fitted with a gate valve.

Costs for Driving Summarized

The unit costs of the different operations in constructing the cofferdam are summarized in the accompanying table. They include payroll, supplies and a charge for repairs to the plant employed.

COST OF DRIVING STEEL SHEETING

	Per Pile	Per Ton	Per Lin. Ft.
Driving land piling	$5.18	$5.77	....
Driving river piling	2.28	2.53	....
Driving piling, average	3.36	3.75	....
Splicing piles	.47	....	....
Handling piles	.30	....	....
Placing wales	....	....	$0.79
Driving wood anchor piles	4.57	....	....

In addition, it cost $29.45 each to install the tie cables. As 17.7 per cent of the total tonnage of steel in the cofferdam became a part of the permanent structure, the cost of driving chargeable to the cofferdam given above should be reduced by this amount.

The construction work was carried on by government forces with government plant under the general supervision of Capt. C. S. Ridley, Corps of Engineers, U. S. Army. Norman M. Chivers was assistant engineer in charge of the work at lock No 2.

POCKETS AT UPPER END OF LEFT WALL LEANED DURING DREDGING

Railroads Burn 24 Per Cent of Coal

Figures given out recently by the U. S. Geological Survey show that the railroads of the United States last year consumed 24 per cent of the country's total coal production. Practically all of the 600,000 tons of anthracite and 62,700,000 tons of the 128,200,000 tons of soft coal consumed by railroads were burned in the Eastern district. Railroads of the Western district burned 43,500,000 tons, and those of the Southern district 22,000,000 tons.

Reinforced-Concrete Arch Has Masonry Facing

Eagle Creek Spanned Near Portland, Ore., by Structure in Harmony with Surroundings —Details for Tying Masonry to Concrete

A COMBINATION arch bridge of reinforced-concrete ribs with spandrel columns and a rubble-masonry facing and abutment walls was found more economical than an all-stone arch at the given site for an ornamental structure crossing Eagle Creek in the Northwest. The design and the details used to tie the face wall of masonry to the concrete ribs and columns illustrated herewith indicate an effective solution of a common problem.

The Eagle Creek bridge in Multnomah County near Portland, Ore., consists of a 60-ft. semicircular arch span of three concrete ribs, the foundations of which are cemented gravel. The 20-ft. roadway is carried on spandrel columns carrying beams of 10-ft. spans. A 12-in. random rubble wall set in cement mortar carried on a stone arch ring conceals the concrete work, producing the effect of a stone arch bridge. The curved abutment walls are of dry masonry, having a face batter of 1:4.

ARCHED STONE HANDRAIL AND RUBBLE FACING IMPROVE APPEARANCE OF ARCH BRIDGE

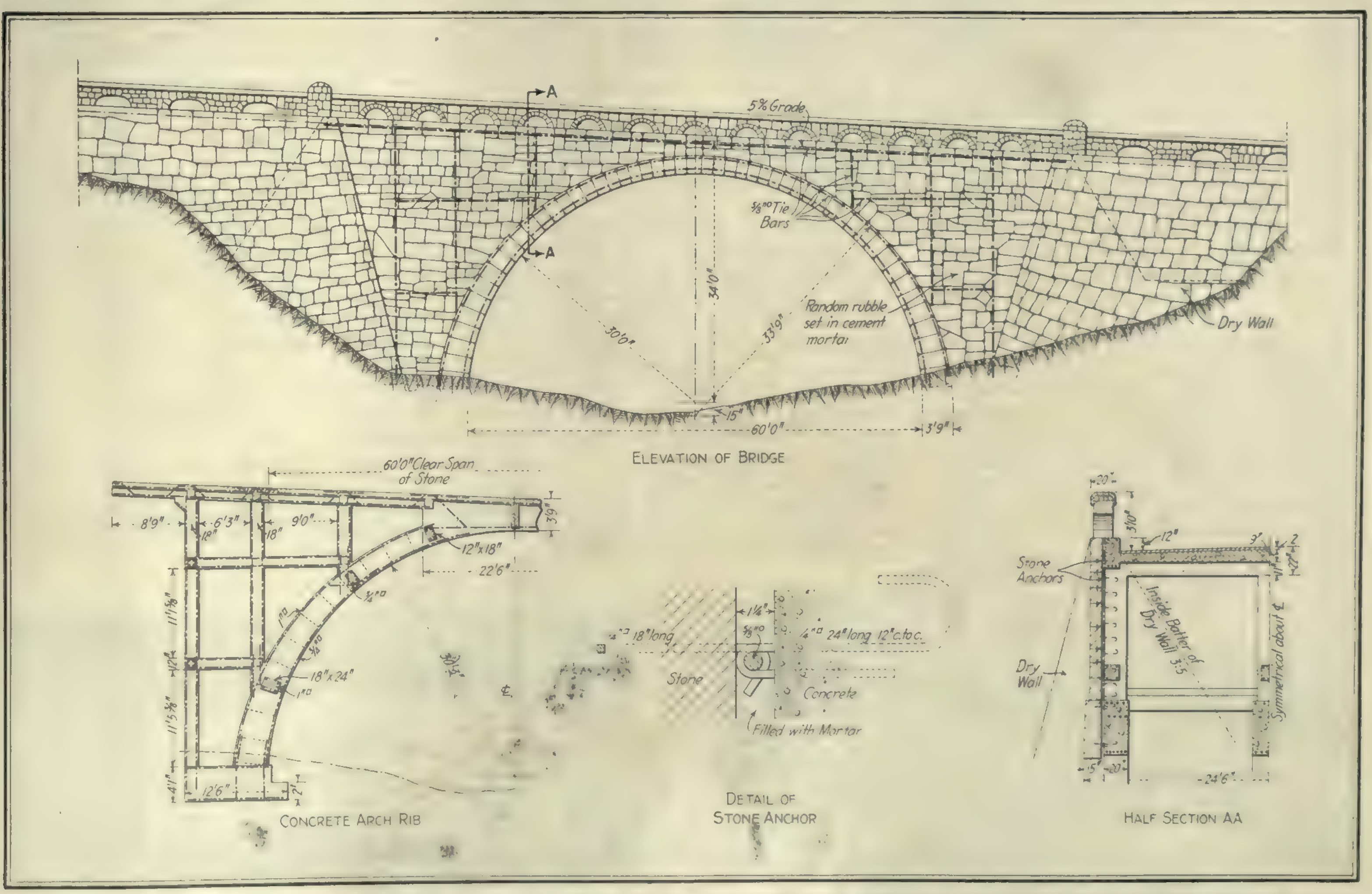
Masonry Tied to Arch Rings

The masonry arch rings were tied to the outside concrete rib, spandrel columns and struts by means of hooks of ¼-in. square deformed bars, buried in the mortar joints. Steel rods ⅜ in. square were embedded in the concrete rib, allowing a loop to extend beyond the face of rib. Through these loops ⅝-in. round bars were threaded. The masonry bars were hooked around the ⅝-in. round rod and buried in the masonry joints, as indicated on the detail in the drawing. By the same method the masonry spandrel walls were attached to the concrete spandrel columns and struts. A 1¼-in. space was left between the concrete rib and spandrel wall, to be filled with mortar as the work progressed.

Design of Arch Ring

The stone arch ring was designed as carrying the weight of the stone spandrel wall. The entire live load was assumed to be carried by the concrete structure. The bridge is designed to carry two 20-ton trucks in line, with an impact added of $L^2/2\ (L + D)$, where L and D are the dead and the live load respectively.

The combination of concrete and stone was found more economical than a stone arch, owing to the high cost of suitable rock at the bridge site. The cost of the bridge complete was $10,000. It was designed under the direction of C. H. Purcell, bridge engineer. The structure was built by county forces. Herbert Nunn was county highway engineer and J. B. Yeon roadmaster.



SECTIONS AND ELEVATION OF REINFORCED-CONCRETE ARCH WITH SPANDREL COLUMNS—DETAILS OF CONNECTIONS TO MASONRY FACING

Construct Dams by Hydraulic Method with Minimum of Cost, Labor and Equipment

Mine Tailings Stored in Arizona Behind Dams Built of the Same Material After Separating Heavier from Lighter by Flume Perforations

By CYRIL WIGMORE

ARIZONA law requires that tailings from mills shall not be allowed to enter running streams which might convey them to agricultural lands in the valleys below. For this reason mining companies have been obliged to find some means of impounding the great quantities of tailings which the mills produce and which would ordinarily be carried by drainage or mill-sluicing waters down the steep slopes and into the streams. This has resulted in the construction of dams by a hydraulic process with a minimum of cost, labor and equipment.

Mill 6 of the Arizona Copper Company is situated near Morenci, at an elevation of 5000 ft. It originally had a capacity of 2000 tons per day, which has since been increased to 3500 tons. After the ore is crushed it is passed in its final state through 1½-mm. screens, resulting in a product of which 40 per cent passes a 200-mesh screen. The average production of tailings from this mill amounts to about 1500 tons per day, and the disposition of this waste product has been the subject of careful study on the part of engineers retained by the company.

Sufficient Storage Not Available

This mill is so situated that storage of sufficient extent is not available in the narrow cañon immediately below it, the nearest suitable location being about 3½ miles below where the general contour of the hills flattens to sloping mesas with a broad main cañon and several tributaries of slight grade and considerable breadth. On account of the floods during the rainy season the main cañon was considered a difficult place to impound tailings. However, the first storage for tailings was provided by a dam constructed across the main cañon about 1200 ft. in length and equipped with a timber wasteway and tunnel for the purpose of carrying off the settled waters and the runoff from the drainage basin located above.

This dam was an earthfill built up with scrapers and provided with a hydraulic-fill core. The height was approximately 50 ft. and the basin back of it was completely filled with tailings, about 250,000 tons being impounded. The cost of placing the earthfill with teams and scrapers, however, was excessive and figured out to be approximately 6 cents per ton of tailings impounded. It was, therefore, deemed necessary to devise some other, less expensive, scheme for disposing of the tailings.

Planning the Tailings Dam

After a series of experiments carried on in 1907 and 1908 a plan was devised for using the coarse sandy portion of the tailings to build up a hydraulic-fill dam, while the finer material was held back from the face of the dam itself for a considerable distance upstream. A site was selected in one of the branch cañons which would hold approximately 6,000,000 tons of solids when filled to the height which the low hill on both sides of the cañon fixed as a storage limit. In making this calculation, 1 ton of tailings deposited under water was taken as the equivalent of approximately 20 cu. ft. in volume.

At the site selected for the dam an 8-in. wood-stave pipe was laid along the axis of the cañon from a point below the downstream toe, extending upstream approximately 4000 ft. At intervals of 300 or 400 ft. in this pipe tees were placed with a nipple, elbow and length of pipe standing vertically, the nipple fitting loosely in the tee so that the pipe could be swung in a vertical arc. By this means the entrance to the pipe could be kept at the reservoir level and would draw off only the clear surface water. At the lower end of this pipe line, below the toe of the dam, pumps were installed which returned the clear water to the mill to be used over again.

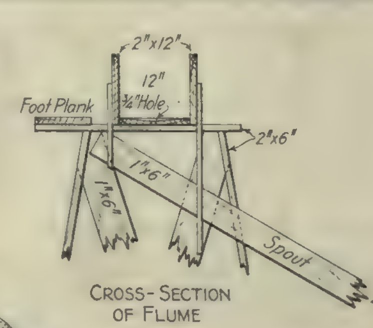
The surface of the ground at the dam site consisted of soil and detritus carried down from the mountains. Nothing was done to prepare the surface for the dam except to scrape up a dike about 6 ft. high along the downstream toe. This dike was to prevent tailings from washing away until the scheme of construction could be put into effect. The flume itself was set back about 20 ft. from this dike.

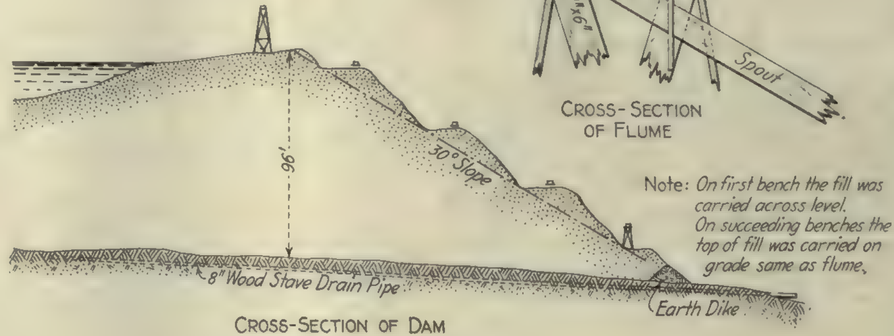
First Installation

The first installation at the dam site consisted of a 10 x 12-in. flume made of 2 x 12-in. plank supported on bents 12 ft. apart. The bents were constructed of 2 x 6-in. lumber with legs supported on small footboards and with 1 x 6-in. diagonal bracing. The flume was approximately 1000 ft. in length and was built on a 2 per cent grade, which made the center bent of the flume about 24 ft. in height.

In the bottom of the flume ¾-in. holes were bored every 4 ft. and beneath these were fastened short troughs or spouts made of two pieces of 1 x 6-in. lumber 6 to 8 ft. in length. These spouts pointed down the cañon and were given a pitch from the horizontal of from 30 to 60 deg., which was varied as required. The coarse sands, being heavier than the finer material carried in suspension, traveled along the bottom of the flume and poured through the small holes in steady streams without permitting the escape of much water. This coarse material rapidly piled up beneath the spouts, and from these piles it was shoveled up by hand in a continuation of the dike which at first marked the downstream toe of the fill.

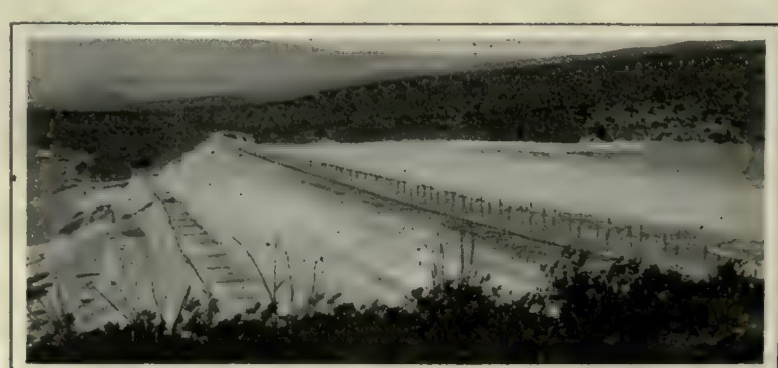
The percentage of coarse sand carried determined the number of small holes that would be kept open. If this percentage were low, only a short section of the flume was used, the remaining holes being





CROSS-SECTIONS OF DAM AND FLUME, LATTER SHOWING DISCHARGE HOLE AND SPOUT

SPOUTS IN SERVICE ON 1000-FOOT FLUME



GENERAL VIEW OF ONE OF THE MINE-TAILING DAMS

plugged. In short, the number of holes opened was that number which would be provided with a steady flow of sand by the grade of material being handled. In order to increase the height of the dam uniformly throughout its length, successive sections of the flume were used in rotation.

At first small pipes about 3 in. in diameter were placed through the earth dike to carry off the excess water and prevent the washing away of the material, but the hydraulic fill was found to build up very rapidly, and by keeping the dike a foot or two higher than the depositing material the fill was found to assume a grade of about 7 per cent on the upstream side. This flat slope resulted from the incoming water and fine material impounded behind the coarse fill. It is notable that the water drained from the coarser material with great rapidity, and it was possible to walk over it almost immediately. In a few hours there was no water visible in the higher portions of the slope. It was observed that the fill settled very slightly on account of the solidity with which the material packed down as it fell from the flume. The filling of the cañon required the use of three dams, all of which were built in the same manner.

Construction Force and Methods

One laborer per 8-hour shift was found to be enough to keep the dike shoveled up along the crest of the downstream slope. It was intended to keep the incline of this slope at about 30 deg., but it was found that the sand shoveled up by hand assumed a slope of about 45 deg., and this was allowed to govern. The fill was continued on each stage until the material reached the bottom of the flume and necessitated its removal to a new position. When the flume was moved it was set back upstream a sufficient distance to bring the general slope of the downstream face to about 30 deg., as shown in the accompanying drawing. In moving the flume, bents which could be easily pulled were taken out and used again, the others being abandoned. It was found that the loss of lumber involved was very slight.

Four men were normally required in the construction of the dam. One man on each of the three 8-hour shifts watched the flume, attended to the plugs in its bottom, and shoveled up the dike or border, while a fourth man acted as foreman and had general charge of the operations. The moving of the flume necessitated by the completion of each stage in the building of the dam occurred at intervals of about 90 days—these intervals varying with the tonnage impounded and the increasing length of the dam, the interval being longer as the length of the structure increased. Flood waters were carried off through a tunnel driven through a hill on the west side of the basin. A 6 x 6-ft. timber waste tower was built at the entrance to this tunnel, and the height of this tower was increased from time to time as the work advanced.

Material Handled at 1 Cent a Ton

At the time the photographs were taken the dam was 1800 ft. in length and 96 ft. in height. The cost of handling the material used in its construction while placing 1500 tons per day has amounted to approximately one cent per ton, not including the cost of the water. The water, however, had formerly been lost when the tailings were allowed to settle and distribute along the cañon and empty into the rivers previous to the enactment of the law that prohibited this practice. Now that the water is saved it is considered that its value should be credited to the impounding system.

It has been suggested that where water is available this system of deposition in a modified form might be used to advantage in the construction of railroad or highway fills or earthfill dams, since it does not require an expensive outfit and the work can be carried on with a small crew over an extended period. It is said to be applicable wherever sandy earth, sand or material not carrying any considerable percentage of rock and gravel is available, as under these conditions the cost of hydraulicking is low and only light grades are required to transport the material, which keeps the necessary volume of water down to a minimum.

These dams were constructed according to the design and under the supervision of the author, who also built the earthfill dam first used for storing tailings from this mill.

Pipe Trestles of Wood Replaced by Concrete

Permanent Structures Supersede Decayed Wooden Supports at Philadelphia Without Interrupting Water Service

By JOHN S. ELY

Assistant Engineer, Bureau of Water, Philadelphia

THE Water Bureau of Philadelphia has recently completed the replacement of several old wooden trestles carrying large feed mains with new structures of concrete and steel without interrupting the service of the feed mains. The largest of these, known as the Silverwood Street trestle in Roxboro, is 432 ft. long, 27 ft. high at the center and carries two 30-in. mains. Another, known as the Fowler Street trestle, is 144 ft. long and 12 ft. high at the center, and carries the same two mains, being about 1 mile north of the Silverwood Street structure. A third and fourth are at Devereaux Street and the Northeast Boulevard, one carrying a 48-in. main and being 180 ft. long and 14 ft. high; the other carrying a 30-in. main and being 396 ft. long and 20 ft. high.

MAINTENANCE OF WATER SUPPLY REQUIRED THAT THE LARGE MAINS BE KEPT IN UNINTERRUPTED SERVICE WHILE THE DECAYED WOODEN TRESTLES WERE BEING REPLACED WITH CONCRETE AND STEEL SUPPORTS

Old Trestles Decayed

The wooden trestles replaced were from fifteen to twenty years old, and for some time had required almost constant repair. They were all of the same general type of construction, as shown in the photograph. Although portions of the timber were quite sound, other parts, especially the mud sills and some of the uprights, were badly decayed.

The maintenance of the water supply required that these feed mains should be kept in uninterrupted service, and it was therefore necessary to design structures which could be built without materially disturbing the old trestles. This was accomplished by spacing the concrete piers half way between every third bent of the old trestle, these piers being 36 ft. apart center to center. The concrete piers carry 24-in. I-beams 36 ft. long, the elevation of these beams being such as to bring their tops just below the old wooden caps so that the latter might be temporarily left in place. It was then an

easy matter to transfer the load to the new structure and remove the old.

The execution of the work required considerable care on account of the condition of the old trestles. This was especially the case on the Silverwood Street structure, where it was necessary to carry some of the pier foundations to a considerable depth through quicksand before suitable footings could be found, and there was constant danger of undermining the old trestle bents.

The structures cost about as follows:

Silverwood Street trestle	$6,800
Fowler Street trestle	1,700
Devereaux Street trestle (48-in.)	2,000
Devereaux Street trestle (30-in.)	3,700

The work was done under the general supervision of Carleton E. Davis, chief of the Bureau of Water, by H. M. Platt, contractor, of Philadelphia.

Bronze-on-Bronze Friction in Sluice Gates Tested

Results on U. S. Reclamation Structures Show Wide Variation in Value of Coefficient

By D. C. HENNY

Consulting Hydraulic Engineer, Portland, Ore.

IN THE DESIGN of the moving apparatus of large sluice gates intended to operate under high pressures, the friction of bronze on bronze is the most important factor. Much difference of opinion exists as to the proper coefficient to be adopted in design.

The U. S. Reclamation Service has installed in the last few years sluice gates at the Pathfinder, Arrowrock and Elephant Butte dams. These gates are provided with bronze wearing faces and are operated by oil pressure on pistons moving in cylinders mounted on the gate bodies. Experiments have been made during the last year to ascertain the coefficient of friction. The operating force was determined from reading of the oil gages. Internal friction of moving apparatus was approximated by the oil pressure necessary to move the gate near its wide-open position. The weight of moving parts was known and allowed for. The gates were moved so slowly that the force required to overcome momentum could be neglected.

Pressures were read and frictional resistances were determined for the gates in various positions. Considerable variation was found in the resultant friction coefficient, the maximum exceeding the average over 30 per cent. The maximum values found for the gates nearly or entirely closed are given in the accompanying table:

RESULTS OF FRICTION COEFFICIENT TESTS ON SLUICE GATES

	Size of gates: Horizontal, ft. x Vertical, ft.	Pressure, ft.	Maximum friction coefficient	Experiments under supervision of
Pathfinder	4.42 x 7.50	127	0.44	A. Weiss
Arrowrock	5.00 x 5.00	48.5–54.8	0.42	C. H. Paul
Elephant Butte	3.92 x 5.00	109.8	0.38	L. J. Charles

With a few exceptions materially smaller factors were found with the gates partly open, which is probably due to vibration.

The gates tested had been raised and lowered previous to the experiment at intervals of not over two months. The effect of leaving gates closed for many months or years cannot well be determined, as Reclamation instructions require gates to be operated periodically to ascertain their working condition.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Stream Flow, Not Rainfall, Best Criterion for Yield?

SIR: The writer was much surprised by some of the statements of Clemens Herschel in regard to rainfall and stream flow as quoted by you in the issue of July 22, 1916. Mr. Herschel evidently ridicules the idea of the usefulness of rainfall data and would have all the estimates on the power available at prospective water-power sites based on the contents of a single volume, in which all the data contained in the water-supply and irrigation papers would be summarized in 400 single-page cuts.

Mr. Herschel states that "if the daily discharge of a river at a certain point be plotted for the 365 days of the year, in order of their magnitude (not consecutively in the order of the days of their occurrence), a perfectly smooth curve showing the year's discharge will be produced. Take fifteen or twenty such years, if the records avail, and three such curves may be produced—one of average flow, another enveloping all the minima flows, and a third enveloping the maxima flows. And for a period of that length the discharge of that river, at that point, has been portrayed practically for all time. Nothing, or little more, is needed in its hydrographic study for the uses of the constructing engineer."

While it would indeed be fortunate if records of from fifteen to twenty years in length were available over the entire country, as a matter of fact there are comparatively few records of such length as this unless it be in New England, where water powers have been in existence for three-quarters of a century. We may take, for example, the thickly populated state of New York, where stream gaging has been carried on to a much greater extent than in most states of the Union. In all of that part of the state in which the rivers drain ultimately into the St. Lawrence, comprising rivers important for water-power purposes—such as the Genesee, Oswego, Salmon, Black, Racquette, Saranac and Ausable—there is not a single fifteen-year record.

Such curves as Mr. Herschel proposes must be taken, almost altogether, from records from one to ten years in length. For an engineer to make estimates on such data without due consideration to the records of rainfall for 40 or 50 years, which are in most cases available, would be absurd.

While it is futile to attempt to formulate the relations between rainfall and runoff, at the same time the amount of runoff is more dependent upon the amount of the precipitation and its variations throughout the year than upon any other factor. While there is no question as to the value of stream-flow records, the study of rainfall data in connection with them will continue to be of the utmost importance, at least for the next twenty-five years, until we have a much greater number of long stream-flow records.

Mr. Herschel deprecates the usefulness of the data contained in the water-supply and irrigation papers on the ground that too much data are given. Sufficient data are given to enable those who use the results to appreciate their accuracy, and the U. S. Geological Survey is to be commended for this practice.

Many of the water-power failures of the country have been due more than anything else to overestimating the power available. Estimates have been made based on short stream-flow records without due consideration to the rainfall. Mr. Herschel's plan of combining all the stream-flow data of the country into one volume would undoubtedly furnish an easy way for those who do not care to take the time to give thorough study to the problem to make rough estimates. However, if the material in such a volume were used without consideration to the manner in which the measurements were made and to the long rainfall records available it would do more harm than good.

JAMES P. WELLS,
Consulting Engineer.
Rochester, N. Y.

His Work Done

SIR: It has been repeatedly remarked in your pages of late that engineers, who are in a large measure responsible for the success of many of the most notable enterprises, fail to get adequate appreciation of the essential part they are playing in the world's development. This is undoubtedly true, and I am therefore happy to be able to bring to your attention an exception, which I am confident must have created a profound impression in the minds of those members of our profession who were fortunate enough to witness the occurrence.

Coos Bay has been many years awaiting the construction of a railway to provide direct connection with the interior, and is celebrating its completion at the time of this writing. One of the features of the celebration was the dedication to the city of North Bend, Ore., of a magnificent natural park of virgin timber, overlooking the bay, and the bridge carrying the Southern Pacific Railway across Coos Bay to the cities of North Bend and Marshfield. A vast throng of people, including representative organizations from Portland, San Francisco and other nearby cities, had gathered in the twilight of a beautful evening, in a natural amphitheater surrounded by giant fir trees, to witness the dedication and to listen to the addresses of Oregon's governor and many other notable men who had come to congratulate Coos Bay. When L. J. Simpson, the donor of the park, reviewed the events that had led up to its dedication, and paid tribute to the men who are leaders in the development of Coos Bay, he asked for recognition of the work done by the man—the engineer—who built the bridges spanning the Coos Bay Harbor and the

Umpqua River on the just-completed branch of the Southern Pacific Railway.

He related how this engineer—crippled for life through the loss of a leg in a collision between his gasoline speeder and a work train—on his bed in the hospital at North Bend had heard the joyous sound of the factory whistles around the bay, welcoming the first through train to pass over his completed bridges, and the salute of the locomotive in reply. He burst into tears and exclaimed, "Thank God, my work is done!" The large spirit of the 3000 Oregonians and Californians, gathered in the mighty solemnity of that virgin forest, responded in an outburst of thundering applause for C. R. Broughton, an engineer.

L. F. HEUPERMAN,
City Engineer.
Marshfield, Ore.

Justice to the Contractor

SIR: I have read with interest the editorial, "Justice to the Contractor," appearing in your issue of April 15, page 502, and believe that there is much merit in what you advocate. However, it would seem that the issue is still somewhat confused. Friction between engineers and contractors arises from a number of causes, of which the following are possibly the most conspicuous:

1. Low bidding, with the resulting tendency of contractors to skimp their work in order to avoid serious financial losses.

2. Careless or crooked superintendents. No contractor of importance can personally supervise all of his projects, and the men whom he selects are naturally more anxious to show profits than they are to follow the specifications.

3. Incompetent contractors and superintendents—men who, though paid a fair price for their work, are constantly in trouble with the engineer because they do not know the difference between good methods and bad methods, and greatly dislike interference on the part of any engineer.

4. Incompetent or unscrupulous engineers.

5. Cloudy or unjust specifications.

The writer has been engaged on government work now for about ten years and, like most engineers, has had his share of trouble with contractors, and it is his candid opinion that at least 90 per cent of the friction between engineers and contractors comes under the first three heads mentioned. The average contractor makes two erroneous assumptions—first, that he is always entitled to profit; and, second, that the party of the first part in his contract has no interest except in the general quality of the finished structure.

The first assumption leads contractors to try to filch a profit when they have underbid on a job. The second assumption is a frequent cause for the underbidding, for instead of bidding on methods and even materials that are definitely described in the specifications, contractors often bid on something that they may honestly enough suppose to be just as good, but which, nevertheless, does not conform with the specifications. Thus, not long ago the writer had charge of a concrete bridge job the specifications for which definitely forbade the use of the sand and gravel found in the river over which this bridge was to be built. The only other sand and gravel available had to be hauled nearly 10 miles. The man who got the contract claimed that the clause forbidding the use of the local river gravel was unjust. A serious conflict resulted. It was evident that the contractor had examined the local material before he put in his bid, and that he thought it probable that he could "bluff the engineer out."

Another case which the writer recently had to handle involved the use of brass-plated hardware on a contract calling for solid cast bronze hardware. The contractor said frankly that he had bid on the cheaper hardware, that he thought it was really just as good, and that he felt it was an imposition to ask him to go to the expense of following a specification that he believed to be unnecessary. Of course there was some friction, for the change cost the contractor a good deal of money.

It is true that engineers are sometimes crooked and, I suppose, often incompetent. But is there any reason for supposing that the standard of honesty is higher among contractors, or any reason for believing that they are less often incompetent? I think not. On the contrary, the long educational training given to the modern engineer makes it distinctly likely that on the average his training is much better than that of the contractors with whom he deals. But as the contractor's financial relation to the job is very different from that of the engineer, he naturally takes every interference very seriously, for interference is usually in the line of demanding higher standards of work at an added cost to the contractor. The average contractor seems to feel that his interest demands that he maintain the lowest standards that the engineer will permit.

So, while the writer believes in doing anything that can be done to clarify specifications and make them entirely fair, and agrees with the editors that the practice of writing specifications which are one-sided should be stopped, at the same time he wishes to point out that even this will not eliminate friction between engineers and contractors, because the real cause of most of the friction lies deeper than the specifications.

Engineers make a great mistake in pretending that an engineer employed by an owner to supervise construction is or can really be an arbitrator between the owner and the contractor. An engineer in such a position is hired to know what the owner wants, and to see that he gets it. If there is friction between the owner and the contractor, either about the nature or the extent of the work, some other engineer or contractor should be called in to arbitrate the matter. The owner's engineer is and ought to be an interested party. Moreover, he ought to know that he is an interested party, and act as an interested party. He would recognize at once the ridiculousness of referring controversies to the contractor's engineer. It is, in reality, equally ridiculous for him to pretend to be able to arbitrate between the owner and contractor.

It is a wonderful thing for a young engineer to have an opportunity to deal with a broadminded, honorable contractor. There are many such. But as long as human nature is human nature, there will always be ignorant, careless and unscrupulous men in the contracting business, and they are not apt to be easy men to do business with. An engineer is the guardian of his employer's rights, and if guarding them requires tact he should use tact, but if guarding them requires a club, he should never be out of reach of at least a couple of them. I believe strongly in writing clear, fair and complete specifications, but engineers should all recognize that no matter how clearly specifications are written, getting them carried out will continue to be a man-sized job.

J. L. HARRISON.
Manila, P. I.

Average Bid as Basis for Award of Contract

SIR: The idea mentioned in the letter of Zenas W. Carter in the Engineering Record of Aug. 19, page 240, that contracts should be let to the bidder nearest the average, appeals to the writer, who has been an advocate of this method for some years past. The writer seriously proposed a number of years ago that when bids are received for any large piece of work the lowest bid and the highest bid should be rejected. The rest of the bids should be averaged and compared with the carefully made estimate of the engineer, which should be submitted in a sealed envelope before the call for bids is issued. The estimate of the engineer should be in the form of a bid, based on day work under his supervision. If the average bid does not exceed the estimate of the engineer by more than 10 per cent, the contract is to be awarded to the bidder closest to, and below, the average, provided his bid is not lower than the estimate of the engineer. Otherwise let the engineer do it.

This method eliminates the low bidders who are ignorant and the men who bid high because they do not want the work, but put in a bid merely to keep themselves in the eye of men having work to do. It is presumed that the only bidders will be those who really want the work and who will figure to get it. Such an arrangement should go far to prevent pooling, for figures cannot be pyramided.

ERNEST MCCULLOUGH,
Consulting Engineer.
Chicago.

New Standard Method for Determining Elastic Limit Proposed by A. S. T. M.

At the recent annual meeting of the American Society for Testing Materials a proposed new method for determining the elastic limit was introduced in the standard specifications for automobile carbon and alloy steels, and sent to letter ballot of the society. Instead of the former simple requirement, "the elastic limit shall be determined by means of an extensometer," the method used by the Pennsylvania Railroad and illustrated by moving pictures at the meeting has been prescribed as follows:

"The elastic limit called for by these specifications shall be determined by an extensometer reading to 0.0002 in. The extensometer shall be attached to the specimen at the gage marks and not to the shoulders of the specimen, nor to any part of the testing machine. When the specimen is in place and the extensometer attached, the testing machine shall be operated so as to increase the load on the specimen at a uniform rate. The observer shall watch the elongation of the specimen as shown by the extensometer and shall note, for this determination, the load at which the rate of elongation shows a sudden increase. The extensometer shall then be removed from the specimen, and the test continued to determine the tensile strength."

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Forms for Handrail on Large Viaduct Used 66 Times Each

By HAROLD E. KETCHUM

Superintendent Hunkin-Conkey Construction Company, Cleveland, Ohio

SIX SETS of forms are being used sixty-six times each to complete 400 sections of the handrail for the lower deck of the Detroit-Superior bridge in Cleveland, being built by the Hunkin-Conkey Construction Company. Hot tallow for oiling the forms and a small, but powerful, hand winch for pulling the tie bolts and handling the outside form have contributed greatly to the speed and economy of the work.

The handrail is being cast in place between the columns which support the upper deck. Five 1-in. square dowels at each column and seven ½-in. dowels in the curb serve to tie the handrail in place. As the sections vary from 8 ft. to 8 ft. 4½ in. in length, a standard size of form is used, with filler pieces on the outside forms for the longer sections. The inside of the rail is flush with the inside of the columns, and the inside form accommodates both lengths without alteration. To provide a tight joint with the columns on the outside of the rail, where the forms must fit between the posts, strips of light sheet iron are tacked on the edges and at the bottom of the form.

The form for the inside is made of 2 x 8-in. studs sheeted with 1¼-in. ship lap. The outside of the rail has a 2-in. recessed panel, an overhanging molded coping and a wide base. Although it was at first thought necessary to make the form in three pieces, this was avoided by providing a ¼-in. draw on the edges of the panel and the molded coping and by oiling the forms with hot tallow. The ten ½-in. bolts which pass through 2 x 6-in. wales and hold the form together are well greased, and are pulled with a small winch, called the "Pull Lift," the day after the forms are concreted.

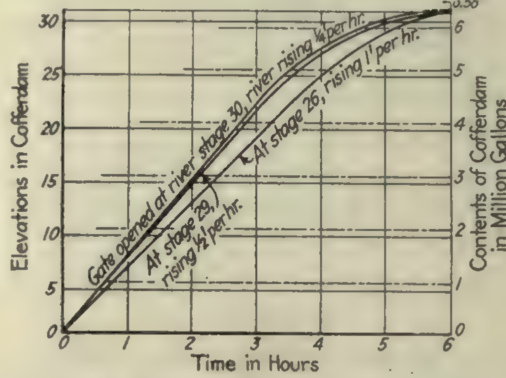
This same winch is used for setting the outside form and removing it, as shown in the photograph. Three men do all the work of setting and moving the forms, a small cart being used to haul them along the bridge. This gang handles the six forms, places the eight ½-in. square reinforcing bars in each panel and helps with the concreting of three complete sections of rail a day. The concreting is done with the regular mixing and cableway equipment used for the east section of the bridge, the concrete being chuted over the edge of the upper deck through flexible pipe spouts. Forty-five minutes is required to fill six rail forms with 7 yd. of concrete. The forms are usually poured in the afternoon and removed the next morning.

The surface of the green concrete is rubbed with a wooden float and a small amount of 1 to 1 mortar until a uniform finish is obtained. A bush hammered surface is required in the recessed panel, and is obtained by scratching the green concrete with a steel brush. One man finishes three sections a day. The long service of the forms is attributed largely to the tallow grease, which is applied hot both inside and outside.

TRUCK AND WATCH-SIZED HOIST AID IN BUILDING BRIDGE RAIL ECONOMICALLY

When to Open the Flood Gate

THE COFFERDAM for lock No. 2 on the Cape Fear River, in North Carolina, described on page 325, was, as usual with river work, expected to be overtopped by extreme floods. Instead of trusting to luck to fill the coffer by opening the floodgate before water could pour over the top and play havoc with the work inside, the time required to fill the dam through the 24-in. diameter pipe that served as a flooding flume was carefully figured for different stages of the river and different rates of rise. Thus the river stage at which it was necessary to open the floodgate so that the water inside would reach the top at the same time as the river outside was determined. The accompanying diagram shows that with the river rising at a rate of 3 in. per hour it was not necessary to open the gate until stage 30 was reached, as the cofferdam would fill under that head in 6 hours, or by the time the river would reach its top at El. 31. A second curve indicates that with the river rising 6 in. per hour the gate should be opened at stage 29, and the third curve gives 26 ft. as the stage at which the gate should be opened with the river rising 1 ft. per hour. The 24-in. pipe was located at stage 19 on the river gage.



CURVES SHOW WHEN TO START FLOODING

The work on the Cape Fear River is being carried out with government equipment by day labor in general charge of Capt. C. S. Ridley, Corps of Engineers, U. S. Army. Norman M. Chivers, assistant engineer, had direct charge of operations at lock No. 2.

Perforating Ties Before Creosoting Increases Penetration

Perforating Douglas-fir ties in such a way as to take advantage of the fact that creosote oil enters the wood along the grain with greater ease than in any other direction has resulted in a penetration of six times as great as obtained when the tie is not perforated before treatment, according to a bulletin published by the Association of Creosoting Companies of the Pacific Coast. By running the ties through special machines equipped with short metal points mounted on revolving drums, the surfaces are perforated in such a way that it is necessary for the creosote to travel only 3½ in. along the grain from each perforation to treat the wood thoroughly.

The effect the perforating might have on the strength of a tie was determined by tests conducted by the Association of Creosoting Companies of the Pacific Coast, which shows that the compressive strength at the elastic limit of the unperforated creosoted tires was 561 lb. per square inch and that for the perforated treated specimen was 531 lb. per square inch—a decrease in strength of only 30 lb. per square inch.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

New England Waterworks Convention Sept. 13-15

Tentative Program Adopted for Three-Day Meeting at Portland, Me.—Addresses by Governor and Admiral Peary

The thirty-fifth annual convention of the New England Waterworks Association will be called to order at 9.30 a. m., Wednesday, Sept. 13, at Portland Me. William F. Sullivan, president of the association, will introduce Oakley C. Curtis, Governor of Maine; W. G. Chapman, Mayor of Portland, and W. L. Blake, president of the board of trustees of the Portland Water District, who will welcome the visitors to Portland. Following the opening ceremonies Rear Admiral R. E. Peary will address the meeting. David E. Moulton will present the only paper now scheduled for the first morning session.

Wednesday afternoon will be devoted to a clambake on Long Island and a steamboat excursion through Casco Bay. In the evening Elbert E. Lochridge will present a paper on the application of coagulant intermittently in excess amounts at Springfield, Mass., and Harvey D. Eaton will discuss the extension of the water-district idea in Maine.

Superintendents' Sessions Thursday

At the morning meeting matters of particular interest to waterworks superintendents will be the subjects of discussion. The materials and methods used in making service connections, leakage from pipe joints and grading cities and towns for insurance purposes are some of the items now scheduled for discussion at that time. An excursion to Sebago Lake, the source of supply of the Portland Water District, and to Poland Springs is planned for Thursday afternoon. The topics at the evening session, at 8 p. m., will be breaks in main pipes and emergency trucks and repair gangs. Friday will be devoted to papers on waterworks accounting and on problems of New Hampshire water supply sanitation. The work of the Public Utilities Commission of Maine will also be outlined. An excursion to Riverton Park will be made in the evening.

The trip to Portland can be made by boat or by rail. Steamers leave Boston Sept. 12 at 7 p. m. A boat leaves New York at 6 p. m., Sept. 11, for Boston, which permits a full day's inspection of the latter city. For those desiring to go straight through from New York to Portland a boat will leave New York at 10.30 a. m., Sept. 11, arriving at Portland Tuesday morning.

Will Place Quebec Bridge Sept. 11

The superstructure for the Quebec bridge will, if weather permits, be floated into position at 5 a. m. Sept. 11. Owing to limited space on the bridge and the necessity of keeping clear that part of the river in which tugs will be operating, no one who is not engaged on the work will be allowed near the span until it is suspended from the links by which it will be hoisted. No steamers or small boats will be permitted to come within certain boundaries while the work is progressing. Space for spectators has been provided close to the bridge on the south shore and on the north shore from about half a mile below the structure to Sillery Cove, where the span has been erected.

Excursions this Friday and Saturday were planned by the St. Lawrence Bridge Company for those who desired a close-up inspection of the structure and the details of the mechanism.

Be Sure to Read It!

Opportunities Offered to American Interests in the Rehabilitation of Europe Are Pointed Out on Pages 310 and 311 by W. S. Kies, Vice-President of the American International Corporation.

Willamette-Pacific Line Completed Last Month

120-Mile Railroad from Central Oregon to Tidewater Opens New Territory — Pay Tribute to Engineer

A three-day celebration was held late last month in the cities of North Bend and Marshfield, on Coos Bay, in southern Oregon, in honor of the completion of the 120-mile railroad between those cities and Eugene. The latter city is on the main line of the Southern Pacific Railroad east of the Coast Range Mountains.

The gathering to witness the dedication included representatives from San Francisco, Portland and other nearby cities. L. J. Simpson, who donated to the city of North Bend, Ore., a magnificent park of virgin timber, in his address paid special tribute to C. R. Broughton, the engineer who built the bridges over the Coos Bay Harbor and the Umpqua River and lost a leg during the construction.

The new railroad has involved some heavy construction in crossing the mountains, including the building of two long bridges. The crossing of the Umpqua River is made on nine 125-ft. spans and one 360-ft. span, while traversing the arm of Coos Bay required nine 150-ft. spans and a 458-ft. drawspan flanked on either side by one 180-ft. span. The Coos Bay bridge with its approaches has a total length of about 1 mile. Both this and the Umpqua River bridges are through Howe trusses. The longest of the nine tunnels on the line is at the summit of the Coast Range. It is 2480 ft. long.

The construction of the road, which is a branch of the Southern Pacific Railroad, has been anticipated for many years and industries have in the meantime developed until the two coast towns are now important ports with a combined population of about 6500. The sawmill at Marshfield is said to be the largest on the Pacific Coast.

Hurricane Sweeps Over West Indies

A hurricane which recently swept over the British West Indian island of Dominica is said to have caused fifty deaths and wrecked a number of bridges and houses. The wind velocity is given as seventy miles per hour and the lowest barometric reading as 29.10.

Concrete Reservoir Collapses

Water released by a 30-ft. break in the concrete reservoir in Madison, Wis., on East Dayton Street, between Blount and Blair Streets, Aug. 26, flooded the new excavation across the street as well as nearly all basements. It is reported that poor concrete, lack of proper reinforcement and the weakening of the wall by excavations for the new reservoir caused the accident.

The nearness of the new excavation into which most of the water rushed is said to have prevented the flood reaching the city barns and other nearby structures. The reservoir was erected about ten years ago.

Outline Water Policy for Pennsylvania Commission

Report Urges Co-operation in Planning Projects—Cost of State-Wide Survey Estimated at $800,000

Plans to provide for more perfect co-operation between the state and different communities or corporations considering flood-control or water-supply construction in Pennsylvania are included in a report submitted by the Pennsylvania State Water Supply Commission made public this week. The report also recommends the enlargement of the present water code so that methods will be provided for legal co-operation in constructing and maintaining water-control works.

It is pointed out that a condition is being reached where, unless the water sources are controlled and conserved, those sources will not be sufficient to serve the needs of the state and a gradual slackening of development will occur. Also, states the report, there is every indication that an increase in the use of water will continue indefinitely and at an accelerating rate.

Must Have Knowledge of Streams

An adequate policy for the control and regulation of the waters of the state, according to the document, cannot be formulated until a thorough knowledge is obtained of the streams of the state nor until general plans are prepared for solving those problems. An orderly legal code, which will make practicable the execution of plans and will insure control and supervision over construction affecting the river system, is recommended.

The Water Supply Commission, says the report, should be a clearing house of general information on problems of public water control—not in the sense of being consulting engineers, but in outlining policies and furnishing information which only a public institution can collect. As water-control projects are initiated from time to time in various parts of the state, the commission should furnish advice as to the general methods which may be used in approaching the problems, and, subject to final review by the Public Service Commission, should have regulatory powers over such undertakings. This advice and direction should indicate whether the community or corporation can best work out its problems alone or in co-operation with other communities and whether a single object such as water supply can best be secured alone, or whether more than one object, such as water supply and flood prevention, or water supply and power development should be provided for by the same improvement.

Emphasize Need for Inspection

The question of the safety of structures is also discussed and the importance of proper examination emphasized by pointing out that a single dam failure may cause damage of an amount sufficient to cover the inspection cost for several years.

The necessity is emphasized for a water code giving the commission power to adjust the costs so that co-operation may be secured between communities affected by a development. The creation of a court of appeals is suggested as a possible measure to afford a means of settling differences of opinion between the commission and corporations and municipalities. The cost to cover the entire State of Pennsylvania, developing the possibilities for flood control, water supply and water power on each river system in the state is estimated at $800,000. The time to complete a statewide survey is given as about five years.

Washington Commissioners and Engineers Meet at Tacoma

The joint convention of the Washington State Association of County Commissioners at Tacoma will be opened in the Hotel Tacoma Thursday morning, Sept. 14. After the address of welcome by Governor Lister the two associations will adjourn to their respective halls. Both programs include many papers on road and bridge construction. G. M. Savage, president of the Washington Paving Company, will speak from the contractors' viewpoint.

A joint session will be held Friday morning, after which each body will follow its own program until Saturday evening, when a joint banquet will be held. Sunday will be devoted to an automobile tour of Reese's Camp.

May Revive Mississippi River Traffic

The St. Paul Association of Commerce has appointed a special committee on river traffic which will attempt to work out a comprehensive plan for the development of adequate river terminals. The chairman, J. W. Cooper, has called to his assistance a citizens' "Committee of One Hundred," in the membership of which are included nine civil engineers, who will constitute a subcommittee.

200-Foot Slide Reported on Panama Canal Last Week

A slide on the Panama Canal was reported last week to the Panama Canal Commission at Washington. Despatches stated that about 200 ft. of the channel was blocked. No news of the reopening of the canal has yet been received.

Will Build Canal in Uruguay

The Congress of Uruguay has decreed that plans shall be made for dredging and making into a canal the Miguelete River, which runs through Montevideo and empties into the bay. The decree states that in addition to the work in the stream, an avenue, necessitating much bridge construction, is to be built on each bank.

Will Investigate Need for Improvement of Quequechan River

The nuisances in and along the Quequechan River in Massachusetts and upon the lands adjacent thereto and the necessity for the construction of drains and sewers for the disposal of sewage will be investigated by a commission just appointed. A suitable method for the control and protection of the waters of the river and plans for its improvement will be suggested later. The report must be presented on or before April 1, 1917, to the city council of Fall River, Mass.

Joseph Turner, of Fall River, is chairman and H. K. Barrows, consulting engineer, of Boston, is consulting engineer for the commission.

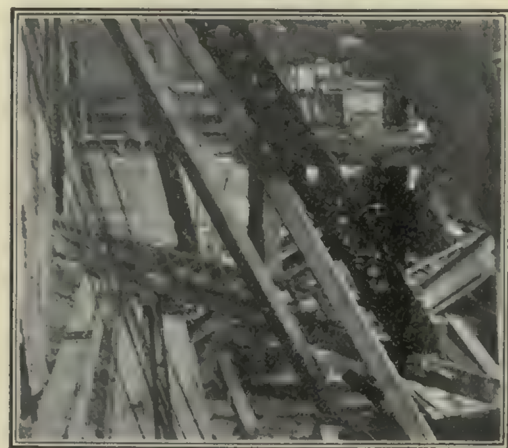
Town and County Roads Subject of Convention at Syracuse Next Week

The meeting of the New York State Association of County Highway Superintendents will be opened by the president, James F. Loughran, Sept. 13 at Syracuse. Discussion of the office of town superintendent, uniform prices of machinery, the use of automobile license fees in county or town highway work and the county as a unit in highway administration will comprise the work of the first day. County road construction and maintenance and a paper on the class of road or pavement best suited to towns and counties are included in Thursday's program. The advisability of increasing the carrying capacity of new steel and concrete bridges will also be considered.

Many Lives Endangered When Boom Buckles Under Load

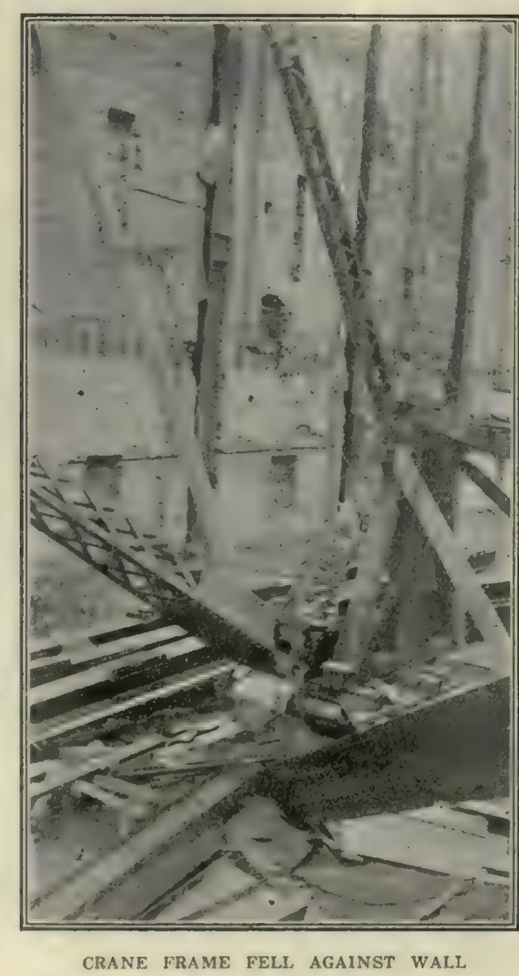
Seven-Ton Load Causes Failure During Erection of Steel Building in Erie, Pa.—Nobody Injured

Although many lives were endangered on Sept. 1 by the buckling of a steel boom during the erection of the Ariel Building, at the corner of Eighth and State Streets, in Erie, Pa., no person was injured. The 7-ton column section which caused the failure balanced vertically on end before it toppled over toward State Street and fell directly across the construction shanty, crushing it.



BOOM BUCKLED AT END OF TIMBER BRACE

The steel boom had been reinforced near the center by a piece of 8 x 10-in. timber 20 ft. long, lashed to the boom. While raising one of the front columns weighing about 7 tons the boom buckled at the ends of this timber brace and allowed the column section, which was about 64 ft. long, to drop vertically into the cellar of the building. The warning cries of those who saw the failure made it possible for pedestrians and workers to escape. The boom and its supporting frame struck the wall of the Arcade Building, but caused no damage to wall or building, as indicated in the photographs.



CRANE FRAME FELL AGAINST WALL

It is reported that hereafter cranes will be inspected by the commissioner of public safety of the city. The erection is being done by the Erie Steel Construction Company.

Ohio County Will Not Use Macadam

The Board of Hamilton County commissioners, Cincinnati, Ohio, decided at its meeting Aug. 29 not to use macadam for any more permanent road improvements. Following a conference the announcement was made that all future improvements on county roads will be either of concrete or brick. Hamilton County has been spending about $700,000 a year on the construction of macadam roads.

Will Consider Applications for Contract on Bridge or Tunnel

At the last session of the Louisiana Legislature a joint resolution proposing a constitutional amendment to authorize the construction of tunnels or a bridge to connect the east and west shores of the Mississippi River at or near New Orleans was adopted. The amendment will be voted on at the general election Nov. 7, when it is expected the measure will be passed with a large majority.

The Public Belt Railroad Commission of New Orleans has appointed a special committee to study the situation. The committee has heard discussions of the project by a few prominent engineers, but desires to hear from all engineering firms that may wish to submit applications for contract in connection with the work. F. H. Joubert, secretary and general manager of the Public Belt Railroad of New Orleans, will furnish further information.

Organize to Secure Nitrate Plant on Ouachita River, Arkansas

A meeting was held Aug. 31 in Arkadelphia, Ark., at which representatives of ten cities organized for the purpose of having a government nitrate plant erected on the Ouachita River near Hot Springs. It was claimed that a dam could be built "with a crest elevation as great as 750 ft. and a reservoir capacity of 400,000,000,000 cu. ft. without flowing through any gaps." All of the land that would be inundated is said to be owned by the government.

The next meeting will be held at Hot Springs, at which Major Harold C. Fiske will be the chief guest.

Boise & Arrowrock Railroad for Sale

The sale of the Boise & Arrowrock Railroad, which was built and operated by the U. S. Reclamation Service to carry material to the site of the Arrowrock dam, was authorized by Congress last month. The right-of-way and such equipment as it may be deemed advisable to sell will be disposed of by the Secretary of the Interior. The value of the road will be appraised by three disinterested persons and the property disposed of at public auction at a price not lower than the amount named by the committee of three.

Panama Official Weekly Changes Size and Name

Beginning with the issue of Aug. 23, the *Canal Record*, the official weekly publication of the Panama Canal, became the *Panama Canal Record*, and its page was reduced in size to 6 x 9¼ in., conforming to the prevailing form for pamphlets of other government publications. The new form begins Vol. X. The original form of the *Canal Record*, which was adhered to throughout nine years of canal work, beginning with the publication of the first number Sept. 4, 1907, was derived in general from the make-up of a bulletin published by the first French company.

What Engineers and Contractors Are Doing

JOSEPH H. NUELLE, formerly assistant general superintendent and chief engineer of the New York, Ontario & Western Railway, has been promoted to the position of general superintendent. He will continue to make his headquarters at Middletown, N. Y. After graduation from Princeton University in 1906 Mr. Nuelle joined the engineering forces of the Pennsylvania Railroad as transitman. He resigned early in 1907 to take a similar position with the New York Central and Hudson River Railroad, which he left in June of the same year to become assistant engineer of the New York, Ontario & Western. Promotion to the grade of principal assistant engineer came in 1911 and to that of chief engineer soon after. In 1915 he was made assistant general superintendent in addition to his duties as chief engineer.

EDMUND GELWIX has resigned as assistant engineer for the St. Louis-San Francisco Railway to become valuation engineer for the Kansas City, Clinton & Springfield Railway, with office at Springfield, Mo.

ROSS MILLER has been appointed engineer of the South Dakota Railroad Commission to succeed J. E. Love, resigned.

W. C. NIXON has been elected president of the recently incorporated St. Louis-San Francisco Railway, which succeeds the St. Louis & San Francisco Railroad. Since July, 1913, he has been chief operating officer and receiver of the old St. Louis & San Francisco.

C. N. YARGER, superintendent for J. L. Richmond, general contractor, of Richfield Springs, N. Y., having completed the work of reconstructing highways and bridges adjacent to the Hinckley reservoir barge canal water supply, has moved to Richfield Springs. From that point he will direct the building of eight miles of state highway in Otsego County, for which his company recently secured the contract.

WENDELL M. JONES, a recent graduate of the engineering department of the University of California, is now assistant hydrographer for the U. S. Reclamation Service. He is located at Spanish Fork, Utah, and employed on the Strawberry Valley project.

A. C. LYON, expert chemist, has been placed in charge of the laboratories of the recently organized General Testing Laboratory, Kansas City, Mo. Mr. Lyon was for ten years chief chemist and vice-president of the Kansas City Testing Laboratory Company, previous to which he was employed by the Carnegie Steel Company. He also at one time taught chemistry at the University of Missouri. He will direct tests and analyses of asphalts, cement, metals and alloys as well as conduct general physical tests.

E. L. BROWN, formerly vice-president and general manager of the Denver & Rio Grande Railway, has been elected president of the Minneapolis & St. Louis Railroad, succeeding Newman Erb, resigned.

GEORGE C. WHIPPLE, professor of sanitary engineering at Harvard University and member of the consulting engineering firm of Hazen & Whipple, New York City, has been appointed a member of the commission to investigate the proposed garbage-reduction plant for Staten Island. The residents of Richmond Borough claim that the plant would become a menace to the public health. Mr. Whipple has studied water-supply and sewage-disposal problems in a number of large cities in the United States and served as a member of the faculty of the Brooklyn (N. Y.) Polytechnic Institute for several years. He was graduated from the Massachusetts Institute of Technology in 1889 and immediately thereafter engaged in water-supply engineering. After fifteen years of laboratory work in Boston and New York he became associated with Allen Hazen in the firm of Hazen & Whipple. He was appointed to the Harvard faculty in 1911.

LOUIS K. ROURKE, of Rourke & Sherman, consulting engineers, of Boston, has been retained by the Braden Copper Company to investigate and report on its railroad at Braden, Chile. Mr. Rourke will sail almost immediately and be gone for about five months. Mr. Rourke is a graduate of the Massachusetts Institute of Technology, class of 1895. His first engineering work was with the Boston & Maine Railroad, whose employ he left in 1897 to become supervisor of track for the Panama Railroad. During the next five years he was engaged on railroad work in Ecuador, following which he spent about two years in Mexico. In 1903 he was made superintendent of construction of the Guayaquil & Quito Railway, but returned to Massachusetts the following year to engage in highway construction contracting. Again he went to Panama in 1905 to join the Isthmian Canal Commission, returning to the United States in 1910 to become superintendent of streets for Boston. He resigned last year to join Edward C. Sherman in the consulting firm of Rourke & Sherman.

FRANK H. OLMSTEAD, of the consulting engineering firm of Olmstead & Gillelen, Los Angeles, Cal., has been named by Franklin K. Lane, Secretary of the Interior, as the engineer to design flood-protection plans for the Gila River.

D. K. CALDWELL, who has for the last year and a half had charge of the expenditure of a bond issue in Gregg County, Tex., was recently appointed engineer of Caddo parish, Shreveport, La. The parish expects to spend about $1,000,000 on road construction during the next few years. Mr. Caldwell was graduated from the Alabama Polytechnic Institute in 1908 and was then made assistant county engineer of Montgomery County, Alabama. A year later he was appointed assistant city engineer of Montgomery, resigning in 1911 to become county engineer for Covington County. Upon the completion of that county's road system Mr. Caldwell went to Elmore County in a similar position, from which he resigned to become assistant to the parish engineer at Shreveport, La. He left Shreveport to go to Gregg County, Texas, early in 1915.

C. B. CARVER has resigned as junior engineer for the New York Conservation Commission to enter the engineering department of the New York Central Railroad, with office in New York City. Since his graduation from Bucknell University in 1914 Mr. Carver has been employed by the commission on water-power, drainage and storage work.

E. A. KEMMLER, formerly department engineer on the new Akron (Ohio) waterworks, is now chief engineer of the Coventry Land & Improvement Company of that city. The company is developing a large tract in the south part of Akron in which model sewers, streets and houses will be constructed as rapidly as possible. The enterprise, which will involve millions of dollars, is not being run for profit. Mr. Kemmler was graduated from the Ohio State University in 1888. He was assistant professor of civil engineering at his alma mater from 1891 to 1896, resigning to become city engineer for Columbus, Ohio. He engaged in engineering work in Oklahoma in 1910, but returned to Ohio the next year to become department engineer of the Akron waterworks.

F. T. CROWE has been promoted from construction engineer for the U. S. Reclamation Service to the managership of the Flathead project, with headquarters at St. Ignatius, Mont. Mr. Crowe was graduated from the University of Maine in 1905 and immediately entered the employ of the reclamation service as chief of party. For two years he was employed on irrigation and canal work, resigning in 1906 to become engineer for James Munn & Company, contractors, of Deadwood, S. D. He again joined the reclamation service in 1908 and in 1911 was made assistant superintendent of construction on the Arrowrock dam. In 1913 he was transferred to the Boise, Idaho, and later to the Jackson Lake projects as construction engineer.

LINCOLN BUSH, consulting engineer, of New York City, has been chosen the third member of the arbitration board to settle the controversy regarding the rehabilitation of the Galveston causeway. As stated in this journal in the issue of Aug. 5, page 185, Professors A. N. Talbot and George F. Swain were the appointees respectively of the steam railroads and the county and electric railway, and these two have now selected Mr. Bush to officiate with them.

R. N. BEGIEN, chief engineer of the Baltimore & Ohio Railroad, has been appointed a member of the engineering committee of the Presidents' Conference Committee, the railroad organization formed to uphold the railroads' interests in the federal valuation of the carriers. Mr. Begien succeeds F. L. Stuart, resigned.

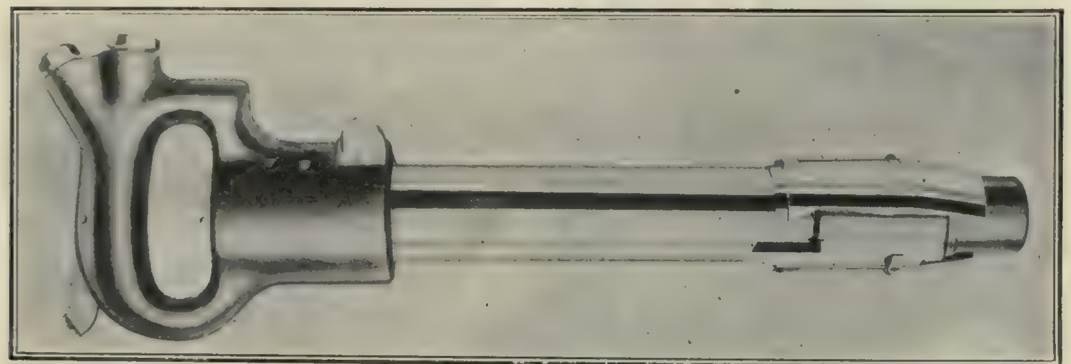
GUSTAV ADOLPH MATHIAS LILJENCRANZ, U. S. assistant engineer at Chicago since 1871, was recently given a dinner at the Chicago Engineers' Club on the occasion of his departure for Sweden, the land of his birth, as noted in these columns last week. He was born in 1842 and obtained the degree of civil engineer from the Royal Technological Institute, Stockholm, in 1866. For two years thereafter he was engaged on the construction of the Dahlsland Canal, Sweden. He entered the employ of the U. S. engineer office at Milwaukee in 1869, leaving the government service the next year to go to the Chicago, Milwaukee & St. Paul Railway. In 1871 he returned to the government service and was stationed at the Chicago office, where he has been since employed. Mr. Liljencranz has been a member of the Swedish Technological Society since 1866.

Obituary Notes

JESSE SUPPLEE, civil engineer, of Erie, Pa., died recently at his home in that city at the age of 74. Mr. Supplee retired from active service about two years ago after nearly fifty years in engineering work. He was born in 1844 at Gwyneed, Pa., and first took up engineering in 1866 as draftsman and transitman on branches of the Philadelphia & Reading and the Columbia, East Pennsylvania & Perkiomen Valley railroads. The following year he was made assistant engineer in charge of surveys and construction of Fairmount Park, Philadelphia, retaining that position until 1872, when he went to the Pennsylvania Railroad. For seven years he was assistant engineer in charge of new work, tracks, buildings and bridges on the Pittsburgh division of that road and also directed the grading for and construction of four tracks through Pittsburgh. From 1879 to 1881 he was supervisor of the Bald Eagle Valley Railroad and assistant engineer on the Tyrone division of the Pennsylvania. In the latter year he took a position as assistant engineer for the Philadelphia & Erie Railroad, in which capacity he had charge of maintenance of way and building of all new works, tracks, buildings and bridges. He and his son formed the engineering firm known as the Supplee Engineering Company in 1900 and Mr. Supplee, senior, became chief engineer of the Pennsylvania & Ohio Bridge Company. The firm, among other things, had charge of all engineering on an electric line from Erie to Albion, Pa., and Conneaut, Ohio. Mr. Supplee retired from active practice about two years ago and the firm was dissolved.

Device Prevents Dropping or Shooting Out of Rivets

A new attachment for pneumatic hammers, which is claimed to eliminate accidents caused by dropping or shooting out of rivet sets or chisels and pistons, is being manufactured by the Keller Pneumatic Tool Company, Fond du Lac, Wis. The device, it is said, will hold any rivet set in place even though the air be turned on when the instrument is held in the hand.



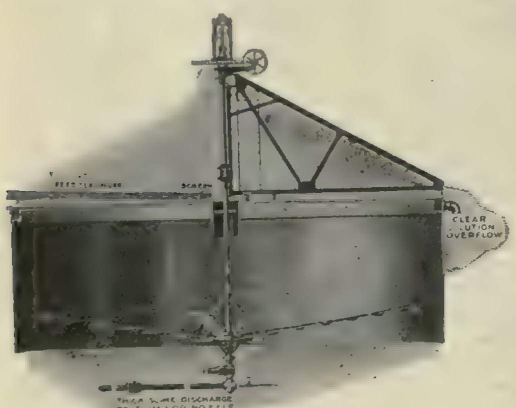
POSITION OF ATTACHMENT WHEN CATCH AND SPRING ARE RAISED

The two retainers are raised by a slight turn of the metal casing to which they are attached, thus sliding them out of the slots into the smooth surface of the tool. The spring is sufficiently strong to hold the flat surface of the retainers in the slots and keep the device in place. The safety retainer can be attached by hand to any make of hammer.

Metallurgical Thickener Applied to Sewage Purification

Engineers interested in sewage disposal have recently been searching other industries for apparatus and methods that may help them to solve their problems. Some have investigated the metallurgical field, where many problems similar to theirs have been successfully met, and where there is a growing tendency to use continuous methods.

One problem which for many years gave the metallurgist a great deal of trouble was the treatment of the large volume of slime always produced in crushing ores. "Slime" is the name usually given to that portion of the ground material which will pass a 200-mesh screen. The Dorr continuous thickener, invented by J. V. N. Dorr, was developed to handle that slime. It is now being introduced for sludge settling.



THICKENER PERMITS BUILDING EXTREMELY SHALLOW SEDIMENTATION BASINS

The apparatus consists of a central-vertical shaft carrying radial arms equipped with plows set at such an angle that the slow rotation of the arms brings the thickened material to the center. At that point it is discharged, thus allowing the settling operation to be continuous. The slow motion of the arms is obtained by means of a worm gear. The illustration shows a standard machine.

The liquor to be settled is delivered near the center of the basin in a suitable well, with a float to cause minimum disturbance. The overflow is taken off by a peripheral overflow channel. The bottom is built so as to conform to the slope of the arms. The plow blades are provided with rubber scrapers so that the bottom is always kept clean.

The arms revolve at a very slow speed. For thin sludges one revolution in from 45 minutes to one hour is recommended. The power required to operate the mechanism would not exceed 1 hp. for a thickener 90 ft. in diameter. The thickener is built for basins up to 200 ft. in diameter. The slope required for the bottom is only 1¾ in. to the foot, which permits large sedimentation basins equipped with Dorr thickeners to be built with unusually shallow depths. This greatly reduces the original cost of construction, compared to hopper or conical bottom basins, particularly as most sewage sludges require a slope of more than 45 deg. to prevent building up of solids.

As noted in the issue of Aug. 5, the Dorr company has established a sewage-disposal department under the direction of H. W. Morgan, formerly with the Milwaukee Sewerage Commission.

Nesting Drum Makes Portable Asphalt Mixer Compact

Compactness so as to make the whole outfit portable has been obtained in a new ½-yd. asphalt mixer recently put on the market. The large car plants average about 1800 sq. yd. of 2-in. pavement per day of 8 hours, while this one has a capacity of 1200 sq. yd.

The drier consists of three drums built into one unit, the largest of which is 68 in. in diameter. They occupy a space 14 ft. long, while the equivalent continuous single drum would be 4 ft. 3 in. in diameter and 40 ft. 8 in. long As the speed is 8 r.p.m., and it takes 4 minutes for the material to travel the length of the drier there is an effective area of 17,376 sq. ft., permitting, it is claimed, a low fuel consumption and a high heating temperature.

HOT PORTABLE MIXER HAS THREE-DRUM DRIER NESTED FOR COMPACTNESS. OUTFIT WEIGHS 26 TONS AND TRAVELS UNDER ITS OWN POWER. CLAIMED TO HAVE LOW FUEL CONSUMPTION AND HIGH HEATING TEMPERATURE.

The melting pot is located above the drier, so does not need a separate fire. Additional heat comes from exhaust steam in coils run through the kettle. It has two compartments and can be equipped with a fluxing tank for a half day's run. The measuring boxes of one-half batch capacity are equipped with a standard scale beam. The material is screened to proper size before entering the measuring box.

The mixer is of two-spindle, pug type. It discharges directly into wagons which can be driven under the spout without excavation of the ground. The length over all is 34 ft. 9 in.; height, 18 ft. 9 in., and width, 7 ft. 3 in. The outfit weighs 26 tons and travels under its own power at 1 mile per hour. It is manufactured by the Municipal Engineering & Contracting Company, Chicago.

Business Notes

The Chicago Bridge & Iron Works recently opened an office in the Florida Life Building, Jacksonville, Fla., in charge of Elwood G. Ladd, who will handle the company's business in Georgia, Florida and Alabama.

Adolph G. Carlson, formerly assistant superintendent of the Syracuse, Ind., plant of the Sandusky Portland Cement Company, has been made chief engineer of the Universal Portland Cement Company.

A. C. Wilby, who has been in the sales department of the Universal Portland Cement Company for about seven years, has been made assistant to the president.

The Chicago Chapter of the American Association of Engineers held its regular meeting Aug. 18. The meeting was well attended by members and guests, many of whom participated in the discussions of topics of importance to engineers.

The Camp-Te Roller Agency, Seattle, engaged for the last thirteen years in the sale of building materials, has dissolved. H. Te Roller will continue to handle the accounts carried by the agency, with office in the Globe Building, while E. H. Camp will confine himself to metal and hardwood interior finishing materials, and will be located at 515 Bell Street.

W. A. Lamont, for twenty-one years connected with the Pacific Hardware & Steel Company in Portland and San Francisco, recently opened an office in the Colman Building, Seattle, and will represent the Rolph Mills Company, of San Francisco, which handles the L. A. Norris products on the Pacific Coast; the Sneath Glass Company, manufacturer of sidewalk lights, and the McClintic-Marshall Company. A complete stock will be carried in Seattle.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY McGRAW PUBLISHING COMPANY, INC.

Volume 74 NEW YORK, SATURDAY, SEPTEMBER 16, 1916 Number 12

Lay Advice

IT is too bad that engineers will not listen to lay advice. How much better, how much cheaper work would be done if only the public's counsel were sought and heeded. After the Quebec Bridge span had gone into the river, while the lobby of the Château Frontenac buzzed with explanation and conjecture, one intelligent-looking layman suggested a plan that solved all the difficulties. He would build the floor system on barges, hoist that to the bridge level and "there put on the upper iron work." We have all met laymen who on the first trip over a line—on the observation platform—saw where a straight road could have been laid instead of the fool curves used by the engineers.

Winter Concreting

AT the approach of cold weather each year it has become a practice to warn constructors against the dangers which attend the placing of concrete when the temperature is low. To most of the readers of the Engineering Record the warning is unnecessary. Without doubt, however, there are men under their direction whose appreciation of the dangers is less keen. It is rather in the expectation that they will be reminded to pass the information along to their employees that the periodical warnings appear. That they have had a good influence is apparent to those who follow the failure reports winter after winter. They were fewer last year than before. If all in authority and influence will convey to those less well informed admonitions similar to those which were published in this journal last week, page 319, the failures will continue to decrease in number.

"Human" Society Publications

ENGINEERING SOCIETIES are giving much attention at present to their publications. In general, they are very prosaic documents. There are brief, lifeless minutes of meetings, a formal announcement of future programs, various official notices and then the text of papers which have been presented at recent meetings. The human touch is lacking. One looks through them from a sense of duty. Their advent never receives a warm welcome. Here and there a journal is breaking away from the "cut and dried" model — which only shows that a human document can be produced from the data available in technical societies. The difficulty lies in a slavish following of custom and in intrusting the proceedings solely to a secretary or other officer who has passed the springtime of life and to whom no new event is novel. Publicity is the young man's field. He sees the novel side of each new happening. He glows over incidents toward which the older man is cold. He grows enthusiastic where the other is conservative. He probably has not the maturity and judgment to qualify him to edit professional papers. On the other hand, the staid editor will lack that human sympathy which is necessary to make a journal that appeals to its readers. Most societies could to advantage supplement their editor with a young assistant whose business it would be to put the human touch into their publications.

A Good Example

AN EXAMPLE of what is meant by the "human" touch in society proceedings will be helpful in connection with the brief discussion of the preceding paragraph. The August *Journal* of the American Society of Mechanical Engineers indicates what can be done. First there are the papers presented at meetings of the society. (And be it noted that those deemed of lesser importance are published in abstract, not in full.) Then follows the "society affairs" section. There is running comment on past and coming meetings. It is easy to read—in marked contrast with the usual minutes and programs. A two-column article tells about the decision of the American Society of Civil Engineers to move to the Engineering Societies Building. Its very title is a welcome to the civil engineers, while the text shows much enthusiasm over the coming of the senior body. Short paragraphs on various matters of society interest then lead to a long—and be it noted, illustrated — biography of Ambrose Swasey, who established the Engineering Foundation. The reports from sections are letters, not minutes, each one a little human document telling of the triumphs, the plans, and the hopes of the sections reporting. They are interesting and inspiring. And so the *Journal* runs. Even its necrology is devoid of the formality that usually hedges in society proceedings. No one needs to be told that the editors of the *Journal* have initiative and the milk of human kindness. Their work is sufficient evidence.

A Year in an Active Society

REFERENCE has been made at intervals in these columns to the excellent publicity work of the Cleveland Engineering Society. That, it goes without saying, is not the only, nor the most important, part of the society's activities. In all its affairs it has displayed a virility of which its publicity work has been the outward sign. Those who are actively engaged and interested in the development of the full possibilities of the local engineering society are referred to the annual report of the Cleveland society, which appears in the July number of its *Journal*. Each committee tells its own story, and the stories are well worth reading. The faith and fiber of the organization are shown by these words of the president-elect: "For that building (a home for the society) we want $200,000, and we are going to get it."

Effects of Building Vibration

WHILE the evidence desired from owners and engineers regarding the effects of vibration of buildings upon the occupants, machines and output and upon the structures themselves is evidently difficult to obtain, at least enough has been collected and published in preliminary form to indicate qualitative, if not quantitative, values. The abstract given on page 355 of this issue reveals some conflict of opinion, combined with a lack of exact data, which suggests that all engineers who can aid in furnishing such facts as are requested should submit them for the benefit of the profession. Undoubtedly some of the effects of vibration are merely psychological and difficult to measure, yet none the less real. The designing engineer is directly interested in those methods of design or materials of construction which will reduce all vibration to a minimum, and an increase in the available information on this subject should be encouraged.

Enterprise and Low Bids

ON March 20, 1915, thirty-eight bids, ranging from $270,290 to $633,690, were opened for rebuilding the 4000-ft. bridge of the Cumberland Valley Railroad at Harrisburg, Pa., described on page 340 of this issue. Practically every bid was from a well-known contractor. The price named for the chief item, 56,000 cu. yd. of concrete arch superstructure, with cement, reinforcing and anchor bolts furnished f.o.b. the job by the railroad, ranged from that of $4.73 per cubic yard submitted by the successful bidder to more than $10 per cubic yard. The estimated cost of the work, including materials furnished and work done in building the substructure and removing the old steel by the railroad, was $750,000. The letting was therefore pointed out by one of our contemporaries as a foolish mistake that would ruin the misguided contractor who submitted the low bid, and insure a very poor job for the railroad. On two visits to the work by a representative of this journal, however, both after the back of the job had been broken and trains were running over the new structure, no complaints were heard either of the contractor losing money or of the railroad getting poor work. The job is so evidently first class and the contractor's executives are so far

from contemplating suicide that it is manifest that if a foolish mistake has been made someone besides the railroad and the contractor made it. It is the old story of enterprise and efficiency versus guesswork. The contractor knew exactly what was to be done and how it was going to be done. Indeed, his bid was not so criminally low in the first place, as several others were within a few per cent of it. Instead of loading the contract down with expensive equipment, the work was planned so that it could be done at the specified rate with a remarkably small outlay for plant. The concrete materials were conveyed from cars to form without human handling, and the only power equipment to touch any yard of it was one crane and one gasoline dinkey. Arch forms were devised that did not take a week to move and set up, that were in no danger from floods and that could be adjusted without fuss to both lengths of span required. A type of trestle was provided that gave three tracks in the space usually provided for one, that left 65-ft. clear openings for drift and that could be built and torn down in about the time it takes to look at a framed and bolted structure. The work was arranged so that only enough of this trestle to cross one channel was needed. The I-beams in it alone, but for an unusual flood last spring, would have netted the contractor 150 per cent profit at the end of the job through the increased price of steel. Even as it is, there certainly will not be a loss. No lumber, plant or material that might be good for anything when the job is done has been made up so as to lessen its salvage value. Who can say that bidding of this sort is not good business, or that the contractor with sufficient enterprise to carry it through is not contributing to the progress of construction by contract?

Bay State Railway Decision

BOTH encouraging and discouraging points are to be found in the decision of the Massachusetts Public Service Commission in the Bay State Street Railway case, abstracted on page 342. Although the commission denies the railway company the right to increase its fares to six cents, it turns a deaf ear to some of the plaints of those opposed to the rate increase and shows a disposition to give the company a fighting chance to earn a fair return. For example, the commission does not wholly condemn the company for following the practice common in times gone by of declaring dividends before setting aside a depreciation reserve, nor does it accept the theory that, despite the fact that the company's dividends have in the main been inadequate, deductions should be made for plant paid for out of earnings. And right here it might be pointed out once more to those who see in every investment out of earnings past robbing of the public through excessive profits that many a conservative management has turned back into its property money that could have been dispersed in dividends without swelling them beyond reason.

The commission finds some objection to the estimate method of obtaining original cost, which is the basis of value that obtains in Massachusetts. Advocates of the reproduction basis give as one valid objection to original cost the impossibility of obtaining it accurately in most cases. While the Engineering Record believes reproduction cost, which more nearly represents present value, is preferable in any case, it believes that the estimate method of finding original cost is likely for old properties to be more accurate than the historical method. Certainly the latter is not free from the charge of giving an impression of accuracy not warranted.

The Engineering Record is not sufficiently conversant with the Bay State railway's past to comment on the rejection of claims for intangible values, except to repeat two arguments that seem to it conclusive against treating development expenses as something to be made up by a few years of extra earnings. One is that it constitutes a forced withdrawal of capital, the other that it imposes on the generation of the public that can least afford it a burden for the sole benefit of those who come later. The limiting by the commission of all overhead allowances to 8 per cent seems, however, to clash squarely with experience. The engineers who built the Bay State Street railway must have been foresighted and fortunate indeed if they were able to escape with contingencies less than the 3.23 per cent asked by the company's appraisers, and neither do the other percentages look excessive. In fact, it would appear at this distance that the 12.74 per cent asked by the company was extremely conservative.

Better Utilization of Coal

MORE THAN ONCE the Engineering Record has called attention to the importance of investigating the low-temperature carbonization of coal as a method of conserving our wasted natural resources in fuel. No inconsiderable amount of work has already been accomplished abroad on the solution of this urgent problem, and a recent publication by Prof. H. E. Armstrong forcibly brings to the front the whole situation and emphasizes the lamentable waste now going on. In Great Britain five-sixths of the coal mined is for one purpose or another burned directly, while only from the remaining sixth are the valuable by-products extracted.

It is in the utilization of by-products that modern industry excels, and it is in close attention to avoiding waste that success lies in many branches of industrial work. Professor Armstrong notes with pungent emphasis that while much of the initial work on the low-temperature carbonization of coal was carried out in Great Britain, works for the operation of the process on a commercial scale are still building there, while at least ten similar establishments have been put into operation in Germany, yielding a great supply of necessary raw material for high explosives. If all the bituminous coal capable of successful coking were thus treated an important supply of liquid fuel for internal-combustion engines would be made available; there would be a huge quantity of the crude material for dyestuffs—enough from Great Britain alone to supply the whole world; ample amounts of ammoniacal products for agricultural uses, a vast volume of gas for all sorts of domestic and manufacturing needs, and finally an immense store of coke suitable for all heating purposes, including the highly effective and smokeless operation of steam plants.

To-day, in this country as elsewhere, we are burning up, at small thermal gain, products which amount in value to a large percentage in the price of the raw material. We are lowering the general thermal efficiency of the utilization of the remainder and encouraging the production of smoke instead of suppressing it. We are only beginning to appreciate the vital importance of the chemical industries based on the distillation of coal. The conditions brought on by the present war have been a valuable if costly lesson which should be taken to heart and not forgotten the moment peace brings the resumption of commerce.

Professor Armstrong goes so far as to urge legislation by the British government forbidding the use of raw coal and thus compelling the economic improvements here referred to. Such measures would probably be denounced here as the last degree of paternalism, entirely contravening the spirit of American institutions—which may be summarized briefly in the terms of the old proverb, "Everyone for himself and the devil take the hindmost." But Great Britain has learned some terribly practical lessons on government in the stress of war, and stranger things would happen than some drastic regulations to enforce long neglected economies. The subject is one which ought to be taken up very seriously in industrial circles here, that America may not be left behind in the impending struggle for manufacturing supremacy.

Another Quebec Bridge Disaster

NINE YEARS AGO the engineering public was shocked by the news of disaster to America's greatest structural project—the Quebec Bridge. While still remembered, the event had been dimmed by time, and more so by the confident hope that a still greater structure, although of the same span, would this season successfully bring to a conclusion the expectations of many years. The hope has been dashed. The suspended span, which was to have been erected by a novel method, lies at the bottom of the St. Lawrence. The unparalleled anchor spans and cantilever arms remain standing unscathed, after being put to a most severe test.

The story of what happened—recital of fact—is told in the news section of this issue. The suspended span erected on shore was to be towed to the bridge site and hoisted from the supporting scows to the track level, 150 ft. above. The raising of the 5200-ton load on the scows was successfully accomplished. The 3-mile trip to the site was made without incident and on schedule time. The connection of the span to the hoisting chains, considered the crit-

ical feature of the work, was successfully made. The operation of the hoisting jacks and the falling tide soon freed the scows. They were withdrawn, and for an hour and a half, during which the span was raised in at least seven successive 2-ft. lifts, the huge structure hung free from the cantilever arms, all apparently going exactly as planned.

Then without warning the span slipped into the river, carrying with it, some to their death, the workers on it.

Facts have not been developed which allow the cause of the disaster to be satisfactorily explained. A careful examination of the lifting girders and chains has given no clue. It is doubtful whether we will ever know the initial cause of the failure. The girders and their chains still hang from the cantilever arms. Two of the girders—those that carried the southeast and the northwest corners of the suspended span—make an angle with the horizontal, but that fact is readily explained by the knowledge of how the span went into the river. The hoisting equipment is in perfect condition save for the rupture of piping connections between the jacking platforms and the ends of the cantilever consequent upon the shock. In some way the span slipped from its supporting stirrups. At present, therefore, and possibly for all time, we can only theorize as to the initial cause. Various theories have been proposed and various explanations offered. They can only be weighed with respect to their relative degrees of probability. Facts to test them, to confirm them, to refute them are missing.

First, the theory may be dismissed as least plausible that a main member of the suspended-span trusses failed, and that the slippage from the stirrups followed thereon. While at Sillery Cove, the point of erection, the span had rested on the very supports on which it was being hoisted. Moreover, while so resting it had in place a temporary construction track which was removed before flotation, and also carried a heavy locomotive crane. As a simple span, therefore, it had been stressed higher than while it was being raised from the river.

While, then, the possibility of failure not superinduced by other causes may quickly be dismissed, somewhat more consideration might, were it not for direct confuting evidence, be given to the theory that a difference in elevation of the two corners at one end, combined with a lack of stiffness from the erection standpoint, caused the lateral system to draw two or more main-truss members out of line. But the evidence is indisputable that the two shoes at each end were at the same elevation within a sixteenth of an inch. That theory must, therefore, be dismissed as untenable.

The explanation that would at first hearing seem most likely—that the southwest lifting girder was pulled from its proper place by an extraneous force—must be dismissed as lacking supporting evidence. In fact, the evidence on this head is directly against any such theory. Not more than twenty minutes before the span slipped a very careful examination of all mooring lines was completed and all were found, as they should have been, in slack condition. What rise there was in the intervening minutes slackened the lines still more. Furthermore the removal of the lifting girder would have required a very considerable force. The load on each corner was theoretically 2,600,000 lb., and at present there is no reason for supposing the load distribution to be otherwise. At 5 per cent the force to overcome the friction was 130,000 lb. In addition, plates and lugs added somewhat to the resistance.

The most plausible explanation of the failure is that the casting intermediate between the two pins on the lifting girder on the southwest corner broke. This casting, in fact the whole of this universal supporting shoe at each corner, as well as the lifting girders, carried heavier loads at Sillery Cove, where the span was erected, than during the hoisting operation. Suspicion is directed at the castings only through a process of elimination. Forgings and rolled sections are more reliable than castings, in which concealed flaws are always possible. Furthermore, probably every other detail of the structure and of the hoisting mechanism is more determinate as to calculation than these castings. The shape of the intermediate casting is clearly shown in the drawings and photographs accompanying the article in this issue. While apparently ample in design so that the stresses, as well as judgment can dictate, are conservative, the shape is such that a flaw in one of the wings might allow a crack to start at the root. Total failure would readily result from such an initial crack.

Now that the accident has occurred, it is easy to suggest that the shoes might better have been built of rolled sections and plate; that the bearings, instead of being in semi-cylindrical halves, might have been pin holes; that some auxiliary support might have been provided to supplement the main supporting detail. But the best judgment of the best bridge engineers on this continent said that the detail was sufficient—amply sufficient—for the intended service. Something went wrong, but it was not through lack of ability of those responsible for the work, nor can it be said that the castings were not tested before use. They were tested—and under greater loads than they were presumably carrying when the crash came—for they supported the span at Sillery.

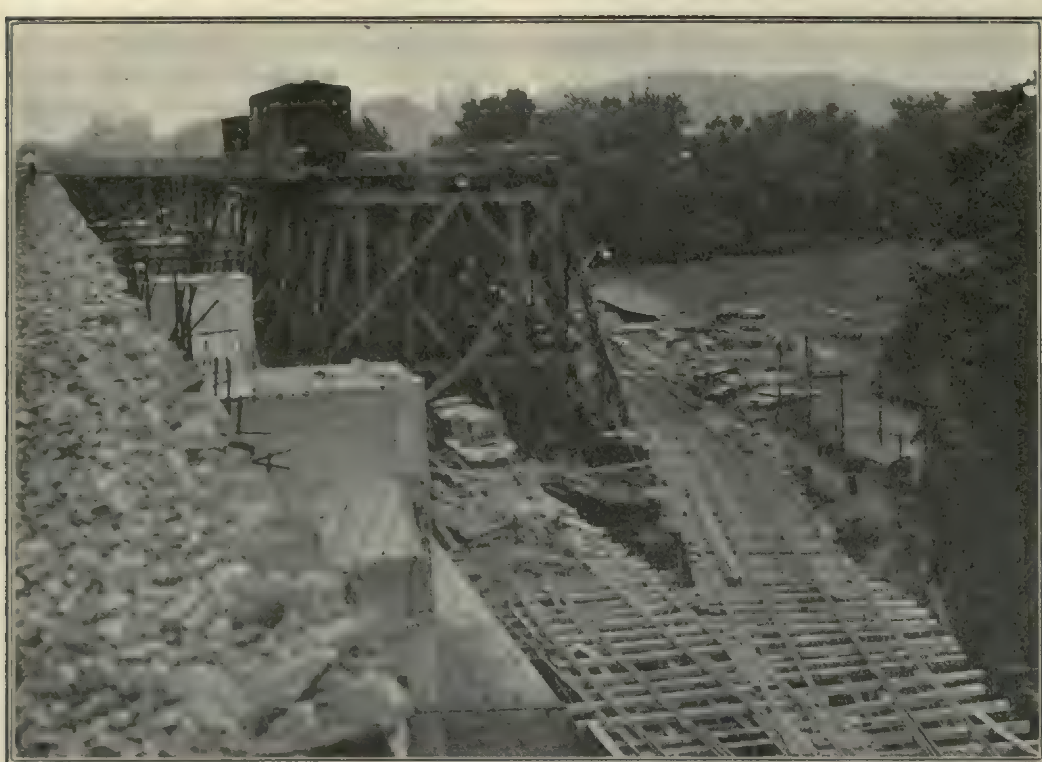
It is natural to look for some inducing cause—even if the breakage of a casting is accepted as the most reasonable explanation —some swaying of the structure, induced by a puff of wind, the unequal working of the jacks, etc. Suffice it to say that there is no evidence of such an inducing cause. No freshening of the wind—which was very light—was felt. The jacks were not operating; the structure had been pinned fast for a full two minutes before the drop came. Vibration from cranes or hoists on the cantilever arms, if any were working at the time, may be considered negligible.

It will be the hope of the entire engineering profession, even, at this minute, against hope, that facts will be disclosed which will allow the mystery to be cleared up. The method was a great step forward in bridge-erection practice. It was originated and developed by the best bridge-engineering talent on the American continent. Its details were thought out with a minuteness and care that were nothing short of marvelous. Moreover, it worked—yes, we repeat it—it worked, even though the span lies to-day on the bed of the river. From the time the span left Sillery Cove until it dropped into the stream there was no hitch in the program. Every operation save one, the driving of the pins connecting the suspender eyebars of the cantilever arms with the suspended span, had been successfully performed. The remaining moves, except the one just referred to, were repetitions of those already made. All the more reason, therefore, for hoping that the error, the accident—call it what you will—may be analyzed.

The loss of the span, while it may in the lay mind cast discredit on those responsible for the work, in reality put the remaining parts of the structure to a most extraordinary test and so proved the ability of the designers and builders. The suspension of the span from the cantilever arms deflected their ends between 9 and 10 in. The application of the load was gradual. Its release, on the contrary, was sudden. Men on the ends were thrown down, while the vibration lasted long enough for one man to run about 250 ft. toward the anchorage. At least the full deflection must have been recovered, and probably the momentum carried the ends above the normal unloaded position. Yet the cantilevers stood—and apparently undamaged. Furthermore, the known details as to the successive steps in the plunge, combined with the evidence of the two diagonally opposite over-stressed hangers, show that very large overloads must have been thrown into at least the downstream truss on the south cantilever and the upstream truss of the north cantilever. But there is no apparent evidence of distress.

The bridge, which has thus received a setback, for it is only a setback, is extraordinary in so many respects that it is a pity it should not have come through with a clean record. The K-truss design, the marvelous precision and finish of the shopwork, the ingenious and highly successful erection methods—each would have made the structure notable among steel bridges, even though the span were less than the record.

Engineers, who must constantly face unknown factors in breaking new paths, will not lose faith in their brethren at Quebec, though the layman, seeing only the outstanding fact of a second serious loss at the site, may be a doubting Thomas. The men at Quebec will stand by their guns. The loss has only served to set their jaws in a determination to complete the structure, and by the method planned. The stamina shown by these men under the strain of the loss was an inspiration. Backed by their determination and ability, the span will be rebuilt and successfully erected.



ALMOST ALL CONCRETE WORK HANDLED FROM THIS CENTRAL PLANT ON WIDE ISLAND

Little Plant Required to Complete 4000-Foot Concrete Railroad Bridge

Build Greater Part of Two-Track Arch Structure Under Traffic with 2 Cranes, 3 Dinkeys, 1 Concrete Plant, 11 Half-Arch Forms and 1/3 Mile of Trestle

A DOUBLE TRACK concrete arch bridge, four-fifths of a mile in length and containing, above water, 56,000 cu. yd. of concrete is being built in longitudinal halves by methods which require the use of a very small amount of equipment. The bridge, which is at Harrisburg, Pa., replaces the old single-track deck truss bridge of the Cumberland Valley Railroad across the Susquehanna River. Two concrete arches replace each of the old steel spans, which were moved 8½ ft. upstream on the old double-track piers and kept in service while the south half of the new bridge was built. Traffic was then diverted over the new bridge, the old steel taken down and work started on the completion of the north half of the concrete structure. With the exception of two spans on the far side of a railroad embankment west of the river, and of a small yardage of concrete placed by the pneumatic method, all of the work was handled from an island 300 ft. wide in the middle of the river.

The small amount of construction plant used is accounted for by the way in which the contractor took advantage of circumstances to develop the work. Briefly outlined, the method followed was to throw 1600 ft. of trestle across the west branch of the river, downstream from the bridge, and carry the new work from it west and toward the island. As fast as the centers could be removed from the westerly arch spans, the trestle was taken up and replaced from the island outward across the east channel. The completion of the work over this channel enabled the railroad to divert traffic over the new structure, as noted in the Engineering Record for Feb. 12, 1916, page 229. The construction trestle was then taken up and stored on the island for the winter while the old steel spans were removed. It was then built out again across the east channel, but on the upstream side of the bridge. The upstream half of the new structure is now being built in the same way as the first half, except that the work is being carried from east to west.

Steel arch centers of one size are used for both the lengths of arch span encountered in the work. These centers are supported on brackets set in niches formed out of the piers, doing away with falsework supports for them. Also, a type of trestle is used which has a high salvage value and which provides three running tracks with four rails.

Concrete Materials Handled by Gravity

The main concrete plant, located in the middle of the island on the upstream side of the bridge, receives all materials by rail. The level of the old bridge being considerably above the island, it was easy to arrange under a trestle turnout from the main line stone and sand bins with a capacity of 150 tons and a cement shed holding about 200 bbl. Sand and stone are delivered in hopper-bottom cars, and cement is dropped down a wood chute to the level of the charging platform. Directly under the partition between the sand and stone bins are located three measuring hoppers which empty into a ½-yd. Haines mixer suspended over the track for the concrete cars. Two of the hoppers are for measuring stone, one being filled as the other is emptied, and the third is for sand. It was planned to install two mixers, but as one proved able to turn out concrete at 35 yd. an hour —as fast as it was necessary to place it— the second was never used. Five batches fill two 1¼-yd. buckets on a platform car, which is handled by a gasoline locomotive. Three of these units are kept going between the mixer and the crane which places the concrete in the forms.

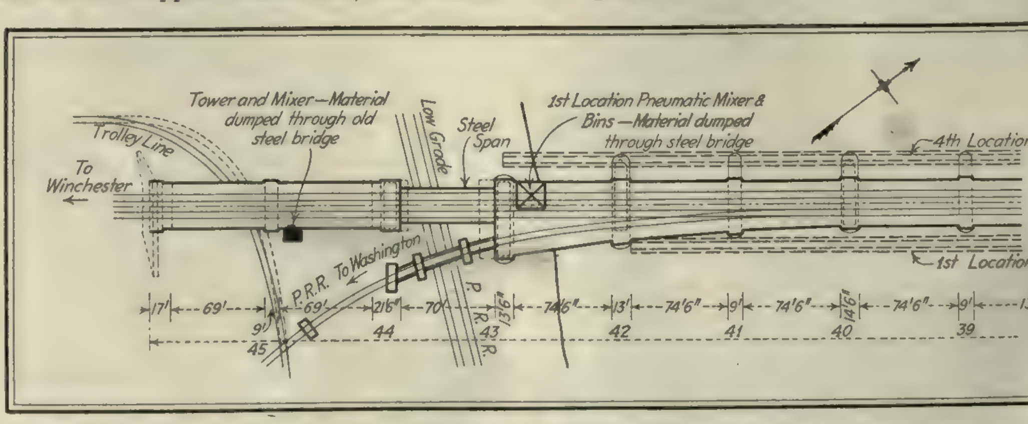
Trestle with High Salvage Value

The type of trestle developed on this work provides three tracks with four rails, the inside track standard and the outside tracks 3-ft. gage. The same type was used in building the Philadelphia & Reading Railroad bridge at Milton, Pa., and was described in the Engineering Record of May 20, 1916, pages 676 and 686. The trestle at Harrisburg differs from that at Milton in that pile driving is not required in its construction. The rock bottom is exposed over most of the channel, and timber posts, cut to lengths determined by sounding with a rod, placed and capped by a gang working from a small barge, were used instead of piles. Some trouble was experienced with this trestle because the rock bottom afforded no anchorage and because the river was subject to floods which produced a strong current at the island. On the other hand, it would have been hard to find a way of carrying on construction without some temporary work in the river. A severe flood on June 18 carried out the entire trestle shortly after it had been erected in its third location, and bent most of the steel stringers around the upstream ends of the piers. The stringers were straightened and the trestle was rebuilt, however, in a very short time.

The track arrangements on the island are shown in the accompanying drawing. It will be seen that the use of three trains and a crossover between the narrow-gage tracks on the island made it possible to supply concrete to the crane on first one and then the other of the outside tracks without having any temporary crossover at the point of work.

Old Piers Utilized

The fact that the river was wide and shallow, with a bare rock bottom, made pier construction simple. The old masonry piers were incased in reinforced concrete to a point above water level and the new



TRESTLE USED IN FOUR LOCATIONS TO MOVE FORMS, HANDLE CONCRETE AND DO PRACTICALLY

UMBRELLA FORMS LINED WITH STEEL AND CONCRETED BY CRANE WHOSE "GOOSENECK" BOOM WAS DESIGNED TO REACH OVER CORNERS

piers built to the same level in the fall of 1914 by the forces of the railroad company. The following winter the old steel spans were moved 8½ ft. north, and in the spring of 1914 the work of completing the intermediate piers was carried on by the contractor with the construction of the south half arches. All of the pier work was carried up to the spring line of the arches during the 1915 season, but the umbrella sections for the upstream half arches were not touched until this year.

One Length Arch Form for Two Lengths of Span

The umbrella sections are concreted before setting the arch centers, and the spandrel walls cast after the arch concrete has set, but generally before the centering is removed, as the specifications require that this be left in place 30 days. Finally the coping, which contains the conduits for telegraph and signal wires, is concreted separately. By employing on the main river section ten sets of half-arch centers, six sets of umbrella forms, six sets of spandrel wall and four sets of coping forms it is possible to keep the concrete plant at work almost continuously.

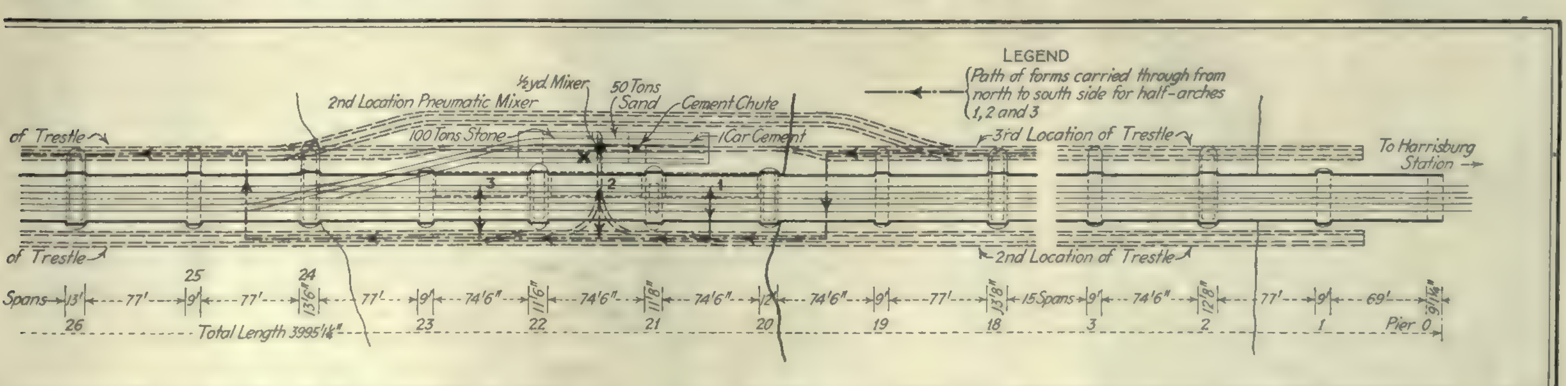
The construction of the arch centering, which is of the three-hinged type with four trusses, tied across the bottom for moving by turnbuckle rods, is shown in the photographs. As it was desirable to use the arch forms in direct rotation, all were made the same size. For the 74½-ft. arches the circle strips that support the lagging rest directly on the top flanges of the arch ribs. For the 77-ft. spans these strips are blocked up from the ribs. Black sheets of No. 24 gage are used for arch lagging. They rest on a double layer of 2 x 8-in. plank spiked transversely to the circle strips. The planks overlap, but are laid with a 1-in. space between pieces in each layer. Every fourth or fifth strip is bolted through. The 2-in. material was used because of the fact that it has a much higher salvage value than the 4-in. which was used at first. It is also easier to work with.

No chances were taken with the river in the support of this centering. Four steel brackets to each end of each arch, set in recesses formed in the sides of the piers, are used. On these brackets parallel to the pier are set 12-in. timbers carrying the rollers used to move the forms sidewise into position from the trestle. As soon as a form is placed it is wedged up to grade, and is later struck by knocking out those wedges and letting it down again on to the rollers. Four trucks running on the outside trestle tracks are used to transport the centers lengthwise of the bridge. During the first season when the steel bridge was in place the centers were, of course, handled on the downstream side. At the end of the season all ten of them were left for the winter under the last spans concreted at the east end of the bridge. At the beginning of the present season they were rolled through to the north side and used for the upstream halves of the same arches, which were the first ones concreted this year.

The road bed on the bridge is carried by a stone fill resting directly on the arches. This fill is retained by the outside spandrel walls; but as the south half of the bridge was put in service before the other half was built, a center spandrel wall extending to within 18 in. of the base of rail was also necessary. The pockets produced by this construction over the arch haunches are drained by 6-in. pipes extending through the arch concrete just above the umbrella section.

Old Steel Removed and Material Track Shifted in Winter

A locomotive crane began last winter to take down the old steel from the east end. As the old spans were about 160 ft. long, they were supported on falsework and taken down a panel at a time from east to west. One of them near the center of the east channel had been about half removed in this way when the flood early last April, on which the ice went out, carried away the falsework and dropped the remaining half into the river. This steel will be cut up at extreme low water with the oxy-acetylene torch and removed from the work trestle.



ALL WORK ABOVE WATER ON 56,000-YARD CONCRETE BRIDGE PROVIDES THREE TRACKS WITH FOUR RAILS AND HAS HIGH SALVAGE VALUE

When the removal of the old steel had progressed past the concrete plant on the island, the trestle connecting the latter with the old main line was rebuilt and a turnout put in the track over the new bridge. When the removal of the old steel bridge was completed, the crane used for this purpose was employed to concrete arches and piers on the island which could not be reached by the gooseneck crane on the track below because of the material trestle being in the way.

ROUTING OF FORMS IN CROSSING ISLAND

The moves to be made with the arch forms in crossing the island for the second time were carefully mapped out because access from the north to all of the arch spans across the island except one span at each side is blocked by the concrete plant and trestle. Three of the forms released from the east end of the bridge were brought up, slipped through the span at the east end of the island to the south side of the bridge, rolled along opposite three of the arches to which access from the north was blocked by the concrete plant, moved sidewise through these arches to the north side and concreted. Meanwhile the remaining eight forms were used to complete the spans across the east branch of the river. These forms are being rolled around the north side of the concrete plant and started in again at the west shore of the island.

RIBS WEDGED UP ON BRACKET SUPPORTS

SOUTH HALF COMPLETED, RIVER EXTENDS UNSOLICITED HELP TO CRANE IN REMOVING OLD STEEL

The forms used on the island will be taken to the west edge, rolled through to the north side and put to work again in regular rotation with the other forms.

This maneuvering leaves one north half arch at the west end of the concrete plant unfinished. This arch is blocked by the trestle turnout. Its completion will be the last work done on the bridge. After everything else is finished, enough material to concrete this span will be stored in the bins, the trestle turnout removed, and one arch center brought back to this location and concreted.

ARCH FORMS MOVED ON TRUCKS

The extreme west end of the bridge consists of a concrete-incased girder span, not included in the general contract, crossing the low-level tracks of the Baltimore division of the Pennsylvania Railroad, which is on a high fill at the river bank, and of two arch spans beyond. As concrete could not be carried across the Pennsylvania tracks, a separate plant, supplied with materials dumped from the old steel bridge, was set up. This plant consisted of a ½-yd. Smith mixer, a short steel tower and a spouting system. Also wood centers were used for these half arches. The centering for the extreme easterly arch span, 69 ft. long, which crosses a road in the park along the east bank of the river, was cut down from a set of 74 ft. 6 in. centering used for one span on the island. When this centering had been used to concrete the north half of the extreme east span, it was trucked across the river and used to complete the two 69-ft. spans beyond the Pennsylvania tracks. These spans, of course, could not be finished until the old steelwork had been removed.

A pneumatic concrete plant, erected near the spouting plant on the west bank of the river and later set up for a short time on the island, was also used for part of the concrete work across the west channel. On account of the trouble encountered with the high velocity of discharge in placing concrete on the arch slopes and in the spandrel walls, concreting by this method was not experimented with long enough to reduce its cost to figures comparable with the cost of concrete placed by the other two plants.

BRIDGE WILL SOON BE COMPLETED

In spite of the six weeks' delay occasioned by the flood referred to, it is expected that the concrete work on the bridge will be completed this season. Arch forms are usually concreted in eight hours, and one of them, containing 275 cu. yd. and distant 1000 ft. from the mixing plant, was completed in 7½ hours. On Sept. 1, 16 of the north half arches had been finished, leaving 29 to be completed.

The bridge is being built for the Cumberland Valley Railroad, of which T. B. Kennedy is chief engineer, under the direction of Crosby Tappan, engineer of construction. A. F. Byers is chief inspector and S. F. Bloyer resident engineer for the railroad. The work is being done by the Robert Grace Contracting Company, for which F. P. Kemon is in charge as superintendent under B. R. Hundley, eastern manager.

Commission Doubts Accuracy of Estimated Original Cost

Massachusetts Decision, Denying Bay State Street Railway Six-Cent Fare, Discusses Numerous Valuation Problems

DENYING the Bay State Street Railway of Boston the right to increase its fare to 6 cents, the Massachusetts Public Service Commission, in a decision rendered Aug. 31, expressed opinions on various points pertaining to valuation and fair return on investment. The commission thinks a 6 per cent return should be ample for the company. It holds that a fair return should be allowed on all the capital properly invested, without deduction of accrued depreciation, and believes that the company should not be condemned too severely for following in the past the common custom of declaring dividends without making allowances for depreciation. On the other hand, it holds that from now on depreciation should take precedence over dividends, even though for a while the stockholders should suffer a complete suspension of admittedly inadequate returns. Other views of the commission are that development expenses should be made up by additional earnings for a few years, and that 8 per cent is ample for all overhead expenses in this particular case.

ESTIMATED ORIGINAL COST

The decision discusses the valuation of the property made by Sloan, Huddle, Feustel & Freeman, consulting engineers for the company. As Massachusetts has established original cost new as the proper basis of valuation, the appraisal, which totaled $42,987,405, embracing 957 miles of track, was made on that basis—not by the historical method of actual investment, but by the application of estimated unit prices at the time of construction to the present quantities as inventoried. The commission believes this method creates an impression of accuracy not wholly warranted, because of the difficulty of making a correct inventory and the still greater difficulty of determining the original unit prices. The commission reduces the total estimate of original cost by $600,000.

The company's engineers had allowed overhead charges, which were estimated, of 12.74 per cent of the direct property cost,

dividing it as follows: Engineering and superintendence, 3.68 per cent; interest during construction, 2.23 per cent; taxes during construction, 0.12 per cent; insurance, 0.48 per cent; organization and legal expenses, 3 per cent; and contingencies, 3.23 per cent. The commission found from appraisals submitted in thirty capitalization cases from 1890 to 1900 an average of only 2.19 per cent for engineering and superintendence in the case of roadbed, track and overhead system, and nothing in the case of other items. The commission realizes the probability that much overhead expense has not in the past been segregated, but believes, nevertheless, that the estimate exceeds the reality. Contingencies also, the commission believes, have been overestimated. Consequently the allowance for overhead expenses is reduced to 8 per cent—a reduction of $1,822,344.

No evidence was introduced by the company to substantiate its claim of intangible property, embracing reward for promoters' services, cost of securing plant and cost of development. The first claim was that a certain amount of overcapitalization was necessary to reward the promoters and attract capital. The commission avers, however, that most of the "watering" was done during the electrifying of the lines, long after the promoters' stage, the promoters apparently having sought their reward in construction contracts and enhanced land values. Development expenses, in the opinion of the commission, should be charged to earnings—opportunity being given to spread them over a reasonable period of years, but not indefinitely.

The commission rules that no deduction shall be made for accrued depreciation. While the commission does not commend the paying of dividends before a reserve has been set aside for depreciation, it holds that the company should not be condemned too severely for following a prevailing policy in the past in doing this, especially as even then dividends have averaged less than a fair return. It is pointed out that companies under the Massachusetts laws that are not paying dividends find difficulty to finance their needs. For the future, however, the commission holds that needed repairs and renewals should take precedence over dividends, even though it seem harsh to stockholders already receiving only a meager return. Six per cent, in the opinion of the commission, would be ample.

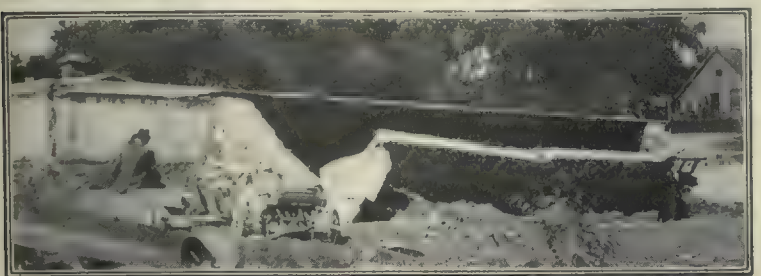
Tar Patching on Concrete Roads

The Ohio Highway Department in patching concrete roads cautions its maintenance gangs not to apply so much tar that it will stand above the level of the concrete surface. If a mound of tar is placed, the pavement is likely to be shattered beyond the mound from the drop of vehicles raised by the patch.

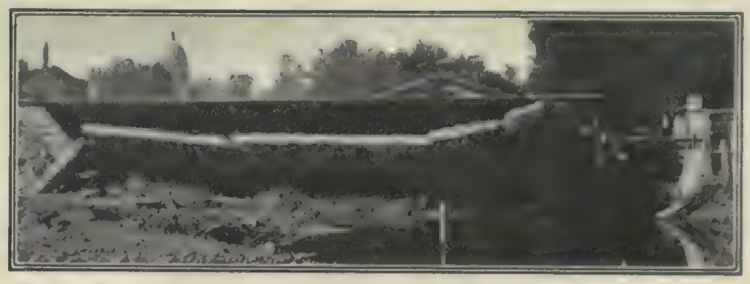
Reservoir Wall Fails When Backfill Is Removed

Faulty Construction at Roof Due to Failure of City Officials to Put on Inspector Said to Be Contributing Cause

On Aug. 26 the 1,000,000-gal. reservoir constructed by the city of Madison, Wis., in 1906, of reinforced concrete, rectangular in plan, about 100x116 ft., partly failed. The reservoir is 16 ft. in depth and has a reinforced concrete roof. Against the outside walls of the reservoir is an earthfill extending up to about 10 ft. above the base. The walls of the reservoir were designed as a simple vertical reinforced beam, supported in part by the earth embankment and in part by the connections at the roof. The specifications called for the reinforcing rods of the roof to be hooked around the vertical reinforcing rods of the walls, but no specific method of doing this was shown on the drawings, the horizontal rods simply extending about 18 in. into the top of the vertical wall.



THIN RESERVOIR WALL ROTATED OUTWARD ON ITS BASE



WALL DID NOT BREAK UP MUCH DUE TO ESCAPING WATER

Funds for Inspection Refused

The city refused to provide funds for an inspector during the construction, as was desired by the engineer who drew the plans, and in consequence the engineer had no further connection with the work. Apparently no attempt was made to carry out this feature of the specifications, and as a result the stability of the wall of the reservoir depended almost entirely on the backfill of 10 ft. of earth on the outside. Signs of failure by the slight yielding of the wall in places had been noticed five years ago, but were not thought to be serious, as the cracks formed thereby did not increase further in size, and the embankment alone appeared to give sufficient stability. The roof was also slightly cracked in several places, and to prevent infiltration of rainwater an additional cover was put on the reservoir.

NO APPARENT ROOF CONNECTION

Unfamiliarity with Conditions Cause of Failure

In 1916 plans were made to build another reservoir of 15,000,000 gal. capacity immediately adjoining the one already built. The engineer planning the new reservoir and also the engineer in charge of the city water department were evidently unfamiliar with the weakness of the old reservoir as regards the roof connections, and using caution which would have been ample for ordinary cases proceeded to remove a part of the backfilling. The result was that on Aug. 26, with a length of about 15 ft. of the backfilling removed along one side adjoining the corner, about 60 ft. of the side wall of the reservoir failed, tipping about the base as a center. The results are plainly shown by the photographs.

Engineers who have examined the circumstances and the wreck state the best lesson to be learned from the failure is that the engineer in making plans for reinforced-concrete structures must insist on retaining full control of inspection until the structure is completed.

Unwatering Holland's Overflowed Lands

In the early part of this year an exceptionally heavy storm broke the dikes on the coast of the Zuider Zee and 50,000 acres of valuable land was flooded. The ground surface was about 4 ft. below the level of mean tide. The unwatering was accomplished by means of pumps manufactured by the Werkspoor Company of Amsterdam. These were assisted by the pumping plants which normally take care of the drainage. The temporary plants had a capacity of 120,000 tons of water per hour. With the exception of one, which was driven by a Diesel engine, they were all electrically propelled, current being furnished by the municipal electric works at Amsterdam. With this equipment, assisted, as before stated, by the regular pumping installation, the area was unwatered in a little more than three weeks. The *Engineer*, from which these notes are taken, states that the same part of the country was flooded in 1825, and that it took from February of that year to July of the following year to get rid of the water, all of the pumping being done with the aid of windmills. All in all, including the building of the pumps and their installation, this year's unwatering was accomplished in less than four months from the time of disaster.

Wind Damages Highway Bridge

Tornado Nearly Overturns Sugar Island Structure in Illinois — Portals Badly Distorted and Lower-Chord Eyebars Buckled

AS A RESULT of the destructive storm on March 21, a steel bridge over the Kankakee River, known as the Sugar Island bridge, was considerably distorted; in fact, it was nearly wrecked. The Iroquois County bridge was completely destroyed by the same storm. Damages to both bridges have been described in *Illinois Highways*. In the July issue Clifford Older, bridge engineer of the Illinois Highway Department, discusses the damages to the Sugar Island bridge. The following abstract from his article describes particularly the effect of the wind on the portals, lower chords and masonry of the west span, which was most injured.

The bridge consists of two spans, each 185 ft. long center to center of end pins. The steel trusses are of the Pratt type, 26 ft. high and placed 17 ft. 2 in. apart. The exact date this bridge was erected could not be determined at the time examination was made. The details and general character of the design are typical of highway-bridge construction common about 15 years ago.

Displacement of Upper Lateral System

One of the photographs shows the trusses of the west span leaning decidedly toward the north. The east span was not so badly damaged, but it also has an inclination in the same direction. It is evident that the wind was blowing in a northerly direction. The top chords, although displaced laterally, were found to be in perfect alignment, and the top lateral truss and diagonals were practically undamaged. It is evident that the top lateral systems served, as intended, to carry the wind load to the portals. The latter, however, proved to be too weak to transmit, without damage, the accumulated top-chord wind load down the end posts to the foundation.

The condition of the west portal of the west span is shown in one of the photographs. It is interesting to observe that the distortion of the portal occurred largely in the part between the kneebraces. The lacing bars were flat and connected by one rivet at each intersection. They buckled in the compression system and some of the bars in the tension system were pulled apart.

VIEW LOOKING WEST SHOWS TRUSSES OF FAR SPAN LEANING TOWARD NORTH

It seems evident that, provided a no more serious weakness developed elsewhere, complete failure of the portals would have been caused by a slightly greater wind load and the tipping over of the trusses and complete collapse of the spans would have followed the failure of the portals.

Lower Lateral System

A partial failure of the lower lateral system of each span occurred—in the case of the west span, even had the portals and top lateral system held, complete failure was imminent because of the weakness of the lower lateral system. The lower chords of the trusses, as well as the floorbeams and lateral rods, are, of course, an essential part of this system. The lower chords are composed of eyebars throughout the entire length of the span. The lateral rods are round, passed through holes near the end of the floorbeam and in bent plates riveted through the floorbeam webs on the far side. The ends of the rods are threaded and provided with nuts.

One of the diagonals was subjected to compression during this storm, and pushed through the holes of the floorbeam and connection plate until the nut was 1 in. or more away from the bent plates. As in the case of the upper laterals, the tension diagonals did not fail, although the bent plates were somewhat distorted by the pressure of the nuts and the rods were probably slightly overstressed. Partial failure of the system occurred because of the reversal of the dead-load stress in the lower-chord bars on the windward side of the bridge. The lower chords, although displaced laterally, were found to be in perfect alignment from the second-panel point at one end to the second-panel point at the opposite end of each truss.

Masonry Stones Displaced

It is evident that the wind force brought to the shoes in excess of that necessary to overcome the horizontal component of the dead-load thrust of the end posts would have a tendency to pull the shoes off the foundations. This excess stress was sufficient to displace the stones on which the shoes rest at the pier. The movement of the upper ends of the end posts would also tend to rotate the shoes and probably aid in this displacement. It is doubtful if much uplift occurred, because of the lack of sway-bracing and the failure of the portals. No hinged bolsters were provided, but rollers were in place under the pier shoes. This expansion device appears to have been sufficiently serviceable to have permitted a recovery movement of the lower end of the end posts when the wind load was released, limited, however, by the length of the slotted holes through which the anchor bolts passed. The final position of one of the anchor bolts with respect to the slotted hole in the shoe is shown in one of the photographs.

The horizontal component of the dead-load stress in the end posts was not sufficient to

LOWER CHORD BARS BENT IN END PANELS

MOVEMENT OF SHOES DISPLACED MASONRY

WEST PORTAL OF WEST SPAN BADLY DISTORTED

push the shoes back to place after the wind subsided. Neglecting uplift, this would lead to the conclusion that the total wind force applied to the shoes during the storm must have been more than double the horizontal component of the dead-load stress in the end posts. Approximate computations seem to indicate that the wind pressure per linear foot of lower chord must have been in excess of 220 lb. The present specifications of the Illinois Highway Department require that a wind load of 300 lb. per foot should be provided for in the plane of the lower chord and 150 lb. in the plane of the upper chord. These specifications also stipulate that the lower chords, as well as all other members, must be composed of shapes capable of resisting compression as well as tension.

Giant Revolving Shovel Used at Gravel Plant

Solves Troubles with 150-Foot Face in Pit by Cutting 85 Feet from Base—Feeds Mechanical Crushing and Loading Plant

A GRAVEL PIT with a working face 150 to 175 ft. high which, in spite of careful blasting and hand trimming, was subject to frequent slides that buried the railroad shovel employed and shut down the entire plant, is now being worked with safety and speed by a 3½-yd. Bucyrus revolving shovel of the double-track type that has been used extensively in stripping coal mines. The plant, that of the John B. Rose Company on the Hudson River at Marlborough, N. Y., produces sand and crushed gravel. The material is handled from the screen on which the shovel deposits it by a system of conveyors through the crushers, washers, sand separators and screens to the bins and storage piles, from which the loading belt and two underground conveyors which feed it draw material to be loaded in cars of the West Shore Railroad or to be carried across the railroad to barges at the loading dock.

The large revolving shovels themselves are something of a novelty, having been designed to remove 30 to 40 ft. of overburden from coal seams and cast it so far at the first handling that a strip of coal 112 ft. wide could be exposed by operating from one line of track. It is said that this is the second one of these shovels to be employed for another purpose than coal stripping, the first having been installed a short time ago in a similar gravel pit in the central states. With its great reach, this shovel dispenses with transportation from the pit to the belt supplying the crushing plant. At intervals of several months or a year this

SHOVEL HANDLES HIGH FACE

belt can be extended as the shovel progresses. The big machine, which can reach the toe of the bank from a distance of 85 ft., has nothing to fear from slides, especially as the material is not stiff enough for a perfectly vertical face to develop. The shovel is operated with a full-circle swing. By not reversing to dump, both power and time are saved, and the operator can work more easily and quickly.

Shovel Increases Output

Formerly a dragline machine was used to handle material from the railroad shovel to the crusher plant, and a large gang of laborers employed to blast and trim the face. It was difficult with this equipment to keep the plant supplied with 1000 cu. yd. of material a day. The big shovel can easily handle 4000 cu. yd. a day, and its use has cut the force to 15 men, including the shovel crew of 4. The plant, originally designed for an output of 1500 yd. in 10 hours, has been enlarged until it is possible to produce 2500 yd. of marketable materials per 10-hour day. The enlarged plant is to be duplicated, so that the full capacity of the steam shovel may be utilized. Meanwhile, in order to catch up with deliveries, a large number of electric lights, ranging from 40 to 1000 cp., have been installed, and the present plant will be operated day and night.

Material is deposited by the shovel on a 1½-in. grizzly screen, all the boulders being mud-capped. About 10 or 12 lb. of dynamite a day is used in this way. From this screen a pan conveyor takes material to the top of the crushing house, where it passes through a bull screen to the main conveying belt. Material rejected by this screen goes to a No. 7 gyratory crusher, from which it passes to a second 1½-in. screen. Material too large for this screen goes to No. 4 twin gyratory crushers, from which is passes to a third 1½-in. screen, rejections from which go back to the pan conveyor. The main conveying belt takes material to twin scrubbers located at the top of a structure over the stone bins. From here it passes through sand separators and successive 1½-in., ¾-in. and ⅝-in. screens, below which are a second and third set of sand separators.

Belt Conveyors Used

All sizes of stone are dropped from the screens directly into the concrete bins. The sand is taken up a bucket elevator to a belt conveyor, which carries it to the sand storage pile of 30,000 yd. capacity. The gravel coming from the ⅝-in. screen is taken to a storage pile of the same size by an aerial belt conveyor, 220 ft. long, suspended from cables. These cables are anchored to the top of the concrete bin structure and to a mast set at the far end of the storage pile.

Underground conveyors from each of these storage piles take material to the main loading belt, which is fed from them by an elevator at the river end of the stone bins. This belt itself extends beneath the stone bins, and transports material across the double-track main line to the river, and to sidings on the West Shore Railroad. Material may be diverted into cars by a tripper located over the sidings. At the far end of the loading belt is a washer for cleaning the gravel again before it is loaded. A short conveyor and a spout take material from this washer to the river barges. Under this washer is located the main 10-in. pump which supplies 2000 gal. of water per minute for the plant. The entire plant except the steam shovel is driven electrically with current purchased from the Central Hudson Gas & Electric Company of Newburgh, N. Y.

With the exception of 18 in. of soil at the top, practically none of the material excavated is waste. The gravel is sold along the Hudson River and to a large extent in the New York City market. The ½-in. gravel is used extensively in road surfacing, and the sand is largely employed in making brick at the adjacent yards of the John B. Rose Company and other brick yards on the Hudson River. The sand is also sold for building purposes and for subway construction in New York City. The plant is in charge of George C. Hudson, superintendent for the John B. Rose Company.

SAND STORAGE AT LEFT, CRUSHER HOUSE AND PIT IN LEFT BACKGROUND, SCREENING PLANT AND STONE BINS LEFT CENTER, FINE GRAVEL STORAGE AND 220-FOOT SUSPENDED CONVEYOR RIGHT CENTER, LOADING BELT AND SPOUT AT RIGHT

Colorado River Conditions This Year Unprecedented

Severe Floods in Lower Sections of Stream Attributed to Discharge of Gila River

By L. M. LAWSON
Project Manager, U. S. Reclamation Service, Yuma, Ariz.

LOWER COLORADO RIVER water conditions for the present year have differed largely from previous records of measurement. The erratic and unprecedented discharge is almost entirely caused by the principal lower river tributary, the Gila River, of Arizona. This stream, with an annual runoff at its mouth in the Colorado just above Yuma varying from zero to 3,000,000 acre-feet, has in previous years, notably 1891 and 1905, augmented the normal discharge of the Colorado to menacing proportions. In fact, all known floods from upper Colorado River sources have been of much less volume and gage height, and consequently less danger to the large irrigated area in Arizona, California, and the Republic of Mexico bordering on the lower river. The section of the river below Yuma, passing through this now large irrigated and heavily producing district, received the full force of the flood waters of both very different drainage areas.

The spring runoff from the melting snows in Wyoming, Colorado and Utah, while occasionally of long duration, has its peak flattened in passing through the long stretch below the Grand Cañon, and the gradual, steady rise permits sufficient scouring and lowering of the sand and silt bed to accommodate without extreme gage height the increased flow. The flashy rises caused by the Gila River discharge have less time to effect deep scour in the short period of the increasing rise, and present much more of a menace to the levee-protection system of the valley lands.

The discharge of the Colorado from its upper drainage area for the period of the present year so far elapsed can be classed as close to normal and the severe flood conditions in the lower river experienced in January and February are attributed to the flow of the Gila. Similar in cause and effect to the floods of 1891 and 1905, precipitation in the region of the upper Gila tributaries in a few days amounted to more than the entire year's normal rainfall. This produced a discharge at Yuma greater in amount, duration and gage height than any previous measured flow. Compared with the discharge from the upper Colorado, its crest was 70,000 sec.-ft. in excess of any measured flood stage.

The gaging station of the U. S. Reclamation Service at Yuma was established in 1903. Previous to that time the only records kept were gage heights, beginning in 1878. Because of the shifting bottom, no accurate estimate of flow can be applied to these river-height observations. A study of the precipitation records of stations in the Gila River drainage shows that the 1891 flood from that source may have equaled in magnitude the 1916 discharge. Table 1 exhibits the comparison between maximum flood runoffs of both drainage areas.

The characteristics of the lower river in the matter of its bed-scouring action are well illustrated by comparing the cross-sections of the low-water period of September, 1915, with the flood measurements of January, 1916 (indicated in Table 2).

In all probability the scour section has been greater at times of other flood discharge. In fact, soundings made during the 1909 Colorado River flood showed a depth of 66 ft. at the Yuma station. This is accounted for by the relatively quick rise of the Gila discharge compared with the more gradual and steady increase in discharge of the flow from the upper Colorado River sources.

TABLE 1—FLOODS IN LOWER COLORADO RIVER AT YUMA GAGING STATION

Date	Gage	Discharge, second-feet	Source
Feb. 27, 1891.	33.2	(not measured)	*Gila River, Ariz.
March 20, 1905	30.3	110,800	Gila River, Ariz.
June 24, 1909..	30.7	149,500	†Upper Colorado River
Jan. 22, 1916	34.0	220,000	Gila River, Ariz.

*Area Gila River drainage, 56,000 square miles.
†Area Colorado River drainage, 169,000 square miles (above mouth of Gila River).

In the matter of changes in river bed it is of interest to note the results of the determination of the river gradient as affected by the change in location from the old route to the Gulf of California and its present course through the Bee River and Volcano Lakes. Beginning in 1909, when the river channel shifted to the Bee River location, and continuing to date, the average of all gage heights is approximately 2 ft. lower than the previous records, notwithstanding the fact that quantities of discharge made no corresponding decrease. The writer is informed that little of the large flow of the January flood found its way down the old channel to the Gulf.

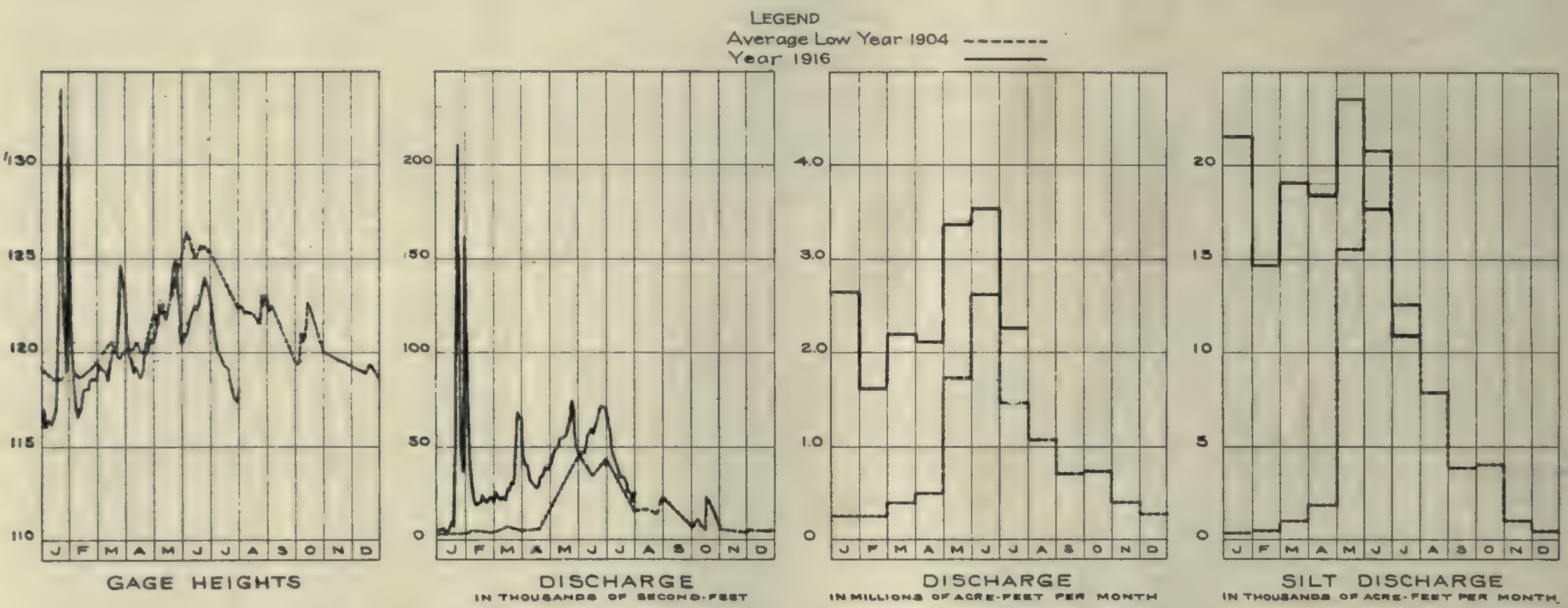
The amount of sediment carried during the past flood stage has been observed and recorded. These observations have been in progress since 1909 and are made triweekly, at times of stream measurement. The percentages by weight vary from 0.04 to 1.26, with the maximum proportion occurring when the discharge is about 25,000 sec.-ft., which represents the bankful stage. During the one month of January, 1916, more than 21,000 acre-feet of silt and sand in suspension passed the Yuma gaging station. The Gila River, with a gradient of more than three times that of the Colorado, contributes when discharging a large amount of the sediment to the lower river.

The effect of this flood condition on the irrigation and protection works of the Yuma project has been reported in this journal. The Laguna dam, located above the mouth of the Gila River, diverts only upper Colorado River water for irrigation purposes of the Yuma project. Provision for sluicing operations and regulator gate control, provided in the construction of the weir, results in the removal of 50 per cent of the heavy sand and silt from the river water. Original plans considered the location of the main canal through the Gila Valley with a crossing under the Gila River. Fortunately the Colorado River siphon was substituted for this plan. The maintenance of a structure of any reasonable length against the wide meanderings and large discharge of the Gila would have been very difficult.

TABLE 2—BED-SCOURING CHARACTERISTICS OF RIVER

Date	Gage	Discharge, sec.-ft.	Area, sq. ft.	Width, ft.	Max. depth ft.
September, 1915	114.5	2,700	1,410	410	6
January, 1916	134.0	220,000	24,000	600	60

The accompanying diagrams of discharge, gage heights and sediment show conditions at the Yuma gaging station for the first seven months of the present year. For comparative purposes the hydrographs of the year 1904, an average year, are also plotted. No record of any year since the station has been maintained is in any way similar to the flow as recorded during the present season.



COMPARISON OF COLORADO RIVER DISCHARGE, GAGE HEIGHTS AND SEDIMENT FOR YEARS 1916 AND 1904

DUMPING TWO YARDS OF WET CONCRETE INTO HOPPER THAT FEEDS TOWER SKIP

Motor Trucks Distribute Materials Within the Job

Wet Concrete Handled at 20 Cents a Yard Saves Building Second Plant—Possibilities of Truck as Construction Tool Brought Out on Cleveland Bridge

"LET ME PUT my motor truck on the job and I'll cut out this 19-man shovel brigade and put that slag right in the cellar where you want it."

Mr. Mullen, of Masters & Mullen, contractors for the Frederick Building in Cleveland, had been impressing on the speaker, A. D. Bender, secretary of the Cleveland Macadam Company, the urgent necessity for faster deliveries of slag, used on the building as concrete aggregate. The owners of the Frederick Building were in a hurry to occupy it, and in view of that fact the sight of the narrow street, a line-up of teams and nineteen men laboriously shoveling material, was depressing.

They had studied the possibilities of backing up the teams in the street to dump into the cellar, and of arranging to drive them within the lot lines—and the study had increased the depression. Then it was that Mr. Bender played his trump. He had just bought the first back-dumping motor truck in Cleveland—the third truck ever built by the White Company. In making the proposal with which this tale opens he was confident that the truck would save the day.

Mr. Mullen, however, was less sanguine. "You couldn't even get in here with that thing, much less dump and get out," he declared.

He was finally persuaded, however, to cut a hole in the fence and give the despised truck a chance.

An hour later, standing with Mr. Mullen on the same spot, Mr. Bender enjoyed his triumph. The truck, with 6½ yd. of slag, drove into the narrow street, backed up to the fence with ridiculous ease, dumped its load into the cellar and drove out—in less than a minute. Mr. Mullen took one look and departed hastily to put the nineteen shovelers to more productive tasks. Thereafter there was no question of the sufficiency of the slag supply.

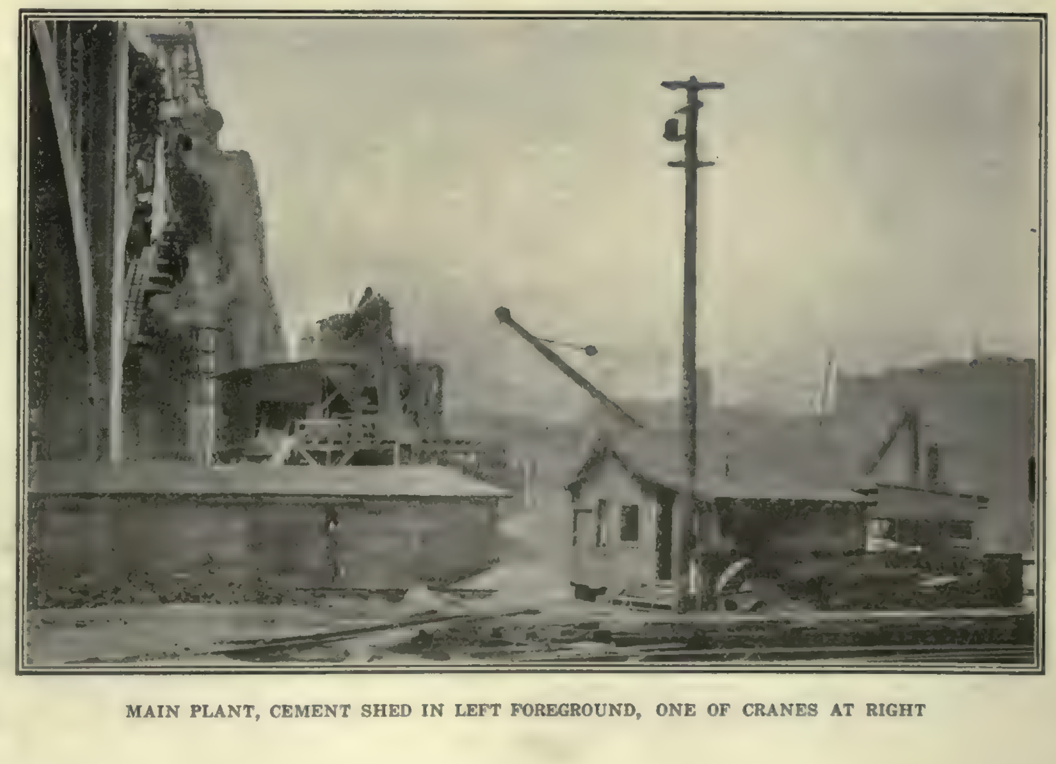
Parts of Long Bridge Difficult of Access

From that day on the possibilities of thus handling materials in large units at high speed have been developed in Cleveland until motor trucks have made easy the building of a $2,500,000 bridge so situated that materials could hardly have been handled cn it otherwise without the most elaborate plant. Though the Detroit-Superior viaduct had both water and rail delivery of materials to within the shadow of its arches, yet access to its different parts, built under separate contracts, was made so difficult by facilities in use under and around it that it is doubtful if any mechanical plant could have been designed to obviate handling the construction material by street.

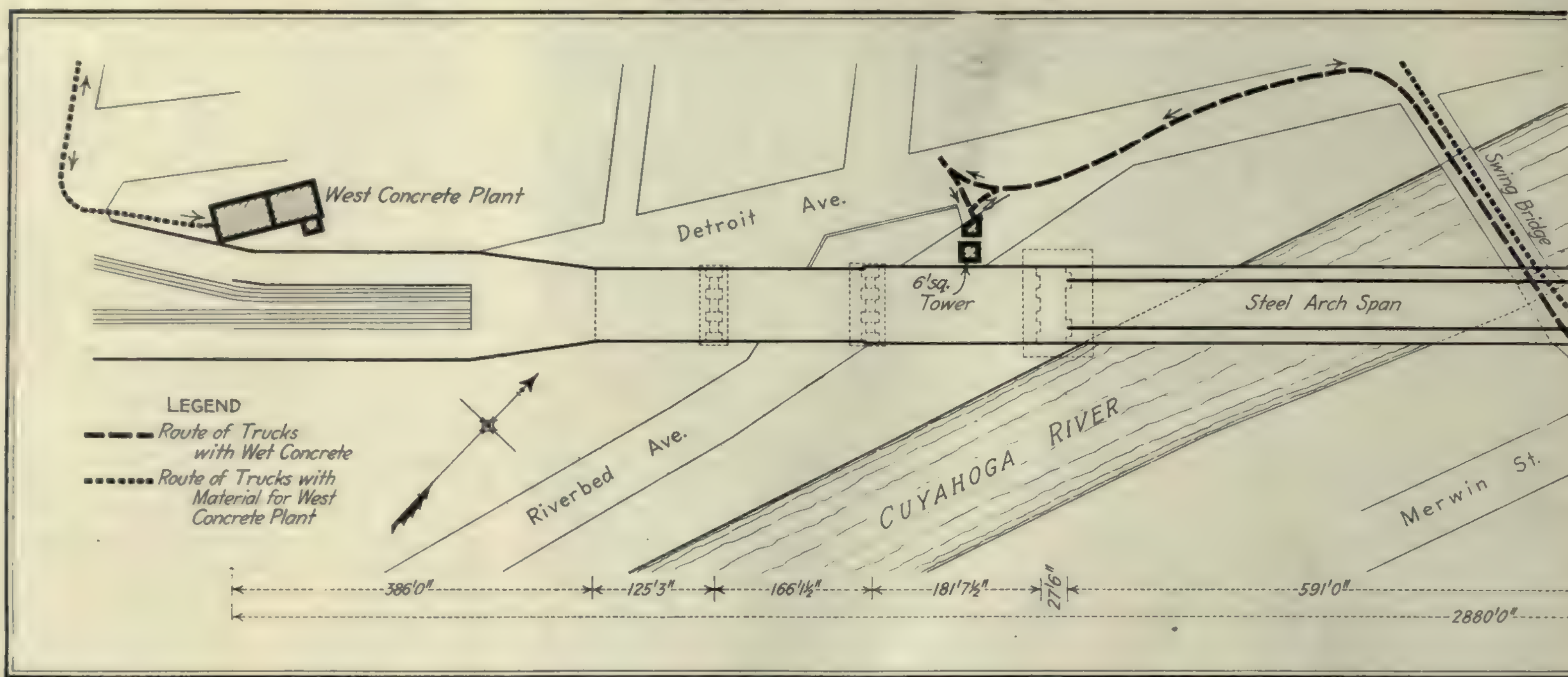
The problem of distributing and placing 63,000 cu. yd. of concrete in the superstructure of a bridge 2880 ft. long would be a large one under any conditions. Moreover, in this case the substructure was let to separate contractors, who had to provide for mixing and placing 45,000 additional cubic yards of concrete. Besides, form lumber, reinforcing and supplies had to be transported. The concrete superstructure was separated into two distinct parts by a navigable river crossed by the main 591-ft. steel span. A railway yard, buildings, a passenger station, several streets and a low-level swing street bridge lie wholly or partly beneath the structure. Though there were both rail and water delivery to within the lines of the bridge, they could be taken advantage of only on one side of the river. The construction trestle, the cableway, the central spouting system and other types of plant could not, singly or in combination, have handled the materials for the entire contract without some connecting link across the river. The only connection available at reasonable expense was over the city streets and the low-level bridge.

Materials Supplied at 60 Tons an Hour

These streets were narrow, steep and by no means smooth. Five years ago no one would have counted on a progress in concreting that meant delivering over their 10-per cent grades 60 tons of material per hour. This speed was necessary in the present case, however, as little storage space could be provided to stock up before each day's concreting, and it was actually maintained by three motor trucks. These units, making a 1-mile round trip from the receiving dock to a concrete plant set at the extreme west end of the bridge, kept up this pace without delay or breakdown while 8000 cu. yd. of concrete was poured from this plant. At the same time other trucks owned by the Cleveland Macadam Company, and one of them the original truck referred



MAIN PLANT, CEMENT SHED IN LEFT FOREGROUND, ONE OF CRANES AT RIGHT



LONG BRIDGE EXTENDING OVER STREETS, BUILDINGS, TRACKS, ANOTHER BRIDGE AND A RAILROAD STATION WAS

to, hauled 500 yd. of slag every 24 hours for a period of two months for the concrete in the river piers. The half-mile haul from the material yard to the piers represented but 12 cents per yard of the cost of this slag delivered.

Trucks in the employ of several other supply firms have hauled cement, sand, stone and supplies continuously from the start of the work for one or another of the contracts. The White Company has estimated that, all told, 44 trucks of its make and some built by other firms have handled materials for this bridge.

Trucks Distribute Concrete

Continuous concreting with limited storage space and handling materials on the job in limited road space have not, however, been the greatest achievements of the motor trucks on this contract. Three of them have supplied concrete from the main mixing plant east of the river for continuous pouring on the west viaduct. The first half of this west viaduct was concreted from the plant mentioned previously, which was on the west edge of the valley level with the roadway of the bridge. While convenient for the first part of the west viaduct, the relocation of this plant in the valley floor would have effected a saving in concreting the last 8000 yd. But a concrete plant was already in operation on the east bank which could be used on the east viaduct only part of the time, because its capacity exceeded the rate at which forms could be got ready. It was to this plant that water and rail deliveries supplied materials direct.

The question arose, if concrete materials from this location could be transported separately fast enough to run a plant continuously on small storage, could not mixed concrete be transported from this plant fast enough to keep a tower and spouting system with no storage in continuous operation?

This idea was put into execution, and a tower whose skip could be filled from a hopper into which trucks could dump wet concrete was located between piers 2 and 3. Thus the building of an additional mixing plant was saved, and the plant already in operation was utilized to capacity.

The last concrete plant, from which all the work is now being handled, consists of a 1-yd. mixer mounted under bins supplied with sand and gravel by bucket elevators, which are fed by two cranes on the river bank. Cement, delivered by rail, is hauled on an automatic dumping car up an inclined track from the cement shed to the charging platform. The east viaduct is being concreted by cableways which handle buckets from cars through holes left between the ribs of the span in front of the mixing plant. These cars are hauled by cable a short distance to the concrete hopper under the mixer on a narrow-gage track. When not in use the cars are moved out under the bridge and the motor trucks drive right over the track.

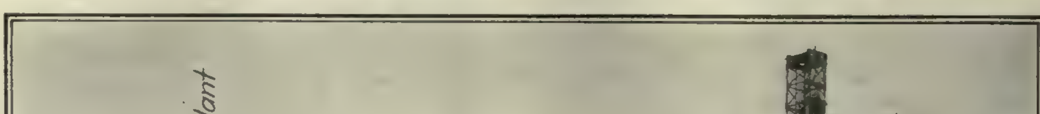
Hauling Concrete at 40 Yards an Hour

The successful hauling of wet concrete to supply a spouting system is made possible by the fact that each of the three 5-ton White trucks employed is able to deliver 2 cu. yd. of mixed concrete every 8 min. This provides a continuous supply for the 1-yd. tower skip, which makes pouring possible at the rate of 40 yd. an hour. The dependability of the system hinges on that of the trucks. Continuous pouring is essential for every unit of the superstructure, and had not the trucks been as reliable as any other type of plant the scheme could never have been worked successfully.

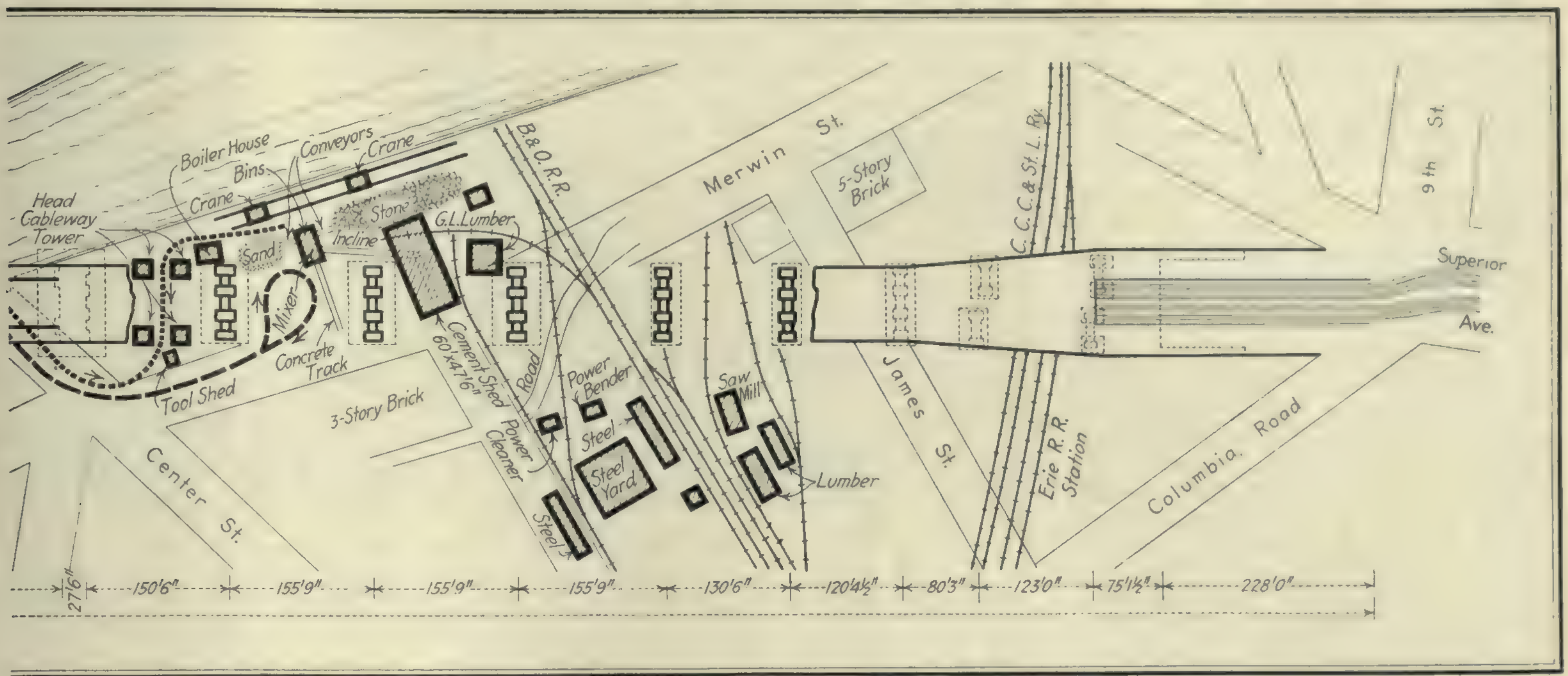
The trucks back up to dump, which takes about 45 sec. Loading from the hopper into which the mixer discharges takes 20 sec., and the round trip of ½ mile can be made in 5 min. The running time does not average this, however, as the swingbridge over which the trucks must pass is frequently opened for short periods, an hour a day being often lost on this account.

Two of the trucks are rented, and valuing the use of these and of the third truck, owned by the contractor, at the prevailing charge of $2.50 an hour, it costs 20 cents per cubic yard to transport the concrete this distance. It would have cost 50 per cent more to haul the material separately, and the contractor has also cut his expense on the job by the cost of providing and operating an additional concrete plant. When the contractor's truck is not hauling concrete it is delivering reinforcing, forms and supplies from the bending tables and storage points to places where work is in progress.

On this one bridge it has been possible for the different contractors to locate their



FROM PLANT ACROSS BRIDGE AT LEFT TRUCKS CARRY WET CONCRETE TO TOWER



BUILT WITH THE HELP OF MOTOR-TRUCK TRANSPORTATION BETWEEN DIFFERENT PARTS OF THE WORK

concrete plants at the point of work and rely on continuous delivery from material yards at the capacity of the plant because of the development of the motor truck. It has also been possible to locate one of these plants with reference to water and rail delivery of materials and rely on its placing concrete in continuous runs a quarter of a mile away and across the river—again because of the development of the motor truck. Although no attempts have been made to break records in its construction, it is difficult to see how this bridge could have been built at the speed attained without trucks. Certainly to have done so would have required a very elaborate plant, complicated by the necessity for keeping in use the river, the streets, the railway tracks and the buildings beneath and adjoining the structure.

The bridge is being completed for Cuyahoga County under the direction of W. A. Stinchcomb, county engineer; A. W. Zesiger, bridge engineer, and K. D. Cowen, engineer of construction. The contractor for the east and west concrete viaducts, on which a great many of the transportation problems have come up, is the Hunkin-Conkey Construction Company, for which Harry Hilton is chief engineer and Harold E. Ketchum is superintendent. The substructure was built by the O'Rourke Engineering Construction Company and the Great Lakes Dredge & Dock Company.

Elephant Butte Reservoir to Serve 233 Years

Service Life Is Estimated by R. R. Coghlan and V. E. Lieb After an Investigation Into the Silt Problem

BASED upon a weight of silt in the dry state experimentally determined at 92.34 lb. per cubic foot, it is estimated that the probable life of the Elephant Butte reservoir is approximately 233 years, determined by the silting probabilities from records by Mr. Follett, according to notes in the *Reclamation Record*. An investigation was undertaken by R. R. Coghlan and V. E. Lieb in March and April, and the average figure, mentioned above, is given in a report by Mr. Coghlan. This investigation to find exact values for the weight of silt in the dry state and to determine the probable sequence in the deposition of such sediment was undertaken because of the very wide variation in the figures used by different investigators.

The silt beds for sampling, selected as typical of average conditions, were bars deposited in the lake during the high water of June and July, 1915, about 15 miles upstream from the dam. The sampling was undertaken in March of this year, when these bars were exposed. Samples were taken at three different locations in the silt beds, the first about 15 ft. from the river and 1 ft. above it, the second about 65 ft. from the river at a slightly higher elevation, both about 1 mile above the delta, and the third about 2 miles above the delta from a bank approximately 20 ft. from the water and 1 ft. above it. Results from seventeen samples are tabulated in Table 1, and the fineness of grain of the samples from the three locations is given in Table 2.

TABLE 1—VALUES FOR SILT SAMPLES

	Maximum	Minimum	Average
Weight per cubic foot, natural state	124.31	96.68	104.75
Percentage moisture	20.89	4.45	11.56
Weight per cubic foot, dry state	101.18	87.90	92.34
Specific gravity	2.657	2.590	2.642
Percentage of voids	46.57	38.97	43.99

A statement forecasting the service life of the Elephant Butte reservoir from the data at hand is questionable at best, but a surmise is possible. The available storage capacity of the reservoir is computed at 2,638,860 acre-feet. Using the records of flow and percentage of silt which passed San Marcial, N. M., from 1897 to 1912 inclusive, computed by Mr. Follett, and the weight of 92.34 lb. for dry silt per cubic foot of deposit, the average annual inflow of silt into the reservoir area during that period was 11,336 acre-feet. Based on this figure, the probable life of the reservoir may be computed as approximately 233 years. This may be influenced by variable and unknown conditions. It might be predicted that with the reservoir silted to half of its capacity and with the delta toe approaching the dam, a succession of dry years in the river above the reservoir would not mean a cessation of water from the reservoir, as the 44 per cent., more or less, of voids in the silt would insure a steady supply of seepage water which would add materially to the flow.

TABLE 2—FINENESS OF SILT

Sieve	Location 1, per cent	Location 2, per cent	Location 3, per cent
Passing No. 200	88.14	79.64	76.56
Passing No. 100	99.78	99.64	99.29

How to Make a Good Impression with a Rubber Stamp

By THOMAS A. HAYDEN
Surveyor General's Office, Phoenix, Ariz.

IN offices where, for filing and other purposes, printed forms are placed on maps, drawings and documents of different kinds by means of rubber stamps, difficulty is frequently experienced in securing a satisfactory impression. In small stamps this difficulty is less marked; but in the larger sizes, uneven printing, or total failure to print at all over the entire area, is the rule rather than the exception.

The noticeably inferior results secured on rough-surfaced paper, such as that in most detail papers, particularly in the better grades, suggested to the writer the obvious expedient of smoothing that portion of the surface on which the impression was to be made. A very little work with a small piece of fine sandpaper taken from an ordinary pencil pointer, such as will be found on any drafting table, resulted in a completely satisfactory surface.

Electric Propulsion for U. S. S. Tennessee

Electric drive for battleships, adopted by the Navy Department after careful investigation, is to be applied in the new U. S. S. Tennessee, a superdreadnought of the largest class, by using two steam turbines of 33,000 hp. driving electric generators which furnish current to four 6700-hp. motors, each motor driving one propeller. The contract for furnishing the electric equipment has been awarded to the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

Wire Drag Supplements Lead Line in Sounding

Government Surveys of Navigable Waters Made More Trustworthy—Hidden Rocky Pinnacles Easily Discovered

THE inherent danger in the use of the lead-line method alone for the purpose of making soundings and obtaining data from which navigation charts can be prepared is being overcome by the United States Coast and Geodetic Survey by the use of the wire drag. As described in special Bulletin 38 on the elements of chart making, this method is of special value in detecting obstructions and menaces to navigation. The following extracts describe the apparatus and the method of operating the wire drag as used by the Survey:

"Until quite recently the lead-line method was the sole dependence of the chart maker. That it is untrustworthy as applied in many localities is apparent. With the recent greatly increased importance and exacting requirements due to the deeper draft vessels, the opening up of new water areas, the greater demands of our navy, and in general a greater necessity for absolute accuracy owing to frequent marine disasters, its defects became alarming. The most important forms of these menaces, not generally found by the use of the older method, are rocky pinnacles, ledges, boulders, coral reefs, etc. As surveys by the lead-line method failed frequently to reveal even an indication of their presence, it became more and more evident that some new device specially adapted to the needs of such localities was urgently required.

"For this purpose the wire drag was adopted. From its crude original form there has been rapidly developed by the Coast and Geodetic Survey an apparatus which in practice gives absolutely accurate results that are final. It consists of a horizontal bottom wire, supported at intervals by adjustable upright cables suspended from buoys on the surface. These uprights can be lengthened or shortened for various required depths, and to maintain the bottom wire at a given depth below the surface of the water by making allowance for the rise and fall of the tide. The uprights are maintained in a nearly vertical position by means of weights attached to their lower ends. Intermediate between the uprights wooden floats are attached directly to the drag wire to prevent sagging between the uprights. The end weights and buoys are larger than the intermediate, and to them the towing gear from the launches is attached.

Operation of the Wire Drag

"In operation the drag is extended by directing the course of the launch outward from the middle of the drag as well as forward along the center of the area to be swept. In some instances the forward motion of the drag is due entirely to the current, and when this is the case the effort of the launches is expended entirely in maintaining the drag in an extended form. An interesting feature of the apparatus is the signaling system between the end launches, made necessary on account of the great length of the drag, which is sometimes four to five miles.

"Upon meeting an obstruction in its course the drag at once indicates the obstruction and points out its location. As soon as the drag wire touches the obstruction there is a marked increase in the tension on the drag, which is noted immediately on the spring balance to which the tow line is attached; and the position of the shoal is shown by the buoys, which line up between the obstruction and the launches. A buoy is then placed at the intersection of the two lines of drag buoys, the drag is cleared and moved ahead on its course, and the detailed examination of the spot is then made by a sounding party in a small tender or sounding boat. The great length of the drag and the maintenance of an ample overlap along adjacent dragged strips insure the completeness of the operation, and the stability of the drag wire at the required depth and its certain indication of any contact with the bottom give ample assurance of the certainty of its results."

Photographs of Samples Aid City Paving Records

Portland Keeps Detailed Statistics of Street Building Materials and Views of Specimen Sections

THE Public Works Department of the city of Portland, Ore., maintains a detailed record of all street paving, giving the proportion and grade of materials used, the date and extent of the work, and other data that might prove useful when there is need of referring to such statistics. The interesting feature of the records, however, is that it has been found feasible, and of great value, to append to each description a photograph of a specimen section of the pavement.

These specimens are secured after the paving is laid, in the case of new work, or are obtained from old pavement when the street is cut for laying mains, etc. The sample is taken to the bureau of standards and is sawed to secure a suitable section by means of a home-made device the cutting edge of which is a wire running in water. The section is cut in a true vertical plane, care being taken that the harder fragments in the aggregate do not cause deflection or breakage. After a suitable specimen section has been secured, the surface is photographed full size and the print is attached to the particular record sheet describing the paving. The accompanying typical samples of records as filed indicate the method used.

BUREAU OF STANDARDS

Contractor - Warren Const. Co. Date Sampled 2-4-16

Contract: 7th St., Burnside to Hoyt - Accepted Sept. 17, 1913.

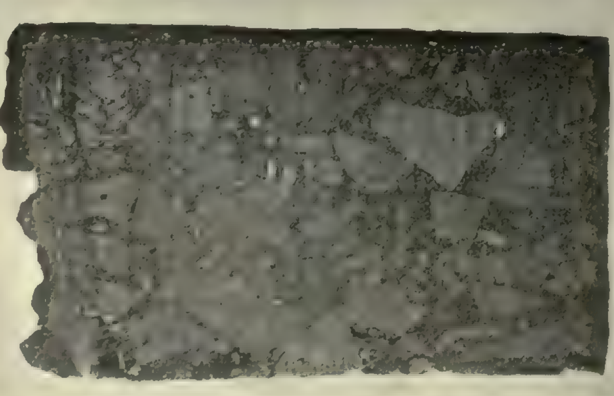
Maintenance 10 years. Length in feet 1500.

Location of sample - by manhole. Intersec.of Broadway & Davis.

Bitulithic on Concrete Base.

Cut by Northwestern Elec. Co.

A.C. -	7.40	Sp.Gr. of finished top	2.44
1½	40.25	" " aggregate on 10	2.83
½	13.70	" " " passing 10	2.72
¼	11.40		
10	23.20	% voids in finished top	2.00
200	4.05		
	100.00		



Department of Public Works

BUREAU OF STANDARDS

Contractor - Barber Asphalt Pav. Co. Date sampled: 3-6-16.

Contract - 4th Street, Sheridan to Jefferson Streets.

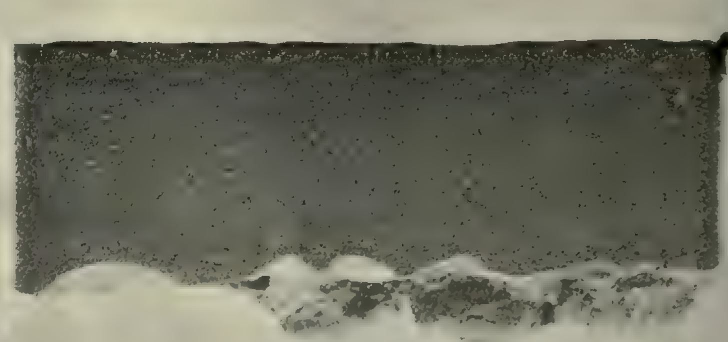
Length in feet - 3550 Accepted Sept. 25,1911.

Maintenance 10 years.

Location of sample - Intersection of Fourth and Market Streets.

Sheet Asphalt

A.C. -	12.00%	Sp.Gr. of finished top	2.17
10	4.20	" " aggregate	2.69
20	9.95	% voids in finished top	4.40
30	27.50		
50	18.40		
[illegible]	16.30		
200	11.65		
	100.00%		



TYPICAL SAMPLES OF RECORD SHEETS, WITH PHOTOGRAPHS OF SPECIMEN SECTIONS OF PAVING AS USED BY CITY OF PORTLAND

THE CONSTRUCTION CAMPS WERE SOMEWHAT DIFFERENT FROM THE AMERICAN TYPE

Handling of Filipino Labor One of Problems in Construction of Baguio Railroad

Line to Philippine Summer Capital World's Longest Rack Railroad—Hydraulic Rock Excavation a Feature—Work Suspended Because of European War

By W. M. BUTTS
Assistant Division Engineer, Nashville, Chattanooga & St. Louis Railway, Tullahoma, Tenn.

BAGUIO, the summer capital of the Philippines, was created to provide the islands with a more temperate and invigorating climate than Manila provided during dry seasons. Nestled in a range which rises to more than 9000 ft., the climate incomparable, the mountains covered with pines and oaks and filled with cold springs, the place is a temperate-zone paradise within the tropics. With its cool climate, invigorating atmosphere and wonderful scenery, however, Baguio had one serious drawback—it was hard to reach. After the famous Benguet road was built and washed out repeatedly, such pressure was put upon the Manila Railroad Company that it was obliged to undertake the building of an extension to Baguio.

In 1910 a party headed by C. J. Hogue was selected to go to the island and make surveys for the proposed line. The route chosen by the government through the Budd River Cañon (that followed by the Benguet road) was rejected upon reconnaissance, and all preliminary lines were run from Aringay on the Gulf of Lingeayen, to which point the railroad already reached.

Adhesion or Rack Line

The condition suggested a comparison of an adhesion and a rack line. The former, with a 4-per cent grade, would have required a length, it was found, of 53 miles, and the cost would have been prodigious. The second preliminary, for a rack line, was surveyed with a maximum gradient of 12 per cent and a maximum curvature of 15 deg. 16 min. This line figured 25 miles in length, with a lower cost per mile. It was therefore selected for the route.

TABLE 1—ESTIMATED QUANTITIES AND PRICES

Right-of-way, 385 acres, at	$65.00
Clearing and grubbing, 286 acres, at	30.00
Earthwork, 650,760 cu. m., at	.30
Loose rock, 345,100 cu. m., at	.45
Solid rock, 459,960 cu. m., at	.70
Concrete, 84,650 cu. m., at	5.00
Riprap, 25,660 cu. m., at	2.60
Bridge steel, 4,005,200 lb., at	.06
Tunnels, 970 lin. m., at	300.00
Timber for false work, 662,000 ft. c.m., at	50.00
Piling, 39,130 lin. ft., at	.40

Table 1, the estimate made on a projected location, will give a slight idea of the difficulties foreseen in the construction of this 25-mile extension. Subsequent changes in the alignment increased the amount of right-of-way, but as most of the changes were upon government land, which was deeded gratis, no material increase was effected thereby. The amount provided for clearing was far too small, as the dense tropical growth on the lower parts of the line soon proved. The estimates of earthwork were too small because of the tendency to slide, the astonishingly small amount of rock and the desire on the part of the engineers to get into the hill because of the heavy rainfall. The cost of nearly all concrete deposited was about $15 per cubic meter. The final estimate for steel was 7,148,000 lb. By subsequent changes in alignment the tunnel distance was nearly doubled.

The government being anxious to see the railroad in operation at the very earliest date possible, work was started January, 1912. The extension was divided into two parts. Mr. Castilvi was to push up from the lowlands and Mr. Hogue was to work from Baguio down. The difficulties met and solutions presented on the upper division were more novel.

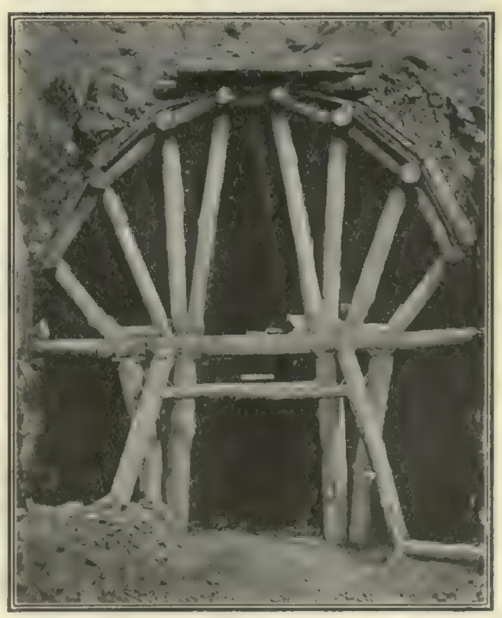
The labor in the upper division was, in most cases, supplied by the government. Igorrotes from the northern province were ordered to report at Baguio for work in stages of three months. They were willing workers, but though quick to learn were not accustomed to disciplined labor. The wages were 12½ to 20 cents a day for boys, 25 cents for men and 50 cents for "little bosses." The laborers were furnished rations, which consisted of a can of salmon to four men and about a quart of rice per man each day. Sometimes "Igorrote turkeys" (dogs), pigs and tobacco were issued as specials.

The cost per man on the job, inclusive of native superintendents, cooks and rations, averaged about 35 cents per man. These wages were considered extravagantly high for the Orient. The old maxim, however, that labor is worth only what it costs, proved true. The men were unaccustomed to pick-and-shovel work. It was more or less compulsory, and although at first it possessed a novelty, this soon wore off as the monotony told on the spirits of these wild, free people of the mountains. They grew homesick and slipped away; and as soon as the rain came, nearly all of them went home to till their rice paddies.

Small Contracts Best

This type of labor, although the government continued to furnish it, proved less efficient than labor obtained by other means. A system of contracting with the individual *bucknans* of small groups proved more valuable. By this means a head man was advanced tools, provisions and occasionally dynamite, which were later deducted from his estimate. He was paid 17½ cents per cubic meter for earth, 35 cents for loose rock and 50 cents for solid rock for ordinary excavation or embankment. A careful account was kept on the contractor to ascertain his earnings, and occasionally these rates were increased to make the job attractive to the Igorrotes.

Japanese carpenters on the work were paid from $1.50 to $1.75; Filipino carpenters, 65 cents; Filipino bosses and miners used in tunnels, $1 to $1.50; Filipino time keepers and clerks, 35 to 50 cents. All



THE EUROPEAN AND THE AMERICAN METHODS OF TIMBERING TUNNELS COMPARED

IGORROTES AND THEIR WIVES WORKED TOGETHER ON THE GRADING

NATIVES WERE EMPLOYED AS RODMEN AND INSTRUMENT BEARERS

received rations. The salaries of the white force, with occasional raises, varied by experience and length of service, were as shown in Table 2. The assistant to the president of the railroad received $500 a month and the president $23,500 a year.

TABLE 2—ENGINEERING SALARIES ON WORK

Engineer in charge		$268
Resident engineer	$200 to	225
Assistant engineer	150 to	165
Instrument man and draftsman		150
Rodman and draftsman	$90 to	125
Foreman on hydraulic work		125
General foreman (government forces)		150
Ordinary white foreman		75

One of the features most forcibly impressed on the engineer in going over the line is the extraordinary provision for drainage. Baguio made what is thought to be a world's record in June, 1911. In a single day 43 in. of rain fell, and 30 in. fell in three hours, according to the weather bureau report. Nearly 7 per cent of the entire railroad is bridge.

ROCK EXCAVATED BY WATER

Another noteworthy feature is the hydraulic plant erected to cheapen the excavation. A head ranging from 150 to 300 ft. was used, with the old California mining application of flume, penstock, pressure pipe and monitor. The plant pays for itself in the first two months of operation. The cost of excavation by this method was between two and three cents per cubic meter, covering several months of operation; and because the amount of material was so great the expense, including depreciation, was very little more. Clay, shale and some very hard rock were encountered. Explosives were used on the harder materials, the pieces being carried out of the cuts in flumes.

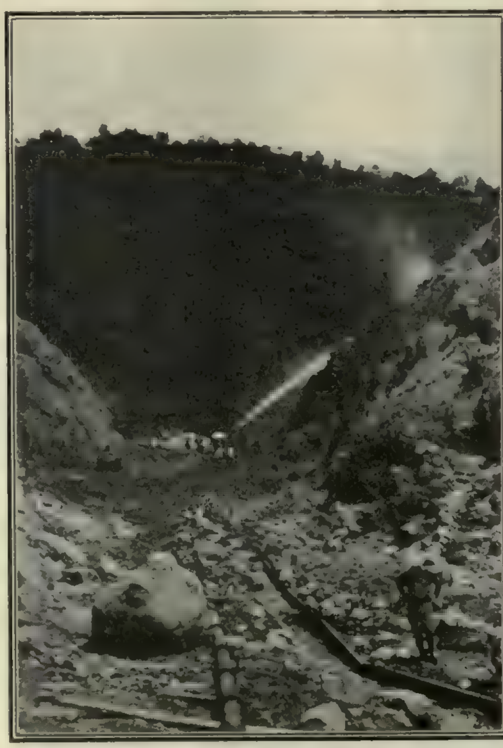
The tunnels—of which there are six, the longest being half a mile long—presented some interesting situations. All of them were driven by hand drilling, and usually with the ventilation provided by home-made hand-driven turbines, which drew the foul air and the gases from the heading through tin pipes. Because of the difficulty of transporting machinery—everything being brought in on the backs of men—these primitive methods were necessary if the work was to be rushed.

The railroad brought a party of Italian and Swiss tunnel men fresh from work in the Alps to the island to handle this work, but their cumbersome methods, their failure to adapt themselves to the conditions and their great fund of tenderfoot tendencies caused endless trouble. The style of timbering used by them is shown, as is the American type finally adopted. The former was characterized by difficulties in erection, lack of working room and insecurity; the latter embodied ease of erection and removal, closeness to the bore of the tunnel, strength and plenty of working room.

TUNNELS LINED WITH CONCRETE

All tunnels were lined with concrete. Timbering for some of them was made from nearby trees, but on the longer tunnel a sufficient quantity was needed to justify the construction of a cableway several miles long, with one span more than a mile in length to a sawmill nearly a mile higher than the site of the tunnel.

The European War necessitated cutting down the work, but its completion, which will require two years, is assured. When the road is finished it will be the longest rack line in the world; one of the most crooked of lines, 55 per cent of its length being curves, and probably one of the most expensive for its length, as the cost will probably reach $5,000,000. When completed, however, it will be a monument to American perseverance and, regardless of cost, will be a paying investment, as the returns will be measured in renewed health and vigor reaped by those who journey to Baguio each year.



EVEN ROCK WAS EXCAVATED BY WATER JETS

Making Specifications Handy for the Contractor

Portland, Oregon, Issues Loose-Leaf Forms Covering Materials and Methods for City Work

THE city of Portland, Ore., has adopted a convenient form for publishing specifications which is intended to make it easy for the contractor to keep handy reference files and at the same time to reduce the cost to the city and simplify the getting out of plans and specifications for new work.

About fifty-five sets of standard specifications have been prepared, covering materials and methods of all sorts from vitrified paving blocks to general requirements for bridges and viaducts. Each set is printed on uniform 4½ x 7½ in. sheets pertorated for loose-leaf binding, and is numbered for entry on an index supplied with the sets. As new work makes it necessary to prepare specifications not already adopted as standard, these are completed once for all and issued as additions to the loose-leaf set.

With this plan in effect contractors are encouraged to provide a small binder in which the sets can be kept, and thus embody in a single book of handy pocket size all city standards. From the standpoint of the city's engineering department, getting out specifications for new work of ordinary character requires only actual plans for the construction involved and references by number to the standards which are to apply particularly.

The plan has been developed by Philip H. Dater, city engineer of Portland.

Credit Given for Calcium Chloride Tests

Through an oversight the name of H. A. Davis, assistant engineer-physicist of the U. S. Bureau of Standards, who carried out all the detail work in connection with the tests, was not mentioned in the article on the effect of calcium chloride on the rate of increase in strength of concrete, on page 266 of the issue of Aug. 26. Mr. Wig requests that the fullest credit be given to Mr. Davis for this work.

Steel Arches Are Designed to Eliminate Rim Tension in Oil Reservoirs

New Design Involves Use of Concrete Abutments Carrying Suspended Parabolic Arches Made of Thin Steel Plates

By HENRY B. POST
Palo Alto, Cal.

THE RAPID GROWTH of the oil industry and the tremendous increase in production of crude oil in recent years have presented to the engineer new problems in finding efficient and economical facilities for storing oil in large quantities.

The first large storage units were uncovered earthen sumps, built by excavating and piling the earth as levees around the rim. These proved unsatisfactory because of leakage and evaporation losses, and later designs provided a concrete lining and wooden roof to check these losses, the lining being a 3-in. concrete slab reinforced with a wire mesh, and the roof supported on wooden columns and rafters and covered with tar and gravel. A few structural containers were also built, such as the 1,000,000-bbl. reinforced-concrete reservoir erected by the Union Oil Company at San Luis Obispo in 1906, a partial failure of which occurred four years later.

Lined Sumps Not Satisfactory

The excavated, lined sump represents an investment which offers no salvage or a possibility of removing to another locality in case of a failure in the oil supply; and with the best of care in its construction, leakage results from settlement cracks in the concrete lining and bottom, and there is always the danger of blowing out the thin shell on account of a chance gopher hole or because of an inadequate backfill, or leaks may develop which will never be found until the sump is drained.

For these reasons steel tankage is being adopted by practically all California oil companies. The tanks reach the limit of economy at about 55,000 bbl., the cost being prohibitive for larger capacities because of the heavy plate required and the excessive fabrication costs. The larger the container, the lower of course the cost per barrel. In the cylindrical steel tank the thickness of the containing wall is a function of the depth of the oil and the diameter of the container. The larger the diameter, the greater the rim tension, hence the greater the thickness of resulting plate necessary to resist that tension.

The New Design

To meet the demands for steel tankage in large units which would be efficient as well as economical, a design involving the suspended steel arch has been worked out for the Dutch Shell Company. Plans and specifications have been prepared for a 100,000-bbl. reservoir of this design, and the type has been accepted by the company as the most economical yet proposed for future storage extensions. In the new design the reservoir comprises a series of steel arches supported on concrete buttresses, the arches being placed so as to receive the load in tension and transmit it as compression to the buttresses, which in turn carry it to the ground.

Each arch is a section of the surface of the frustrum of an inverted cone, which assumes a parabolic cross-section, normal to the axis of the cone when the load is applied. The buttresses are of reinforced concrete and are placed on radial lines from the center of the container, and on the circumference of a circle, thus giving the tank a circular perimeter. Each buttress has a rounded nose on its upper edge which gives ample clearance in riveting together the nose and arch plate of the arch on each side of the buttress. The inclination of the oil face of the buttress is 45 deg. with the horizontal, so that the span of arch increases from the floor line upward.

The true curve for a linear arch sustaining a uniform load is a parabola whose maximum tension exists at the point of suspension. The suspended steel arch used in this design has a parabolic cross-section, as the load being hydrostatic is uniform across any horizontal plane at a given depth.

Analysis of Design

Assuming the formula for the maximum tension in a parabolic linear arch as

$$T = \frac{w}{8h}\sqrt{L^4 + 16h^2L^2} \qquad (1)$$

in which T = maximum tension at point of support; h, rise of arch at crown line; L, span of arch in feet at given depth d (16 ft. at floor line); w, intensity of pressure at given depth d; t, thickness of plate required, in inches (assumed at 0.25 in.); S, safe working stress of steel (assumed at 12,000 lb. per square inch), and e, efficiency of riveted joint (75 per cent), assuming d as 30 ft. Then

$$T = 0.75 \times 12{,}000 \times 0.25 = 2250 \text{ lb.}$$

$$w = 30 \times 62.5 = 1875 \text{ lb. per square foot,}$$

and substituting in equation (1) we have

$$2250 = \frac{1875}{8h}\sqrt{16^4 + 16^3h^2}$$

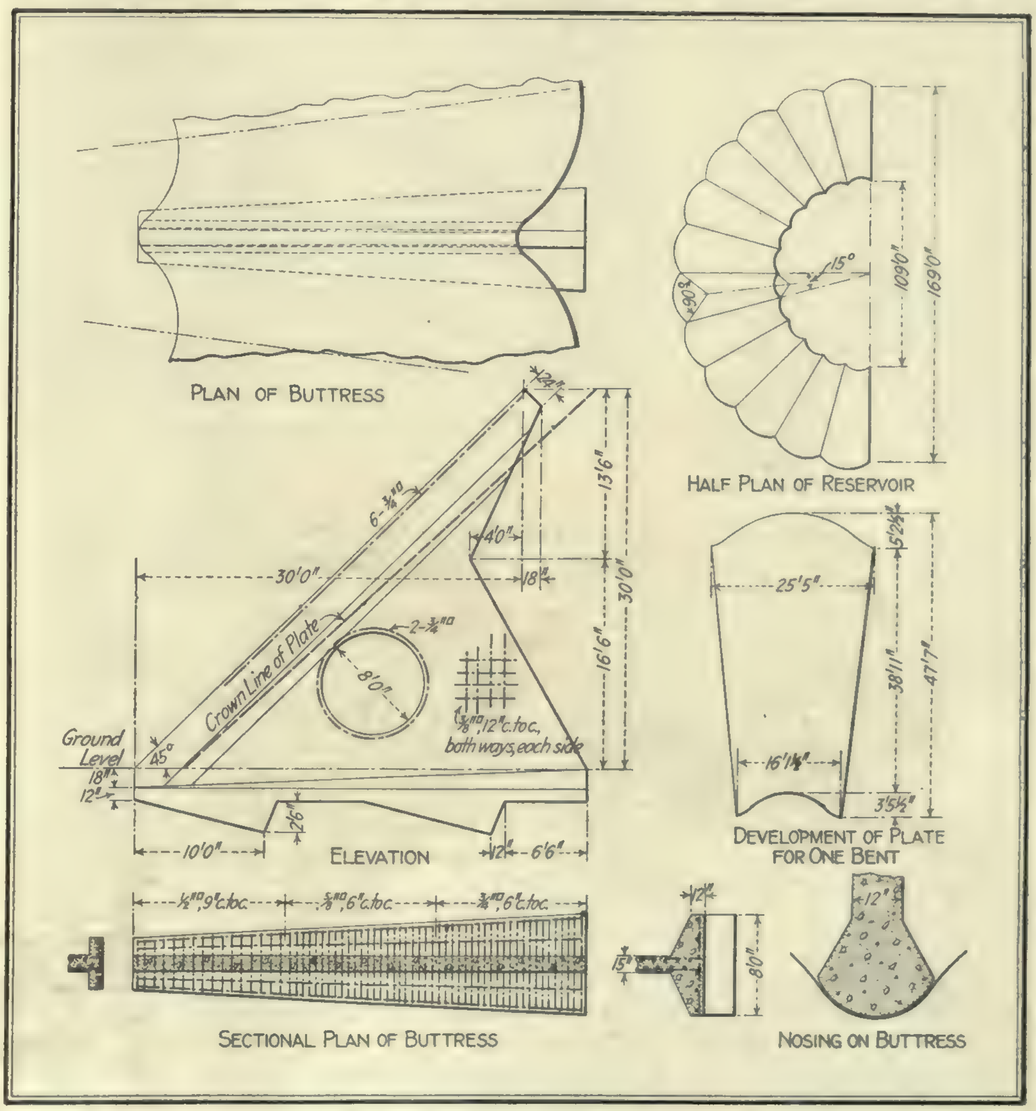
and

$$h = 0.1039\sqrt{16^4 + 16^3h^2} = 4.05 \text{ ft.}$$

The half span $(L/2) = 8.00$ ft., so that substituting these values in the formula $y = hx^2 \div (L/2)^2$ it is possible to figure the x and y abscissas and ordinates to determine the true curvature of the arch. The rise and span increases proportionately up the arch to the top, due to the slope of the arch face and the fact that the buttresses radiate from the center of the tank.

Plate Thickness Constant

In the foregoing calculations, t, the thickness of the arch plate, was assumed to be ¼ in., because that is as thin as it could practically be taken. This thickness remains constant and is independent of the diameter of tank under a constant depth of oil, being only a function of the depth and the curvature and span of the individual arch. As each arch is symmetrical with respect to its supporting buttress, there is no condition of unbalanced loading and no component of pressure exists to cause rim tension. These facts are notable as compared to the cylindrical steel

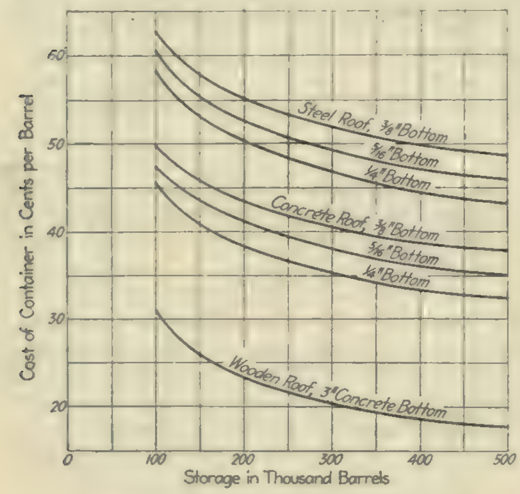


DETAILS OF CONCRETE BUTTRESSES AND STEEL PLATES FOR TYPICAL DESIGN

tank, in which the thickness of containing wall varies directly with the diameter of the container.

The buttress is designed to be safe against overturning and sliding, the resultant dead load of 780,000 lb. cutting the footing at the middle of the center third. The stepped footing, as indicated on the accompanying drawing, gives an added factor of safety against sliding. The average base loading is 1.85 tons per square foot, which can be increased or decreased as the bearing power of the sub-base will permit.

Temperature stresses are absorbed in the steel arch, which expands or contracts with a rise and fall in temperature, while the buttress is reinforced with steel to take care of temperature changes. The floor may be constructed of riveted steel plate of



COST DATA FOR NEW RESERVOIRS

desired thickness, or a concrete floor can be used. In both instances an expansion joint must be provided for at the junction of floor and wall.

The question of evaporation and the importance attached to it by oil companies determine the preferable type of roof. A gas-tight steel roof is best, but expensive at the present market price of steel. The wooden roof, as now used on large reservoirs, is not gas-tight and is a fire menace. A concrete roof, supported on structural steel columns and rafters, would because of its low coefficient of conductivity cut down the evaporation losses to a minimum, would be within the limits of economy and would have the added feature of being fireproof.

Approximate Cost

The series of curves, as shown in the accompanying diagram, give the approximate cost of the suspended steel arch construction for various thicknesses of steel bottom and steel or concrete roof. The wide range of thickness of steel for use in the reservoir bottom is given where salt water is present in the oil. The desirable thickness may be as much as 3/8 in. in a structure where a 1/4-in. plate would otherwise suffice. The lowest curve is based on the steel wall and concrete buttress design, with concrete floor reinforced with Clinton wire mesh, and has a wooden roof covered with tar and gravel. At the present market price of steel, steel tankage in 55,000-bbl. units costs approximately 55 cents per barrel storage capacity. In the suspended arch system, with gas-tight steel roof and 1/4-in. steel floor, the cost at 125,000 bbl. is likewise 55 cents, while for larger units a considerable saving is effected. If a concrete roof is used the cost per barrel is 42½ cents, decreasing to 32 cents at a 500,000-bbl. capacity tank. To these costs a salvage value on the steel at the expiration of the life of the structure may be applied, thus reducing the first cost considerably.

The advantages of a structural container of this type over the excavated, concrete-lined sump are that in the former the storage is all above the ground, where a leak may be readily detected and calked; the units are all standard, so that rapid erection is possible, while the tank may at any time be dismantled and the steel used again at a new location.

This system of construction makes it possible to store oil in large steel units and reduces the cost for two reasons—first, because of the economical use of steel in the wall construction; and, second, because of the large capacities of units feasible with this type of structure. The design has been developed and patent applied for by the writer.

16-Foot Rock Road in Africa Costs $5,500 per Mile

Inefficient Labor, Scarcity of Material and Absence of Machinery Add to Natural Difficulties of Construction

ROAD BUILDING in British East Africa was not seriously attempted until 1905, when it was decided to construct roads to feed the Uganda Railway. One of the first highways to be rebuilt was that between Fort Hall, the administration center of the Kenia Province, and Nairobi, situated in the highlands 5500 ft. above sea level and now the capital. These cities had been connected by a mere trail about 80 miles long, full of bad grades and dangerous river crossings. The reconnaissance was made, the route selected and work started from Nairobi. Native laborers were employed, and the first work was the giving of instruction in the use of pick and shovel. The details of the construction, as presented in a recently issued *Proceedings* of the Institute of Civil Engineers, follow:

The expected traffic did not warrant any great expenditure, nor were funds available at that time. It was therefore decided to form the surface of a material known locally as "murrum." This substance, which is found in large deposits widely distributed throughout the protectorate, is a kind of iron-stone, composed of about 30 per cent free iron, 4 per cent manganese, oxides of both these substances, and a quantity of earthy matter. It is fairly hard and when beaten or rolled with water forms a hard, brick-like surface.

The roadbed having been graded to the required section, a soling of murrum blocks about 1 ft. deep was laid. The interstices were filled with smaller pieces and the surface finally formed by ramming.

Swamps Too Deep for Piles

Several large flowing papyrus swamps were encountered, which were unavoidable without unduly lengthening the route. These upon careful survey were found to be too deep and loose for pile work, and hence the following method was adopted: The papyrus roots were cut out by natives for a width of about 100 yd. to allow of free surface flow and to determine the positions of the necessary bridges. On the bed of mud thus cleared fascines about 18 in. in diameter and 18 to 20 ft. long, composed of green papyrus stalks tightly bound with strips of papyrus, were laid first longitudinally and then, in a second layer, transversely. Each fascine and each layer was carefully and strongly bound to its neighbor with papyrus strips, each layer forming a compact raft.

When several layers had been placed, earth and stone were deposited on top, causing the whole mass to sink gradually. The sinkage was such that a horse could be driven across the causeway at the end of a day's work, yet there would be no trace of the structure the following morning. After this procedure had been carried out several times and sinkage was seen to be much slower, culvert pipes were built into and through the mass at various points and foundations of rough stone were prepared for two temporary bridges. Finally sinkage ceased and the bridges were put in, the roadway being permanently made and raised about 5 ft. above the water level.

Traprock Used

A kind of traprock was discovered within workable distance of Nairobi. It was of bluish-black color, with a specific gravity of 3, practically nonabsorbent, and exceedingly tough and hard. As it was impossible to consolidate that material sufficiently with the 2 to 4 ton ox-drawn rollers which had been used until then, a number of 10-ton steam rollers were imported to deal with it.

The method employed after the new equipment was procured was to strip the black cotton soil for about 10 in. and to steam-roll this bed to the requisite semi-elliptical section, with the crown 5 in. higher than the sides on a 16-ft. road. Upon this bed a 9-in. layer of quarry chips of the softer stone, broken to about 6 to 8 in. gage, was spread and dry-rolled until it was thoroughly compact and true to section. A 4-in. layer of trap ballast, broken to 2½-in. gage, was then spread and dry-rolled until firm. It was then well watered and again rolled wet, a binding of murrum being used as a top dressing.

Roads Wear Well

These roads wear well and are said to be quite equal to most English roads of a few years ago. The cost of a 16-ft. road was about $2,000 per mile. Later experiments have shown that the 2½-in. gage ballast was too large, and that consequently it picked up badly after considerable wear. It is now found that the best gage for ballast is 2 in., with about 20 per cent of 1½-in. gage mixed with it.

The latest first-class roads are made with soling as before, but hand-packed on edge, and with a 6-in. thickness of ballast laid in two 3-in. layers and consolidated separately. The surface is tar-grouted when perfectly dry and ¼ to ½ in. screenings from the broken ballast are spread as filling and lightly rolled. The surface is finished with a sprinkling of sand. The cost of labor and materials having recently increased, a 16-ft. road as last described now costs $5,500 per mile.

It has been found that excellent light carriage roads and pavements in the province can be so made. The method of construction is practically similar to that for murrum roads, except that a coating of tar is laid when the surface is thoroughly dry, the tar being finally sprinkled with sand. The cost of construction of such a pavement or carriageway is approximately $1,100 per mile for a 16-ft. width.

Cableway Railroad Affords Access to Nevada Quarry

Effects Straight-Line Ascent of 1266 Feet in 3 Miles at Plant of American Carrara Marble Company

A STRAIGHT-LINE incline cable railroad 15,945 ft. long effects an ascent of 1266 ft. from the town of Carrara, in southwestern Nevada, to the quarry of the American Carrara Marble Company, on the slope of the mountains. The trackage consists of a two-rail track from the foot of the incline to a passing siding midway between the terminal and a three-rail track from the siding to the upper end. Two cars, connected by a single wire rope 16,000 ft. long, operate on the track, the arrangement being such that the cars always meet at the passing siding and pass each other without requiring the usual throwing of switches.

The quarries are located about three miles up the mountains from Carrara. The company's offices and the dwellings for the employees are all located in Carrara, and the problems of bringing the marble from the quarry to the railroad and carrying the employees to and from the quarry made it necessary to resort to something other than straight adhesion ascent. The cost of switchbacks, it was found, would have been prohibitive, and their operation would not, it was thought, be nearly as satisfactory as the straight-line incline.

Three rails instead of two are used above the siding to avoid complications in the disposition of the cable. Because one car would always be below the upper switch when the other was passing over it, it would be impossible to have the cable for the lower car pass over the switch rail, and it would therefore be necessary to cut each rail between frog and switch point to pass the cable through. With the three-rail arrangement each cable is on its own track and there is no cutting of rails required. At the lower switch it is possible to pass the cable over the rail, for the reason that each car gets down and back before the other reaches the switch.

At the upper terminal there are three-rail switches which obviate the necessity of having the car cross from one side to the other while being brought to the upper terminal.

Cars and Their Operation.

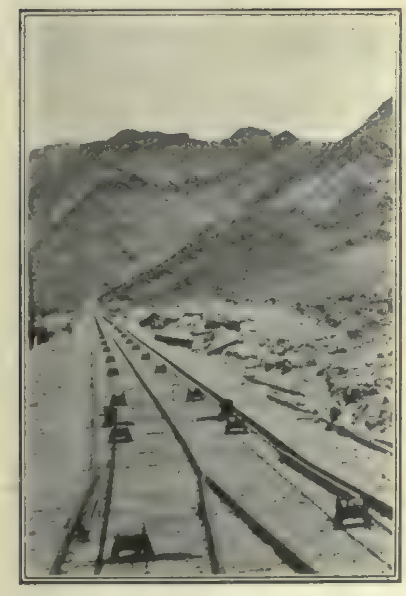
The cars are of structural steel, with platforms 16 ft. long and 5 ft. wide, and are mounted on four-wheel swiveling trucks with 24-in. wheels. They are fitted with handbrakes, which are used, however, only when the cars are in the quarry or at the finishing plant at the foot of the incline. Each is designed for a load of 50,000 lb. They were designed and built by the Union Iron Works, Hoboken, N. J.

The cars are operated by a single wire rope 16,000 ft. long, 1 in. in diameter, manufactured by the A. Leschen & Sons Rope Company, St. Louis, running on 750 Lidgerwood rope rollers, especially designed and self-lubricating. The hoist, built by the Lidgerwood Manufacturing Company, is designed to lower a loaded car with an empty car ascending or to hoist a maximum load of three tons with an empty car descending at a uniform rope speed of 700 ft. per minute, operated by a three-phase 60-cycle 440-volt alternating-current motor. When a loaded car is descending the motor automatically becomes a generator and returns current to the line, this providing automatic breaking and a uniform car speed.

The hoist is of the double-drum endless rope type, the drums fitted with slip rings. The drums are arranged tandem, with the rear drum bolted to the drum gear and the front drum so arranged as to serve for an idler. Each is 53 in. in diameter. There is a magnetic automatic brake to hold cars in case of current failure, also an overwinding device to bring the cars to rest at the terminals. For emergency purposes only a heavy hand-operated post brake is fitted on the rear drum. The hoist is operated by a 100-hp. General Electric slip-ring induction motor.

The upper terminal is higher than the quarry. The difference in elevation of the upper terminal and the quarry floor is such that the empty cars descend to the quarry by gravity, while the loaded cars are brought out by means of a Lidgerwood single-friction-drum electric hoist.

At the lower terminal the loaded cars are taken to the finishing plant by means of a storage-battery locomotive.



THREE-RAIL TRACK AT UPPER END OF PASSING SIDING, AUTOMATIC SWITCH AT LOWER END, AND CAR AT CLOSE RANGE

With the railway as installed the total length of car travel between terminals is 14,780 ft. The average grade of the line is 8.54 per cent, the maximum grade at the top being 13½ per cent and the grade at the bottom 2.13 per cent. The track gage is 40 in. The rails are 56 lb.

Automatic Switch at Passing Siding

At the lower end of the turnout, which is approximately 150 ft. long, is an automatic point switch. Supposing that the descending car is on the left-hand track, as it trails through this switch the flanges of its wheels throw the switch to the left-hand track. Returning up the incline, this car reaches the switch first and takes its proper track, and immediately afterward the other car, descending, throws the switch to its track. Thus without the need of any switchman each car takes its proper track. The switch points are counterweighted so that they will remain firmly in position until thrown by the descending car.

Effect of Vibration in Factory Buildings

Preliminary Report of Investigation Shows Wide Diversity of Opinion and Experience —Exact Data Not Available

WHILE the final comprehensive report of the results of a study of the effects of vibration in structures upon the operation of machines and the efficiency of labor, undertaken by the Aberthaw Construction Company of Boston, by means of a questionnaire sent to professional men and manufacturers, is not yet completed, a preliminary report recently issued indicates the need for further exact information, which is solicited. The replies to three definite questions present a wide diversity of experience and opinion, yet only about one-third of them can be classed as informative. The following brief abstracts from the preliminary report are of special interest to designing engineers:

Effect of Frequency of Vibration

The effect of coincidence between the natural frequency of vibration of a floor and that of a source of disturbance is well illustrated by the following experience in connection with the testing of a small engine upon a floor of timber construction: At a speed of about 550 r.p.m. the intensity of the floor vibration was so great that it was impossible to work in the drafting room located on the same floor more than 100 ft. away; but this effect entirely disappeared when the speed was either increased or decreased by about 50 r.p.m. When the disturbing force is represented by a number of machines at practically the same speed, the effect may be like that of dancers upon a floor or soldiers marching over a bridge, and prove most destructive to the

entire structure if the step time coincides with its natural pitch.

Obviously, most vibrations are the result of several components, and records must be made of not only the vertical but also the horizontal components, both longitudinally and crosswise of the building. Vibration recorders are modeled on the principle of the seismograph; the three-component type developed by Maurice Deutsch of New York and Prof. Elmer E. Hall of the University of California is much lighter than the ordinary seismograph, thus rendering it capable of recording vibrations of higher frequency. The records are made on a rotating drum covered with smoked paper by a recorder which separates a given vibration into three components, two horizontal components at right angles to each other and the vertical component. These three components are recorded simultaneously.

Obviously, the type of construction and the extent to which it permits or prevents vibration must be considered. The context of many of the quotations which have been selected referred to buildings, usually old, entirely unsuited to the requirements. Hence the resulting vibrations. Other correspondence shows with equal clearness that the absence of vibrations is due to the rigidity of the structure, to foresight in the placing of certain machines on solid foundations, to the proper cushioning of others and such arrangements of duplicate machines operating at the same speed as to avoid cumulative effects.

The general experience is that severe vibration tends to tire the workmen and make them nervous, with the result that they become irritable and inefficient. The plant manager of a large concern says that he has had four different clerks leave because they could not stand the vibration of the building. During the past nine years, about eight or ten men left because they found they could not do a day's work on the chipping hammer floor because of vibrations.

Machine Output Reduced

An instructive contrast in conditions and results is shown in a letter from a consulting engineer. A mill in which weaving apparatus was originally located was of the old-fashioned mill type, but rather light, and the looms could not run more than 120 picks per minute without serious difficulty with breaking threads. In the new plant the design speed was about 145, but through error it was made 160. When the plant was started, in spite of the superintendent's vigorous complaints, no trouble was experienced, and the mill is at present running at this speed with less loss, so far as breakage is concerned, than was experienced in the old mill at far slower speed, and of course with greatly increased output. It is claimed that this was owing solely to lack of vibration.

Solid foundations apparently insure greater output. A case is cited of one machine which was first placed directly on the floor and vibrated very badly. To overcome this vibration, the floor was cut away around the machine and a foundation put under it. The increased output is claimed to be almost 40 per cent, due to the fact that the operator can take measurements with the machine running when there is no vibration, but was unable to do so where the vibration was so great. Apparently, the quality of the work is also considerably improved. An engineer says that perhaps one of the reasons why some of the English and other foreign fabrics are better than American fabrics is that greater attention has been given to the construction of their mill floors, which are surprisingly free from disturbing vibrations.

The general effect of vibrations in machine shops is clearly expressed by the following quotation: "With the heavier tools where there is an excessive amount of vibration, the depth of the cut is limited, and we cannot use the full power of the tool. It produces a sort of chattering which marks the work and limits the amount of stock which can be removed in one cut." An industrial engineer states that there is one point where the vibration of buildings is not considered sufficiently, and that is in transmission of power by shafting. The losses caused by vibration in such transmissions are considerable.

Design to Decrease Vibration

The trouble caused by reciprocating machinery may be eliminated by proper cushioning or bracing. Where machinery creates more or less vibration due to shock, an effort should be made to use either a massive construction to absorb the shock or else put in direct supports which will transmit the vibration to a point below the foundation. Statements regarding the comparative merits of different types of construction cover a wide range of experience and opinion. In the case of a knitting mill in which considerable trouble with combination steam and joist construction buildings was experienced, it was found that buildings of modern reinforced concrete having heavy machines on the first and second floors showed no sagging, nor is any vibration noticeable.

The replies include a great number of statements from consulting and designing engineers, ranging from the opinion that there are no material advantages in a reinforced-concrete building to the following: "The owners had some mill construction buildings in use before we built the reinforced-concrete buildings. Some sections of the former vibrated like drums, but we believe the concrete construction has proven quite free from vibration."

Fifty-Mile Road in Utah Costs $26,000

Built on Ground So Level That Grading Was Unnecessary—Construction at Rate of a Mile a Day

A FIFTY-MILE ROAD has been almost completed in Utah across the Great Salt Lake desert, the estimated cost of which is $26,000. The Wendover road, as the highway is known, is built on a straight line, and throughout the entire length the grade is practically the same. In fact, it is said that a spirit level laid down at any point will show no indication of a grade. The route connects Knolls, on the east side of the desert, with Salduro, on the west edge.

As the route was to parallel the track of the Western Pacific Railroad, the survey consisted of driving stakes 110 ft. from the center of the railroad to the center of the new highway. A 70-hp. tractor of the track-laying type was used in carrying on the work at the rate of a mile a day. A 4-in. crown was formed and side slopes built with a ratio of $1\frac{1}{2}$:1. In the spring a 6-in. layer of gravel will be added.

About twenty-five miles of the road required no work of any kind, as it was high enough to have a natural drainage, and was smooth and level as well. This reduced the necessary expenditure to $11,000 for the work already completed. The additional cost for surfacing to be done next year is estimated at $15,000. The new route reduces the length of the Lincoln highway by nearly 100 miles.

ROAD WAS BUILT ON FLAT SALT BEDS

GRAVEL SURFACING WILL BE DONE IN SPRING

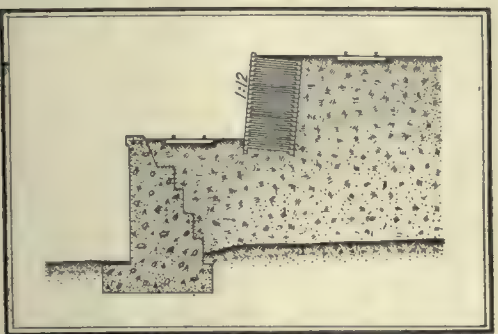
New York State Issues Unique Highway Map

A complete highway map which folds into a size that can be conveniently carried in a pocket and shows not only the condition of the various roads but also points of historical interest has recently been issued by the New York State Commission of Highways. The map is printed in black on thin, tough white paper. The condition of the roads is indicated by symbols. Historical references are printed on the back in alphabetical order. By means of key numbers printed on the map the user can quickly locate the point desired and determine the route to follow.

Rock Island Finds Concrete Cribbing Effective

Gets Satisfactory Results from Its Use in Place of Retaining Walls at Certain Locations of Chicago Track Elevation

VARIOUS elements entering into the question as to the advisability of the use of concrete cribbing in place of retaining walls in special cases have been under close observation by the Chicago, Rock Island & Pacific Railway on its track elevation at Chicago. Thus far the results as to cost, efficiency and appearance are very favorable to the cribbing. The economy in the use of this type of structure is brought out most prominently on two-level fills



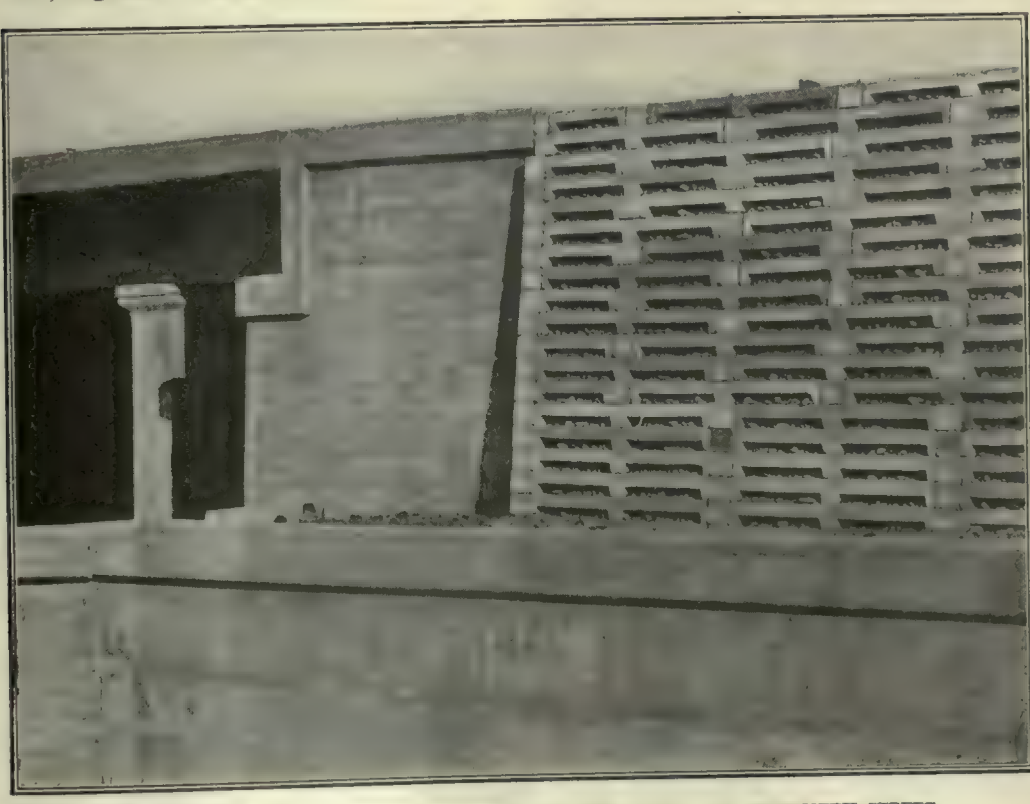
MARKED SAVING IN USE OF CONCRETE CRIBBING ON TWO-LEVEL FILLS

where a retaining wall between tracks would have to be carried down through many feet of fill to the solid foundation.

Tests as to the settlement and movement of the cribbing for a period of nine consecutive months show movements which could not be detected with the eye and are practically negligible. The photograph shows one of three types now under test. The cost thus far has been about 20 per cent of a retaining wall of the same height.

This crib wall was constructed of 6-ft. headers, 8-ft. stretchers and a front batter of 1:12, and has formed a very stable and substantial-looking wall.

The cribbing was placed and tests of it were made under the direction of R. H. Ford, engineer of track elevation.



APPEARANCE OF CRIBBING AND JUNCTION WITH BRIDGE AT EIGHTIETH STREET

More Proof of Need for Supervision of Dams

California Structure That Failed Two Years Ago Violated at Least Four Established Principles of Dam Design

By RALPH BENNETT
Engineer, Los Angeles

SOME two and a half years ago there was in Southern California a dam failure that, though fortunately unattended by loss of life, illustrated most forcibly the need of proper supervision over this class of structure. The dam in question violated at least four rules of dam design, in spite of the fact that a proper structure could have been built for less money.

At about 6 o'clock on the morning of Feb. 21, 1914, there failed in Sepulveda canyon, near Sawtelle, Los Angeles County, Cal., a 65-ft. earth dam having a thin concrete core wall. Considerable property was damaged, but no lives were lost. Portions of the concrete core wall were swept downstream to distances of more than 2200 ft. There were no eyewitnesses of the occurrence, and in order clearly to connect up the dam failure with the damage it became necessary to reconstruct from the physical evidence the conditions which existed during the catastrophe.

The dam had originally consisted of a concrete wall, without useful reinforcement, standing 60 ft. above a rotten bedrock of soft shale. This core wall was 2 ft. thick at the top and not more than $3\frac{1}{2}$ ft. at any point. It had a horizontal angle of 20 deg. downstream near the deepest section. Most of the earth backfill was carried to within a few feet of the top of the wall, but at places it was more than 9 ft. below. It consisted of silt, debris and earth, and was but slightly compacted. The slope was about $1\frac{1}{2}$:1 on both faces.

A small spillway was provided, but the structure when filled showed signs of such serious distress that it was drawn down and a notch 26 ft. deep and 12 ft. wide cut in the core wall near the center. As no opening was cut lower in the wall and the 16-in. drain could handle not more than 26 sec.-ft., the waters of any considerable storm, flowing from the 1688 acres of steep hills above, had to pass over the lip of this cut and over the downstream fill. This discharge occurred during one or two small storms without washing away sufficient of the fill to release the core wall, but the very severe and continued storm of Feb. 18 to 21, 1914, completed the work and the dam failed.

PROBABLE RUNOFF

Using the rational formula for runoff, the maximum discharge from runoff across the dam site would not have exceeded 1700 sec.-ft., but was probably not more than 700 sec.-ft. judging from the channel evidence, above the reservoir. In this locality the flat bottom of the canyon is covered with brush and grass, through which there is a small weed-grown channel showing no evidence of heavy flows. The condition starting at the dam and for a long distance downstream was entirely different. Brush and small vegetation had been entirely swept away, while trees and shrubs were wrenched and damaged. The channel was clean-swept and scoured. Brush and debris were lodged in the trees and on rocks at a very considerable elevation above that of any ordinary flood. Most of the heavy blocks into which the core wall had disintegrated were swept downstream considerable distances.

The canyon for some thousands of feet below the dam was cross-sectioned and levels were run. Definite high-water indications were noted and located with reference to the cross-sections. From these data and a value of n assumed to suit the channel the maximum flow was computed. Except for one bend of nearly 180 deg. close to the dam the channel was fairly straight.

After careful consideration of the bottom and side conditions and the corresponding features of known channels, a coefficient of $n = 0.035$ was selected. The conditions were rather more favorable, but the channel may have been considerably obstructed by small growth at the time of the passing of the crest, due to the sudden failure of the core wall.

The flood arrived at at the different points at which definite flood marks were found varied from 8000 to 12,000 sec.-ft. without reference to the distance from the dam. Apparently the minor turns in the channel had a considerable effect. As only well-defined brush or heavy débris marks were used, the highest mark may nct have always been taken.

PARTS OF CORE WALL CARRIED FAR

The flood had carried certain well-identified masses of the core-wall concrete long distances. The movement of stones, etc., in a stream is subject to approximate calculation. It must be assumed that the masses are of shapes such that they can be rolled along the stream bed and that they are submerged. Both these conditions could be satisfied by many of the blocks.

As a typical case, there was a concrete mass 2x2x7 ft. about 2258 ft. below the dam. The stream velocity required would be $V = 5.67\sqrt{ag}$ (Kent, page 566), where a is the mean diameter and g the specific gravity of the mass. Substituting $V = 5.67\sqrt{2.5 \times 2}$, $V = 12.5$ ft. per second.

At this point the cross-section of the flood channel is 618 sq. ft., so that the flow must have been 7725 sec.-ft. The channel calculation for the same point gave 8000.

The core wall failed in a roughly trian-

BREAK IN CORE WALL

gular shape. It had been trenched into the shale of the site about 5 ft., but very close to the edge of a small drop. When the wall failed the lower portion sheared this thin shoulder entirely off. One of the blocks of concrete, 3x11x33 ft., was carried directly out from the break 160 ft. and lifted above its original elevation. These and other minor considerations make it evident that the core-wall failure must have been instantaneous. Under this assumption a triangular weir existed until the basin was nearly empty.

Water must have been pouring over the lip of the cut in the core wall to a depth of several feet, but it is sufficient to assume the water level at the lip. This would give an initial depth of 30 ft., which would produce a flow of 13,000 sec.-ft. The rate of discharge would decrease rapidly as the reservoired water lowered.

The dimensions of the basin call for about 5,568,000 cu. ft. of water at this height. Of this, 2,900,000 cu. ft. went out in the first 6 minutes and lowered the level 10 ft. Most of the remaining storage was discharged in the next 33 minutes, at the end of which time the discharge had fallen to 480 sec.-ft., which flow may have continued for some hours, but slowly decreasing.

The sharp crest of this wave reached a power house on the lower stream at 7 minutes 3 seconds after 6 a.m. and extinguished the boiler-room fires. Within half an hour the water had mostly disappeared and the plant was able to relight.

SUPERVISION NEEDED

There can scarcely be a more perfect proof of the need of state or national supervision of this class of work than this structure. As built it was doomed to failure from unstable core wall, insufficient fills, improper fill materials, insufficient spillway capacity, inoperative spillway gates. When these conditions caused incipient failure the only time the basin was allowed to fill, the cutting of an overflow notch in the core wall at the middle of the work destroyed any slight chance of survival which had existed.

The site is a favorable one, and a single arch containing much less material than the useless core wall of this structure could have been put up for a much less sum.

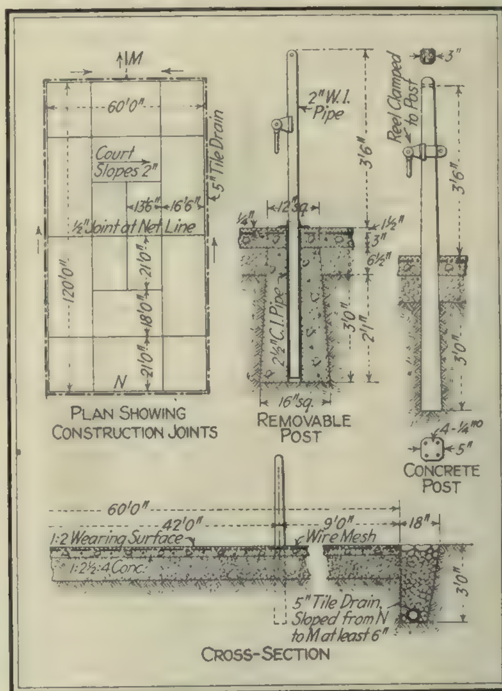
Question of Skilled Help a Difficult Problem on Pennsylvania Highway Work

The question of experienced help, including engineers, superintendents, foremen and even laborers, is a difficult problem with the Pennsylvania State Highway Department, according to a statement made by William D. Uhler, chief engineer, in a paper presented at the meeting of the mechanical and engineering section of Franklin Institute, held in Philadelphia recently. "Because road work along modern lines is in its infancy," he explained, "it is necessary to educate the forces, and one of the chief troubles in holding together the necessary road organization is that it is impossible—in fact, impracticable—to provide work for them during the full twelve months of the year. This is because the character of the work will not permit of continuous employment, and it becomes necessary, usually, to lay off approximately 75 per cent of the force at the close of the working season. Consequently the skilled assistants look for more permanent work."

How to Build Concrete Tennis Courts

Cement Association Offers Suggestions—Courts at Chicago Club Used for Tennis, Dancing and Skating

CONCRETE TENNIS COURTS now under construction in Chicago, Rockford, Ill., Minneapolis, Pittsburgh and other places give evidence that a new field is being invaded by reinforced-concrete construction. The accompanying photographs show the appearance of the courts at the South Shore Country Club, Chicago, while the drawing illustrates typical details proposed in a suggested design by the Portland Cement Association. The finished courts shown in the illustration have been surfaced by a rotary surfacing machine for the purpose of giving a perfectly smooth finish which can, it is stated, be waxed when desired and used for a dancing floor. Other concrete courts for the Chicago Tennis Club will be finished with curbs high enough to allow flooding with water in the winter season for skating purposes.



DETAILS OF CONCRETE TENNIS COURT

Specifications covering the preparation of the sub-base and the laying, finishing and hardening of the court have been prepared by the Portland Cement Association. As

SOUTH SHORE COUNTRY CLUB TENNIS COURTS AT CHICAGO—POLISHING FOR USE AS DANCE FLOOR

illustrated by the drawing herewith, the concrete base is a 1:2½:4 mix, wet enough to flush readily under slight tamping, but which can be handled without causing a separation of the coarse aggregate from the mortar.

The reinforcement of wire mesh or wire fabric is placed lengthwise of the courts and not less than 1½ in. from the finished surface. A wearing course of 1:2 mortar mixed dry is placed 1½ in. thick on top of the 3-in. concrete base before the latter has hardened. Construction joints, as indicated on the plan, should coincide with the court lines. The surface is worked with a wood float and brought to a smooth plane by the use of a steel trowel. A grade of 2 in. transversely is provided for drainage.

Clay subgrade should be excavated to a depth 11 in. below the finished surface of court, while a sand or gravel subgrade will support the slabs without more than a 4½-in. excavation. Fill should be of cinders or coarse gravel. The subgrade should be uniformly compacted before a fill is started and the fills made of compacted layers not over 6 in. thick.

Finally, the usual precautions to insure proper curing conditions should be taken—the surface covered with at least 1 in. of wet sand or 2 in. of wet sawdust, and kept wet by sprinkling for at least ten days.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

The Pioneer in Water-Right Laws

SIR: From time to time my attention has been called to articles appearing in the technical journals relating to the water-right laws of Western states. For some reason the history of this kind of legislation seems to be ignored and prominence given to one or two states which have more recently adopted a modern administrative system, following the example of many that have taken this important step in earlier years.

It is evidently not generally known that Wyoming, first by constitutional provision in 1890 and then by legislation in 1891, laid the foundation for a technical administration of water resources. Wyoming had no other state to guide her when this important departure was determined upon. She was fortunate in having the advice of Elwood Mead, who must be regarded as the great leader in this kind of work. He outlined the constitutional provisions and framed the law based thereon. He administered the law for ten years. His experience can never be paralleled. To select wise principles governing the administration of streams after the courts had been in full possession of the field for years is a task that demands courage and ability.

The principles embodied in the water laws of Wyoming have not been improved upon by any other state. No other state has been able to define the important principles as plainly and as definitely. Litigation has been eliminated in Wyoming in so far as water-right controversies are concerned. Water rights are determined by an administrative board and the water user is protected without cost. The water right belongs to the use. The water always belongs to the state. Speculation is impossible after the right accrues.

Those who have followed the early history of water-right legislation are pleased that the Wyoming system has been adopted in so many states and that it has brought peace, justice and contentment wherever it has been introduced. As a matter of history and to make a record of one of the greatest of engineering achievements in this country, it should be remembered that Elwood Mead, an engineer, discovered the principles which underlie this kind of legislation. It should also be recorded that the engineer has been responsible for the introduction of this kind of legislation in all Western states and the laws thus provided have been successful because they contain wise principles and because they are administered by technical men who fully appreciate the problems involved.

CLARENCE T. JOHNSTON.
Ann Arbor, Mich.

Blueprint Paper, Like Hair, Can Be Rejuvenated with Peroxide

SIR: Engineers and draftsmen in the outlying districts depending on sun-printing outfits for blue-printing are often annoyed by finding their supply of blueprint paper "gone bad" when most needed. I have found that such paper may be used by printing and washing in the usual manner and then applying hydrogen peroxide with a small sponge. This will bring out the print in detail.

Peroxide as an intensifier has the advantage of being non-poisonous and may be obtained at any corner drug store.

R. L. LONGSHORE,
Deputy Surveyor, Adams County, Indiana.
Decatur.

Sewage Disinfection

SIR: An editorial entitled "Sewage Disinfection" appears on page 278 of the Engineering Record for Sept. 2. This editorial contains the following noteworthy sentence: "This (chlorine disinfection) method of destroying bacteria, while often difficult, has limitations which may not be safely disregarded."

My experience with liquid chlorine has been disappointing, especially in cold weather where the temperature of the sewage (effluent from Imhoff tank) and water have dropped below 55 deg. Fahr. At such low temperatures the bactericidal action or efficiency of the liquid chlorine decreases in a marked degree, and at lower temperatures the chlorine makes a taste in the water that is quite as noticeable as the tastes which are produced by bleach.

In view of this situation it seems to me that an effort should be made to find some catalytic agent which can be applied to increase the efficiency of the chlorine when the conditions are adverse to its germicidal action. The addition of lime has been suggested and tried out in a practical way by the use of bleaching powder, but always with the result that bad tastes develop in cold weather.

A far more serious condition goes with this, however, because the good results obtained in summertime create the impression in the minds of the average person that water treated with bleach or liquid chlorine is safe to drink at all times. As a matter of fact, quite the contrary may be the real truth, with the unfortunate result that epidemics of dysentery and typhoid fever sweep through communities that are living under a false sense of security.

I hope that you will take advantage of your wide connection among engineers and sanitarians to urge investigators to devise means for increasing the bactericidal action of liquid chlorine in cold weather and to caution consumers of public water supplies that the simple and cheap installations required for bleach or chlorine sterilizing outfits can be relied upon only as finishing processes, following efficient devices for water or sewage clarification or filtration.

WILLIAM R. COPELAND,
Chemist in Charge, Milwaukee Sewage Testing Station.
Milwaukee.

Justice to the Contractor and the Engineer

SIR: The opinions voiced by H. G. Shirley in his letter appearing on page 180 of your Aug. 5 issue, and by R. M. Stamper on page 270 of your issue of Aug. 26, on "Justice to the Contractor," are well taken, but recent experiences lead the writer to believe that much of the so-called justice the contractors desire is in reality nothing more than a "balm" for "injured feelings" which come on after reading the specifications on being awarded the contract.

Now it is not the writer's intention to say that all contractors do not read the specifications carefully before bidding, but from the way nine out of ten make up their proposals (even when a blank proposal form is included in the specifications) it would appear that they care little as to what the specifications call for. If the specifications call for certain things which are a little out of the ordinary, the contractor (not the engineering contractor, who does things on a scientific basis) takes the notion into his head that possibly the engineer doesn't know what he wants (and at that, he is sometimes correct) and he puts in his bid based on the usual way of doing things, but saying nothing about it. If the job be a large one, the contractor who carefully estimated it is out of the running because some contractor, whose office is under his hat, did not enter his bid as requested to. The contract is let to Mr. Wiseone and he starts to do the work as he bid on it. Then when the "horrid boy inspector," or even a superintendent with more experience than the contractor, calls his attention to the error of his ways as indicated by paragraph so-and-so of the specifications, he raves about the injustice of making him do things according to specifications when his practice for years had been different, whether right or wrong.

Yes, this is an injustice to the contractor, not to the "wise one," but rather to the contractor who bid as the specifications asked him to, inflicted by one of his contemporaries. If the "successful" bidder had been honest with himself and the engineer, he would have stated in his proposal, or before signing the contract, the

PILOT CUTS LEAVE 200-FOOT CORE—BOOM 175 FEET—BUCKET 4½ YARDS

THE ANTIOCH AND THE MONTEREY MAKE PARALLEL CUTS ALONG CORE

details of the departure he wished to make from the specifications, but fear of losing the job prevents this, and during the interval between signing the contract and starting work he hopes that a boy inspector will be placed on the job on whom he can "slip it over" or whom he can make the "goat" if caught up.

This little illustration may seem exaggerated to some, but I am confident that engineers in general will bear me out in this contention. The point I wish to make is that the time to kick about faulty specifications is before signing the contract of which they are a part, and not afterward. If contractors would refuse to enter on work having loosely drawn or deceptive specifications, or add a big percentage for contingencies, the author of them would soon see the light and play fair or quit business.

This question of horse sense is only relative and depends entirely upon whether the interpreter is a thoroughbred or a mule, figuratively speaking. To the unfair bidder horse sense means the allowance by the inspector of stretching of the specifications until they crack, to let him do the work as he bid on it, while to the contractor who gave the engineer credit for knowing what he wanted, it means something entirely different.

I have come in contact with young college-graduate inspectors and the so-called "practical old-timers," and to my mind, the technical graduates with proper instructions from their superiors are on the average as far ahead of the others in horse sense as a race horse would be in a race with a Percheron, if the deciding be done by competent judges. The number of ordinary contractors who can intelligently read and interpret specifications is indeed few as compared with the number of college-graduate inspectors who are capable of so doing. In a way the inspector who, because of inexperience, demands that the specifications be lived up to is a blessing to the profession, for if his insistence on work being done as specified causes trouble, then reform is necessary in the writing of specifications or in the manner of bidding, and not in the inspection. My experience has been that generally the longer a man is engaged in superintendence and inspection the more lax he becomes in his enforcement of specifications, since he is wont to make too great allowance for the "common-sense" interpretation thereof, and to take the easier way of giving in to the contractor who is on the job constantly rather than uphold the engineer, who may visit the work occasionally. After a contractor deals with one of these fellows who make inspecting their life work (or vocation), the way of the young graduate is hard indeed.

The writer's intention is not to create the impression that engineers are never in error, but rather to present a phase of this much-talked-of subject which is seldom brought out. Then also let me make clear that by ordinary contractor as herein used is meant, not the engineering contractor who carefully analyzes every bid, but the fellow who is wont to take chances and lump things together rather than consider every item entering into the make-up of a structure in detail. As in everything else, there are two sides to this question of justice, and instead of talking about "justice to the contractor" let us make the proposition mutual and revise the slogan to read "justice to the contractor and the engineer," which latter implies "owner" also. No real progress will be made by one side heaping the onus of conditions on the other, for there are just grievances on both sides which only a mutual understanding between the great body of engineers and that of the contractors can remedy.

Chicago. ALBERT M. WOLF.

How Wide a Canal Can Available Floating Dredges Dig?

SIR: The writer has studied with much interest the article in the Engineering Record of Aug. 5, page 174, on the Little River Drainage District of Missouri. The surprising statement is reiterated that a canal with "a base width of 123 ft. is practically the limit for economic construction with floating-dredge equipment now built."

The Knights Landing Cut (see the Engineering Record of March 15, 1913, page 298) is now practically complete. It has been constructed throughout with floating-dredge equipment with a bottom width of about 400 ft. About 60,000 yd. at the upper end, where the width increases to 600 ft., was rehandled. On the remainder of the work material was taken direct from the excavation and placed in the spoil banks without rehandling. This was accomplished without difficulty even where the depth exceeded 14 ft. and the cross-sectional area 220 cu. yd. per linear foot. The bulk of the work was done with clamshell dredges of the type commonly used in California, with buckets of from 4 to 5 cu. yd. capacity and booms 170 to 190 ft. in length. These machines average from 2500 to 3000 cu. yd. per day of 22 hours. The largest machines have booms 240 ft. in length, with 6-yd. buckets. All conceivable classes of material are handled with ease. In heavy timber it is cheaper to pull out the large stumps. With the larger machines material can easily be placed without rehandling 300 to 350 ft. from the point where it is excavated. Unit costs, varying with the class of material, will average from 5 to 10 cents per cubic yard.

The writer has studied and observed work of this character along the Mississippi River, and has been utterly unable to understand why heavier equipment with greater capacity and longer reach is not in more general use there as it is in California on similar work.

FRED H. TIBBETTS,
Haviland & Tibbetts, Civil Engineers.
San Francisco.

[Mr. Tibbetts' inquiry was submitted to William A. O'Brien, chief engineer of the Little River Drainage District. Mr. O'Brien states that the discussion arises from the misunderstanding over the type of dredge. What is referred to in the article, although it is not definitely stated, is a dipper dredge. With the machine of this type, having 90-ft. boom and 4½-yd. bucket, the

THE THOR AND THE ARGYLE ON 400-FOOT CANAL 13 FEET DEEP—NO MATERIAL REHANDLED

123-ft. bottom width and 10 to 12-ft. cuttings are the limit for economical construction. There are no dredges of this type of larger size, and for a wider ditch, material would have to be rehandled.

Further he says: "A combination plant consisting of a dipper dredge and clamshell could be used on prisms of greater width. In fact, the installation of such a plant is contemplated by one of the Little River contractors. If Mr. Tibbetts could give us some information relating to the operation of clamshell or orange-peel dredges when working in heavy timber, it would be appreciated."

The query was put to Isham Randolph as to why these large-size machines had not been used in the Mississippi Valley. He replied that the expense of the machines had seemed too great to the contractors for the amount of work they could expect to do with them.—EDITOR.]

Beware of a Confidence Man

SIR: There is a man traveling around over the country calling on engineers and people in engineering work representing himself as not having had employment for the last few months, and as having been laid up in a hospital with typhoid fever or some other ailment, and with a view of getting enough money to tide him over until he hears from home he is "making a touch," or trying to do so, on representatives of manufacturing concerns, engineering organizations and the like.

The writer recently had an interview with him under the name of E. Byrne. Mr. Byrne (?) stated that he was assistant engineer of inspection on concrete work at the large Keokuk hydroelectric plant. He also advised that he was a classmate of one of the members of our organization located in some other city. He reported himself as being a graduate of Lehigh University.

He is a fluent talker. He is about 33 to 35 years of age, weighs about 160 lb., is about 5 ft. 9 in. tall, dresses well, presents a good appearance and has a very convincing argument. X. Y. Z.

Strength of Clamped Splices in Reinforcement Bars

SIR: The writer believes that the paper by E. L. Lasier, entitled "The Strength of Clamped Splices in Concrete Reinforcement Bars," presented at the recent annual meeting of the American Society for Testing Materials, has not been properly commented on by engineers. He has been strengthened in this belief by the appearance of an advertisement of a firm which manufactures bar splices.

The author of the paper states that "clamped lap splices embedded in large masses of concrete undoubtedly can safely withstand a unit load equal to the unit stresses in steel reinforcement." The manufacturers quote the foregoing statement and we may see in the near future a large number of contractors and engineers using spliced reinforcement. For large bars it has been stated that the cost of the splices and labor will be less than the cost of the additional length of bar required for bond.

The author's experiments plainly show that the ratios of load at first slip to yield point of bar for clamp splices embedded in concrete varied from 53 to 83 per cent. We know from experiments that by using embedments of proper length for bond 100 per cent efficiency can be secured. Assuming the yield point of the steel to be 32,000 lb. per square inch, and a fiber stress of 16,000 lb. per square inch is used in designing, the steel when lapped can be depended upon to hold in the concrete until the elastic limit is reached, thus giving a factor of safety of two, based on the elastic limit.

It is poor engineering to use a form of splice in which the ratio of slip to the elastic limit varies from 53 to 83 per cent when 100 per cent can be obtained by methods universally approved.

We are to assume that in the laboratory tests the greatest care was used, yet splices cannot be depended on safely to withstand a unit load greater than the allowable unit stress in the steel reinforcement bars; consequently there is no factor of safety. It is not reasonable to assume that all splices in the field will be better than the bar splices made in the laboratory, and a warning should be issued against the use of clamped splices for reinforcing bars.

The writer noticed in several cases that bars were spliced by welding. In concrete arch bridges where the unit stress in the reinforcement is very low there may be no danger in welding the main reinforcing bars. In beams and girders in which the steel will be stressed to 16,000 lb. or more per square inch, the splicing of bars by welding is a dangerous practice.

ERNEST MCCULLOUGH,
Consulting Engineer.
Chicago.

[A copy of the foregoing letter was submitted to Mr. Lasier, who comments on it as follows.—EDITOR.]

SIR: The letter from Mr. McCullough will, of course, only be commented upon from the standpoint of the testing engineer.

The undersigned has not yet had the opportunity of seeing the advertisement referred to. It must be remarked that the conclusions drawn in the paper under discussion were guardedly and advisedly worded in view of the limitation of the tests; no generalizations were stated, and the conclusions referred only to splices similar in nature to those tested.

No tests were made upon splices consisting of welded bars.

The clamped splices were prepared, as stated in detail in the paper, not with special laboratory care, but using the same practice which could and should be duplicated on the actual work.

It is desired to call attention to one phase in particular of the above letter. Mr. McCullough assumes reinforcement steel of a soft structural steel grade, having a yield point of 32,000 lb. per square inch. No tests were made on splices of bars of that grade. It is distinctly stated in the paper that the reinforcement steel in all cases consisted of 1-in. square cold-twisted bars, having an average yield point of, actually, 60,360 lb. per sq. in. (specification, 55,000 lb. per square inch minimum yield point.) It is not fair, therefore, to criticise the tests reported upon, assuming steel reinforcement of a grade entirely different from that used.

As a matter of fact, the average value of load at first slip obtained for the splices tested, such splices being embedded in a comparatively small mass of concrete, was 39,300 lb., with a minimum value obtained of 32,000 lb. and a maximum of 50,000 lb. That is, assuming an allowable fiber stress in the reinforcement of 16,000 lb. per square inch, the factors of safety, based on the values of load at first slip for the tests made and reported upon had as an average 2.5, and minimum and maximum values of 2.0 and 3.1 respectively.

For a more complete discussion of this subject, those interested are referred to the September and October, 1916, issues of *Concrete*.

E. L. LASIER,
U. S. Bureau of Standards.
Washington.

Worn Macadam Roads Repaired by Tar Spraying

SIR: I note with interest the remarks published by Professor McNeilly in your issue of Sept. 2, page 281, regarding the repair of macadam roads by giving them a light application of a light tar oil, and from the experience that has been gained in the highway department of Wood County, Ohio, I may add that this method has been practised for some years.

From the illustrations accompanying the article it appears that the binder applied by the penetration method to the macadam has fallen short of its purpose through faulty construction, and instead of making a true binder has only formed a carpet coat. This may be true of either tar or asphalt. The fact that the screenings contained a large percentage of fine dust would not seem detrimental to the asphalt, and the probabilities are that the asphalt was "killed" before being applied to the road, through overheating or in any other of the many ways that a road binder may be impaired.

The "picking up" referred to is not a fault of the penetration method road alone, for it occurs wherever the surface becomes broken in any class of road.

From our observations it would appear that where a type of pavement is to be selected some of the peculiarities of the materials in question must be considered, and not a random selection of materials made; and it is highly probable that by using a waterbound roadway of the grade of limestone reported, as good results could have been expected as with the use of the asphaltic binder on a roadway with light traffic.

R. M. STROHL,
Deputy County Engineer, Wood County.
Bowling Green, Ohio.

862 Workers Killed This Year in Pennsylvania

Workmen's compensation to be paid to dependents of 290 workers killed in industrial accidents in Pennsylvania during the first five months of 1916 aggregate $742,-962.75. That amount is for fatal cases and does not include cost of medical attendance and compensation. During the first five months of the year 862 workers were killed, including one civil engineer. It is estimated that when all the compensation agreements are perfected the total amount of compensation for fatalities will approximate $1,500,000. Up to June 1 of this year the total number of compensable accidents reported to the Workmen's Compensation Bureau at Harrisburg, Pa., numbered 26,531. Four thousand compensation agreements have been paid in full and 13,000 compensation agreements have been approved. There have been 397 petitions filed by injured employees claiming compensation.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Two-Way Motion and Revolving Hammer Cage on Land Drivers

A TYPE of land driver with two-way motion leads lengthwise of the underframe to bring the hammer parallel to the two long lines of sheeting to be driven, and carrying the hammer in a revolving cage in front of the leads so that it could drive sheeting on an arc, proved very successful in constructing the land wall of the cofferdam for lock No. 2 on the Cape Fear River, described on page 325 of last week's issue. The lower carriages of the drivers ran on tracks spanning the width of the cofferdam cells. A third track back of the rear wall of sheeting carried an extension of the underframe on which the hoist was mounted. Steam for both the hammers and the hoisting engines was provided from a central boiler plant. Each driver was equipped with two 2-in. jets. The pumps which supplied these jets were mounted on barges tied up at the points where the drivers were working.

The sides of the sheet-pile pockets next the river were curved, and on one of the drivers the frame in which the hammer was suspended in front of the leads was constructed so that the hammer could be turned at any angle to follow the curve of the sheeting. The cage on the other driver did not have this revolving feature, but was useful where it was necessary to over-reach piling partly driven in making the closures of the pockets.

The work was done with government plant and forces under the immediate direction of Norman M. Chivers, assistant engineer, and under the general supervision of Capt. C. S. Ridley, Corps of Engineers, U. S. Army.

DRIVING PILES TO MORE THAN 40 FEET PENETRATION, THESE RIGS AVERAGED 16 A SHIFT

Bent I-Beams Hung Over Fire Straighten of Own Weight

A LARGE number of bent 15-in. I-beams were straightened at Harrisburg, Pa., by F. P. Kemon, superintendent for the Robert Grace Contracting Company, engaged in building the Cumberland Valley Railroad bridge described on page 340 of this issue, by hanging them one at a time between two ginpoles over carefully built wood fires. Each end of each 72-ft. beam was suspended by a set of falls. These falls were attached to the tops of two ginpoles leaning toward each other and each guyed with three lines. In this way there were no guys directly over the fire. The beams were suspended belly up in the case of light kinks, and belly down when badly bent, with the bend resting on the fire, so as to straighten of their own weight when heated. It was necessary to guy them sideways with small wire lines to keep the web as nearly as possible in a horizontal position. The fires, built of scrap lumber from the job, were tended by an experienced blacksmith, who took great care to avoid burning any part of the beams.

The work was very successful, many beams as badly bent as some of those in the photograph being restored to practically perfect straightness. A number of the more badly bent beams could not be quite straightened, but were restored near enough to their original condition to make it safe to use them in trestle construction.

I-BEAMS WERE STRAIGHTENED SUFFICIENTLY FOR USE IN TRESTLE BY HANGING OVER FIRE

The trestle in which the beams were employed was about 1500 ft. long and extended entirely across the east branch of the Susquehanna River. The river bed is scoured bare, and the framed trestle bents rested directly on the rock. The entire trestle, which was upstream from the new bridge, was carried out by a severe and unexpected flood on June 18, practically all of the stringers being bent around the upstream ends of the piers. As soon as the water went down, the stringers were fished out by a locomotive crane on the main-line track. The work of straightening them on the island proceeded so rapidly that it was possible to rebuild the entire trestle and start concreting at its far end in less than six weeks after the flood. Aside from the present high price of steel, it is doubtful if a sufficient number of stringers to replace the bent ones could have been delivered to the job within this time.

Railroad Sold to Philippine Government

The sale of the Manila Railroad to the Philippine government was ratified Sept. 8. The price was $4,000,000. The road, the only one on the island of Luzon, has 350 miles of track.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Suspended Span of New Quebec Bridge Falls Into River While Being Hoisted Last Monday Morning

Broken Intermediate Shoe Casting Suspected as Cause—Span, Supported on Diagonally Opposite Corners, Crumples and Slides Into Stream—Operations Until That Moment Unusually Successful

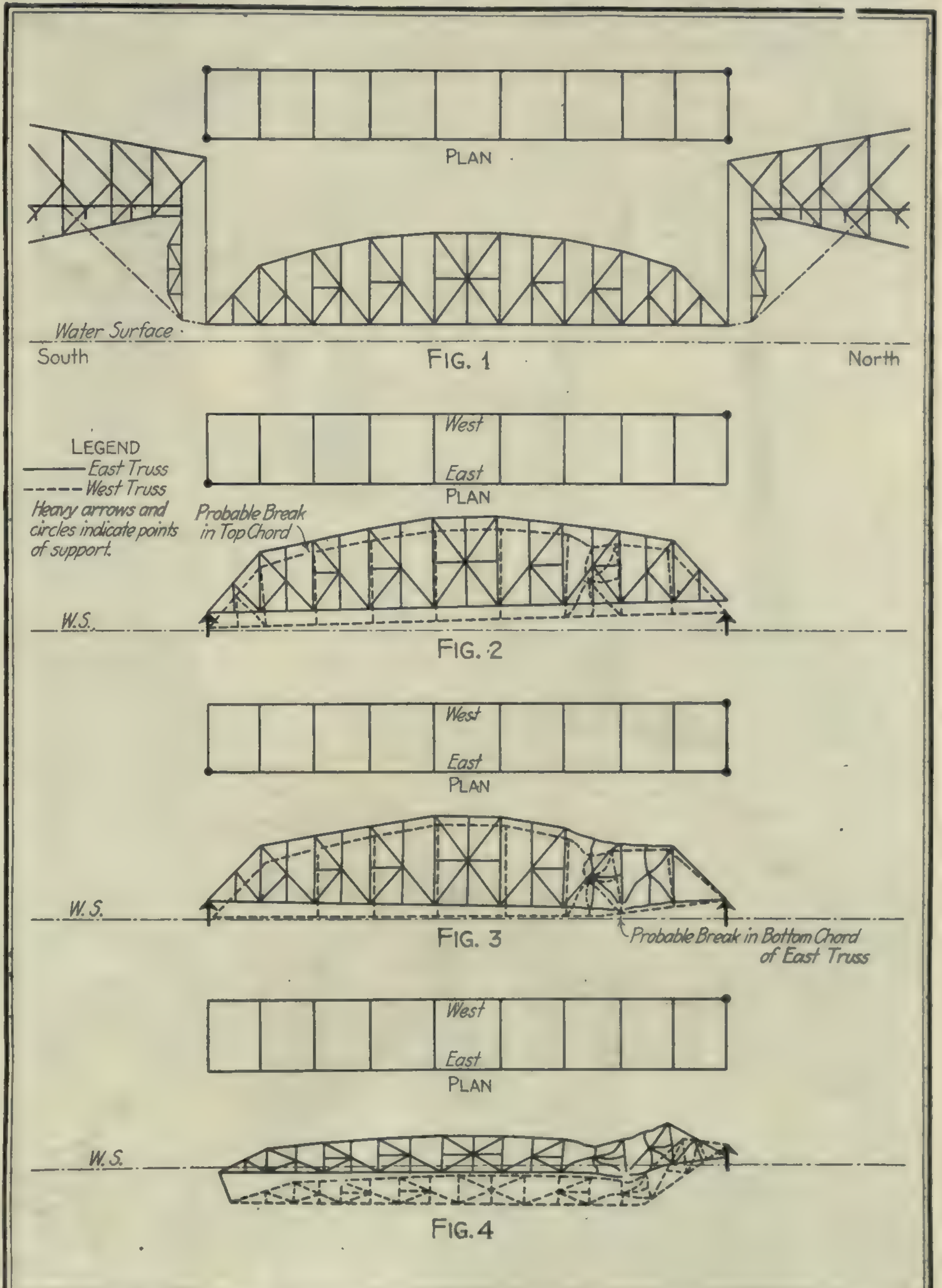
The suspended span of the new Quebec Bridge while being hoisted to position last Monday morning fell from its hangers and now lies a wreck on the bed of the St. Lawrence. Until the instant of failure the remarkably worked-out program was successful in every particular. The floating out from the erection site, the placement ready for hoisting, the connection of the truss to its lifting mechanism, the releasing from the scows, seven or eight cycles in the jacking operations—all had been performed in accordance with schedule. Then when the hosts of spectators were congratulating the engineers over the success of their work, when most of the responsible men, confident of the overcoming of all difficulties, were relaxing from the strain which so serious an operation imposed, the huge structure, without warning, slipped from its supports and in a flash disappeared in the river. The failure occurred at 10.50 a. m., 80 minutes after the barges had floated free and lifting had begun.

The sequence of failure was probably as follows:

The southwest corner of the span slipped out of its supporting stirrup, throwing the weight of the structure on the southeast and northwest corners. The lateral system and sway bracing developed sufficient resistance under shear to crumple the west truss in the center of its north half. At the same time, or just previous, the top chord of the south half of this west truss pulled apart from its own weight. Simultaneously, probably, the unsupported north half of the east truss also pulled apart, or began to do so. The failure of the north half of the west truss robbed the mass of its diagonal support of the instant previous and allowed the north shoe of the east truss to drop back with considerable impact upon its stirrup, causing the north half of this truss, doubtless already weakened, to crumple. An instant later the southeast lifting girder tore its way free from the structure, already turning upstream, or west, and partly in the water. At this moment, apparently, both north corners still rested in their stirrups. Which of these left its seat first the evidence does not yet clearly indicate, but whichever did, snapped first the mooring lines (none of which had been cast off), exerting the greatest pull on the east corner of the mooring truss, breaking in the instant previous the east set of heavy falls attached to the lower corner of the mooring truss and to the lower chord of the cantilever. This movement severely stressed this truss, warping it permanently while it was still held by the west set of falls. By this time the north pair of hangers had undoubtedly been kicked far back, so that when the last corner of the suspended span let go it was under or even north of the mooring truss. The two lines from this corner must have swung the mooring truss north, letting it go as they snapped, so that it fell back and broke its west set of falls by its own weight. Eleven lives, all those of workmen, were lost in the failure.

This account of what happened on the fatal Monday morning at Quebec, after everything in the unprecedented operation of raising this 5100-ton span of nickel steel had gone so smoothly that most of the distinguished engineers present had left for lunch, is based on testimony of eyewitnesses, photographs and conditions after the accident, the information having been gathered by two representatives of the Engineering Record, who were at the site. This evidence will be presented in detail below, but for its understanding a brief review of the method employed and of the operations under way at the time is necessary. This method, which was most unusually successful in every detail up to the moment of the collapse, will be described more fully in a subsequent issue of the Engineering Record.

The span in lifting condition was completely erected at Sillery Cove, 3 miles below the site, except the floor system, of which only the floorbeams and such of the center and end panel stringers as were needed to support the hoists and platforms required during erection were in place. Beneath each end, securely fastened together, was placed a group of three specially built steel frame barges, which were blocked



SUCCESSIVE STEPS IN BREAKING UP OF SPAN AFTER FAILURE OF SOUTHWEST SUPPORT

Fig. 1—Just before accident. Fig. 2—Southwest support gone. Fig. 3—Failure of east truss. Fig. 4—Final plunge.

These Photographs, Taken During, Before and After the Fatal Accident to the Suspended Span of the Quebec Bridge, Show the Lifting Mechanism and the Manner in Which One Corner Jumped from Its Support, Precipitating the Plunge

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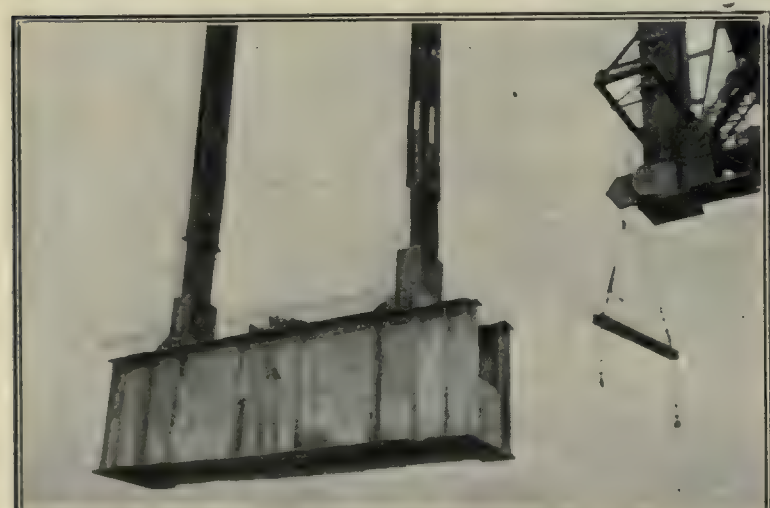
REMARKABLE PHOTOGRAPH, LOOKING WEST, SHOWS SOUTHWEST CORNER UNDER WATER BEFORE OTHER THREE HAD LEFT THEIR STIRRUPS AND CONFIRMS THEORY OF MOMENTARY DIAGONAL SUPPORT AND CRUMBLING OF NORTH HALF OF WEST, OR FAR TRUSS

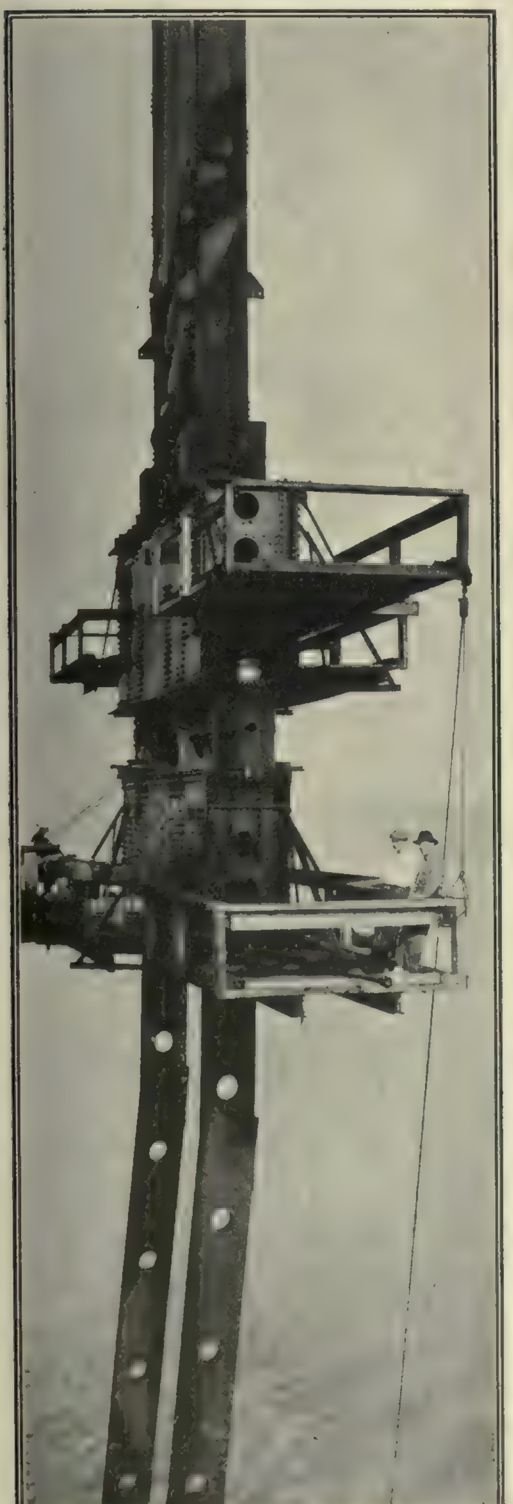


THE TWO STIRRUPS THOUGHT TO HAVE CARRIED DOUBLE LOAD—LEFT IS AT NORTHWEST CORNER, RIGHT ONE AT SOUTHEAST, SHOWN VERTICAL AT LEFT OF VIEW ABOVE—PLATFORM WRECKAGE IS FROM SPAN—NOTE BENT LINK OPPOSITE IT

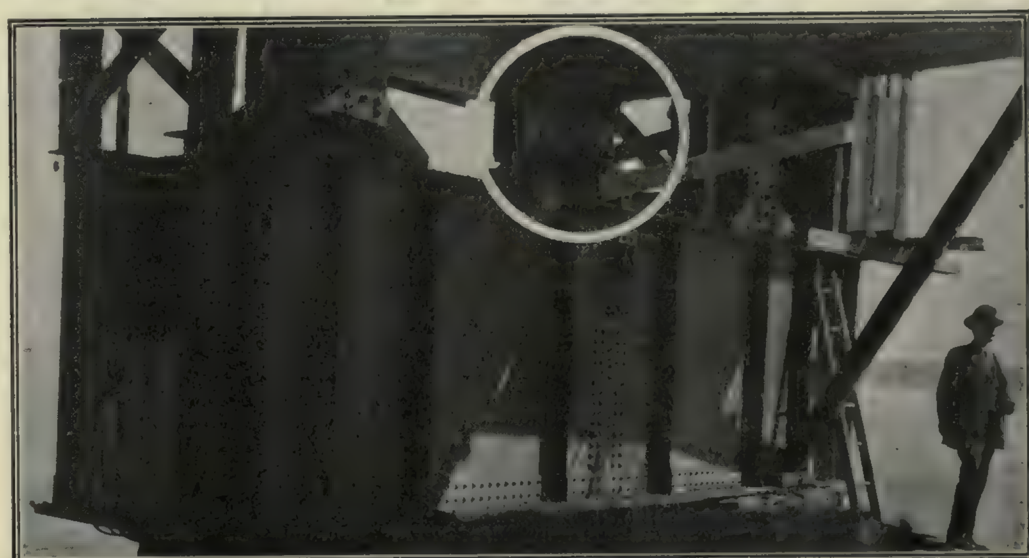
LEFT, SUSPENDER LINKS ATTACHED TO SPAN; RIGHT, SAME PAIR AFTER ACCIDENT—FAR HANGER IN BOTH VIEWS WAS FIRST TO JUMP OUT

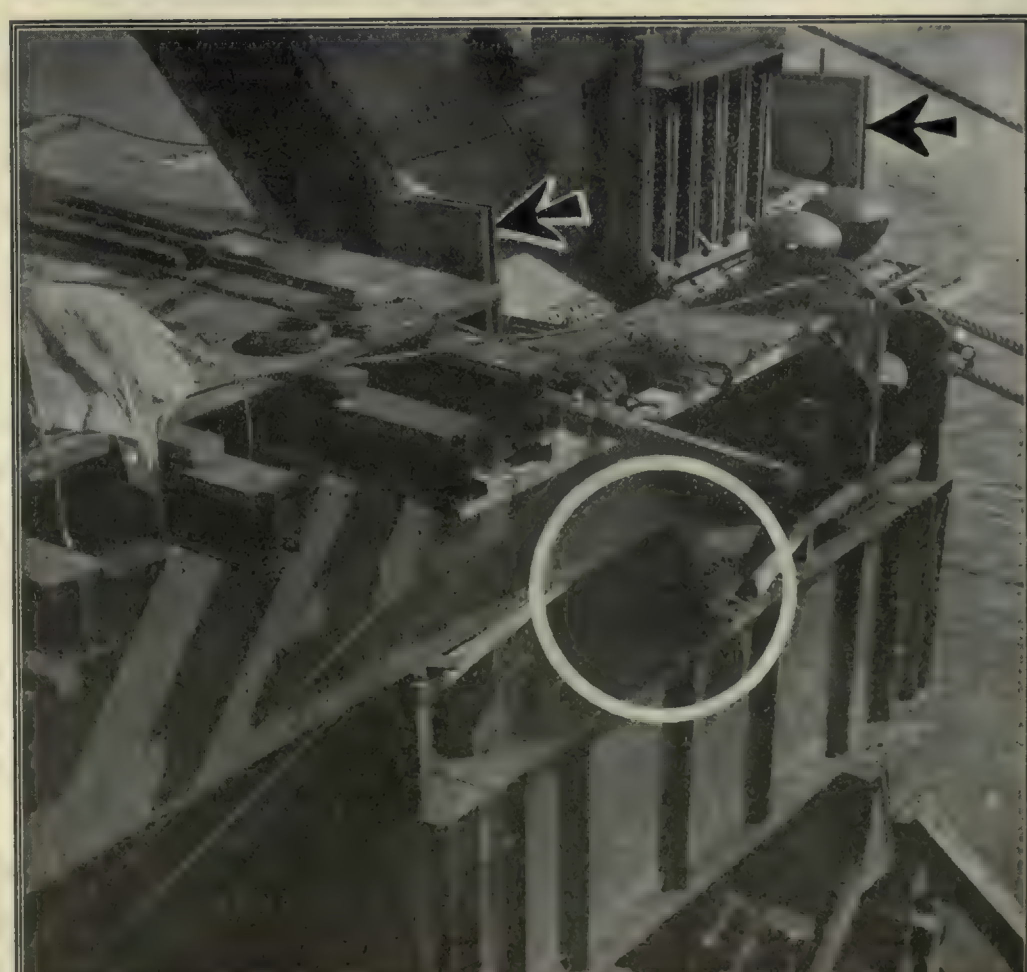
Photo by the Standard, Montreal

THIS PHOTOGRAPH, SNAPPED ALMOST AT THE MOMENT OF COLLAPSE, SHOWS EXACT CONDITIONS IMMEDIATELY BEFORE THE FAILURE



A PAIR OF JACKING GIRDERS, BEFORE PLACING OF SPAN—UPPER ONE IS RAISED AND LOWERED BY JACKS SEATED ON LOWER ONE—NOTE PIN HOLES





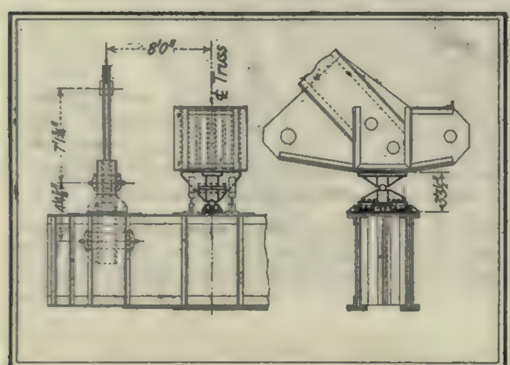
ABOVE, INSIDE AND BELOW, OUTSIDE OF STIRRUPS, BEFORE FLOATING FROM FALSEWORK

Circles show suspected cast rocker bearings; arrows, stub suspender links. Note that left link comes up through box girder of span

from the span with the remaining floor steel. Valves in these scows were closed on the rising tide at midnight between Sept. 10 and 11, and the span floated at 3.53 a. m., the barges drawing 8 ft. 2 in. of water. The span started to swing out into the river at 4.40 a. m., and by 5.12 a. m., when the last line to shore was cut, was in complete control of the tugs. It reached the bridge site at 6.55 a. m. and was moored in position with remarkable precision and in very short time. The hanging links of the lifting mechanism had been completely attached by 8.35, and in about 40 minutes jacking operations were started, which raised the span sufficiently for the last group of barges to float clear by 9.30 a. m. At this point breakfast was served to the men, and jacking operations were not resumed until a few minutes before the accident.

Taking one corner of one cantilever arm as a unit, the lifting mechanism may be briefly described as follows:

First, on blocking on the outer end of the top chord rested a universal rocker bearing composed of a base casting bearing a pin parallel to the axis of the bridge, an intermediate casting resting on the first pin and bearing a pin at right angles to it, and a top casting resting upon the second pin and directly supporting a short, heavy box girder. From this girder on each side of the chord hung heavy steel plate links supporting a second girder at approximately the level of the track. Both of these girders were fixed with refer-



DETAIL OF SUSPECTED STIRRUP

ence to the raising of the span, and did not change relative position during lifting operations. On the lower girder rested a pair of hydraulic jacks tested to a capacity of 1250 tons apiece. Upon these jacks was carried a third and movable box girder similar to the first pair. Passing through diaphragms in the movable and in the lower fixed girder on each side of the truss were suspender links in 30-ft. lengths having pin holes on 6-ft. centers and extending down to the level at which the center span was floated in. After this span was moored in place, the lower ends of these suspender chains were pinned to stub links at the corners of the suspended span. Each pair of these stub links in turn supported a fourth box girder similar to the other three upon which rested a corner of the span. The support at this point was identical with that above the top chord of the cantilever arm, and provided, by means of three castings and two pins at right angles to each other, for movement of the suspended span in any direction, due to wind pressure, without putting any bending stresses on the hangers and their connections.

At the time the span came to a bearing on these hangers, which are plainly shown in the accompanying photographs, pins were inserted through the diaphragm holes of the movable girders resting on the jacks and through holes at the top of the suspender links. The jacks were at the bottom of their stroke. To raise the span, two hydraulic pumps on each cantilever arm were started, supplying pressure at 4000 lb. per square inch to the jacks through a system of control valves which made it possible to regulate the relative movement of the corners and ends of the span very accurately. When the jacks had reached the top of their 2-ft. stroke, pins were inserted through the diaphragms of the lower fixed girders and through a lower hole in the links, thus releasing the jacks, permitting the withdrawal of the upper pins and the lowering of the movable girder for the next stroke. During the upward stroke, the movement of the hydraulic jacks was closely followed by two counterweighted screw jacks at each corner, to provide against dropping the load through any accident to the hydraulic piping. Three complete jacking cycles, the first requiring 15, the second 12 and the third 10 minutes, were completed to release the scows before work was stopped for breakfast. After work was resumed, three or four more cycles were completed and the span was held by pins in the fixed lower girders while the jacks and the upper movable girders were being lowered for the next stroke, when, without warning, the span slid out of the hangers and plunged into the river.

Evidence to Support Explanation of Failure

That the southwest corner left its hanger first is indicated by the testimony of eyewitnesses, one of whom went down with the span, several of whom were in boats in the vicinity and looking at the span at the time and several of whom were on the banks of the river observing the span through field glasses. This testimony is confirmed by the fact that the southwest hanger remained comparatively still, while the other three hangers were violently agitated, and swung back and forth, with a movement having components transverse to and longitudinal with the bridge, for some time. This would indicate that the southwest hanger was not affected by the subsequent movements of the span before it plunged into the river, while the other three were. It is further confirmed by the positive evidence from the very remarkable photograph which shows this corner beneath the water at a time when the other three corners were still above the level of the supports. This photograph also confirms the testimony of eyewitnesses that the span turned over toward the west in disappearing.

That the span broke up in the manner indicated by reason of the fact that it was supported for a short space of time on the southeast and the northwest corners is evidenced by eyewitnesses who saw:

1. A parting of the top chord of the west truss at the second panel point from the south end.

2. A crumpling of the top chord of the west truss at the north end.

3. A pulling apart of the eyebars in the bottom chord of the east truss at the north end.

Photographs Important Evidence

All of these statements are confirmed by the photograph of the plunging span published herewith. They are further confirmed by the fact that the southeast and the northwest hangers sustained more damage than the other two, and that the platforms on the jacks at the top of these hangers were more completely broken up by swinging than those around the other two. The violence with which the southeast hanger tore loose from the southeast corner of the truss is evidenced by the fact that its westerly suspender bar was considerably stretched, and that this is the only hanger in which the girders were thrown to any extent out of level. Also the lower pin, half of which remained in place on this hanger, was broken in two. The hanger diagonally opposite also showed some inclination, though slight, with the horizontal.

The remaining deductions, regarding the manner in which the east lower corner of the north mooring truss became warped and the blocks by which this truss was pulled out of the way while the span was being placed were broken loose, are borne out by the testimony of eyewitnesses to the fact that the truss swung violently to and fro, as did the hangers on this arm, and by the warping of the truss and the breaking loose of the falls.

So far as could be observed, without going minutely over the main trusses, no damage of any sort was sustained by them. The normal camber of the cantilever and anchor arms before taking the weight of the suspended span was visible to the eye at certain points on the structure and appeared to be unchanged after the accident from the condition obtaining on the Sunday previous. There is no testimony of any pieces of steel or rivet heads having sheared off and fallen. Locomotive cranes were operated on the structure out to the ends of the cantilever arms on the afternoon of the accident without producing any motion or vibration not discernible during the preceding week—all this, in spite of the fact that for a short time during the collapse of the center span the west truss of the north cantilever and the east truss of the south cantilever must have been under at least 100 per cent greater load from this span than they were designed to carry. The strength of the hanger mechanism is fully attested by the fact that all four hangers are intact, as may be seen in the photographs. The fact that the inner suspender bars of each hanger are bent near the bottom is accounted for by the detail of the lower connection shown in the photographs. A heavy box girder connected the lower ends of the inclined posts of the trusses of the suspended span, and the inner links of the suspender chains came up through the inside of this girder. It was necessary for them to tear it apart before the span could break free from the hangers. The fact that at least the calculated friction was developed by the longitudinal pins in the shoes under the corners of the span is well attested by the manner in which the last three corners hung on until the span had broken apart.

Other Theories Considered

It is not possible to suppose that the southwest stirrup could have been pulled out from under the span in any manner, both because of the fact that such a great friction was developed on the other pins, because a close inspection of the mooring lines had been made a few minutes prior to the accident and because the upward motion of the span was at the time loosening instead of tightening these lines. The photographs also prove conclusively that the members of the truss itself could not have failed and thus caused the slipping out of this shoe, as the truss continued to hang on at both ends after its members had actually come apart.

For these reasons, as well as for those discussed editorially, this journal is led to suspect the failure of the intermediate cast-steel supporting shoe as the primary cause of the loss of the span.

Ohio District Court Finds Luten Patent Invalid

Judge Sater, of the U. S. District Court at Columbus, Ohio, handed down an opinion on Aug. 28 which concurred in the ruling of Judge Lewis against the Luten patent for arch reinforcement in the Colorado case of Luten vs. Washburn, et al. This later suit, in which the patent is declared invalid, had been brought by Luten against officials of Delaware County, Ohio, and two firms of contractors who constructed two highway bridges of reinforced concrete, employing the Kahn system of reinforcement.

The Court accepted the explanation by Professor Turneaure that three prior patents, one to Hyatt, U. S. patent No. 206,112; one to Thatcher, U. S. patent No. 617,615, and a British patent to Hyatt, No. 289 of 1877, showed exactly what Luten claimed to have invented—that is, "a reinforcing bar for concrete, provided with projections of such height and spacing that the space between adjacent projections is more than ten times the height of the projections."

It was held that the mere fact that these former patents failed to point out this relationship did not permit the idea to be monopolized by anyone who might point it out later.

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Quebec Span to Be Rebuilt

IT WILL BE a source of great satisfaction to all engineers to know that the St. Lawrence Bridge Company, contractor for the Quebec Bridge, has already taken steps toward the rebuilding of the suspended span, and to learn also its announced intention of hoisting the structure to place by the identical methods used last week. The Engineering Record predicted that such would be the case. The anchor and cantilever arms have been tried under a most severe load and have come through unscathed. The hoisting equipment was satisfactory in every respect. A single detail failed, and a repetition of that failure can be easily guarded against next year. No one who has studied the details of the hoisting plan, and has learned of its smooth operation until the moment of failure, will doubt that a year or so hence the suspended span will rise smoothly and safely and close the 640-ft. gap between the ends of the cantilever arms.

The Supermule

PROGRESS in the use of motor trucks has been so rapid that this journal has been prepared to believe almost anything regarding their wonderful powers. Years ago, when the use of motor trucks by contractors was in its infancy, the name of "mechanical mule" was borrowed from mining practice and applied to them. The term expressed the high regard in which the old-time contractor held the abused, but invaluable, four-footed feature of his "outfit." But the truck has proved to be more than a mechanical mule. It is a supermule. It has all of the virtues and few of the vices of its humble predecessor, and, in addition, qualities that are entirely different in nature and degree. Occasionally, but very seldom, it balks, probably to remind us of its predecessor and to school us to a proper humility. In hauling power and staying quality it leaves its erstwhile rival hopelessly outdistanced. With these thoughts in mind we were almost ready to believe this week's dispatches from Flanders. The cablegrams said that armored motor monsters had climbed a redoubt and killed men in it. "They cut up houses and put the refuse under their bellies and walk right over it. They knock down trees like match sticks. They go clean through a woods. They leap ditches like kangaroos. They simply love shell craters—laugh at them." With all our faith, we could not help but feel some doubt as to the truth of the statement. The correspondent had probably had the nightmare. We were worried, too, by having fun poked at the trucks. A day later the mystery was cleared up. It appears that these demons are none other than our well-known caterpillar tractors (American made), wearing steel clothing appropriate to the war zone. The explanation is satisfactory and has restored our poise. Our faith is even more firm than before—for is not the caterpillar tractor first cousin to the motor truck? And we have seen the caterpillar brave conditions that would appall other machines.

Co-operating with the Scientists

THIS WEEK a meeting was held in New York which may, and we sincerely trust will, mark an important step in the broadening of the co-operative activities of our national engineering societies. The meeting was that of a conference committee representing, on the one hand, the National Academy of Sciences and, on the other, the national chemical, civil engineering, mechanical, electrical and mining engineering bodies. The purpose of the committee, appointed in pursuance of a resolution of a preliminary meeting held last May, is to work out some plan by which the pure and applied sciences of this country can work together on matters of common, and of public, interest. The National Academy of Sciences is the leading body representing pure science in this country. It was chartered by Congress during the Civil War for the purpose of aligning the scientific skill of the country in support of the government during the war and during the peace that was to follow. As its title, "Academy," indicates, its scope, as to membership, is much more limited than that of the engineering and chemical bodies represented at the conference. The problem, therefore, apparently is not one merely of securing co-operation between the academy and the engineering societies, but rather of mobilizing pure science and engineering and chemistry for the public good. The Engineering Record trusts that the deliberations, under way at this writing, will result in the adoption of some working agreement by which these great forces can be brought effectively together.

No Water-Power Legislation

AGAIN a session of Congress has closed without giving to the industrial interests of the country legislation which would encourage them to develop the country's wasting water power. Year after year men who have understood the situation thoroughly have given generously of their time to advise senators and members of the House. Many who appeared at the hearings and advised with the committees, it is true, had an "axe to grind." They were prospective bidders for the powers that would be made available. Nevertheless, the money and time they have lost must eventually be charged up to the public, as is every economic waste. At the last session prospects for legislation seemed to be particularly favorable. Having inherited certain measures from the previous Congress—measures that had already gone through committee and been whipped into good shape—the session had an excellent start toward the enacting of effective and satisfactory laws. Preparedness and appropriations, however, had the right of way, and tremendous water powers must still continue to waste for lack of proper statutory provision. More interest was displayed in the measures recently, however, than ever before, justifying the hope that the needed legislation may be secured soon.

Standardized Water Meters

WHAT success will attend the plan for standard specifications for water meters, proposed at the convention of the New England Waterworks Association in Portland, Me., last week by Robert J. Thomas, only the future will disclose. If a superintendent of a municipal waterworks plant could go into the open market and purchase the meter which his experience indicates to be the best, the need for a standardized specification would not be felt. Under present conditions, however, ordinances in many localities require the award of a contract to the lowest responsible bidder. Under such conditions specifications are necessary, but Mr. Thomas finds that those now in use contain merely a few broad requirements which all meters can fulfill. Specification requirements regarding accuracy or sensitiveness, test pressure, loss of head, testing rates, maintenance of accuracy and similar important matters are conspicuous by their absence. From his survey of the field Mr. Thomas is led to the belief that the New England Waterworks Association has an opportunity for service in the field of meter specifications. Whether manufacturers of water meters will concur in this belief is open to grave doubt. The leading firms have been in the business many years and have developed designs which certainly could not be changed at short notice without a substantial loss in profit. The commercial side of this question is one which will have a decided bearing upon the ultimate results. The New England Waterworks Association has not taken any definite action upon Mr. Thomas' suggestion. It has, however, been authorized to appoint a committee to report on the possibility of standardizing water-meter specifications. It is impossible, now, to say just how far this standardization will go. The first step, if any step is taken, will probably be in the direction of standard requirements for accuracy and for methods of testing.

Limitations of Engineering as an Exact Science

IT IS NOT EASY, in the nature of things, for a layman, however intelligent, to gain a measurably correct conception of the difficulties that confront the engineer in the solution of his manifold problems. Engineering activities are apparently conducted with such unerring certainty, in the eyes of the casual observer, that he is unconsciously led to look upon engineering as an exact science. He utterly fails to realize that operations which seem to proceed with almost automatic ease and smoothness are in reality subject to innumerable contingencies which, if not adequately gaged in advance, would invite partial or complete failure.

The significance of full success under difficult circumstances for which there may be little or no precedent, and in which the failure of any one of numberless details may entail disaster to the whole, can be appreciated only by the trained engineer. He knows, too, how hazardous it is to lean too heavily upon theory alone in dealing—as he must at every turn — with the uncertain forces of nature and materials, concerning which human knowledge can be approximate at best. It is because these factors are inseparable from engineering enterprises that engineering—unlike its handmaids, mathematics and mechanics — can never become an exact science. That fact, however, serves as a stimulus rather than a drawback to engineering, constituting as it does, in the views of its followers, at once the hazard, the fascination and the glory of their profession. Engineers cannot be book-made. The highest professional achievements in engineering must be predicated on that happy blend of theory, practice and native common sense known as engineering judgment. That quality is, indeed, indispensable in the solution of difficult engineering problems. Such problems require the judicious integration of numerous factors which, though rarely susceptive of exact evaluation, have nevertheless to be recognized and given due weight at their approximately true values.

Thanks to modern engineering skill and foresight, great achievements in that field have become seemingly so commonplace and important failures relatively so rare, that in the superficial public view engineering has quite naturally come to be regarded as something at least closely akin to an exact science. The prevalence of that fallacy denotes, in its underlying basis, a high tribute to the profession. When failure does occur, however, as occasionally it must, that fallacy serves also to suggest the conclusion, in lay circles and in the public press, that it must have been due to incompetence, negligence, or professional culpability of some sort. It is, of course, not to be denied that in some, and perhaps most, instances such inferences are well founded. No one knows better than engineers, however, that in certain circumstances failures may occur for which no blame whatever can rightly attach to the engineers in charge. Whether the recent calamitous failure of the new Quebec Bridge presents such an instance can be established only by rigid inquiry. Pending this inquiry, the engineering profession can only hope that the preliminary evidence which points so strongly in that direction will be abundantly sustained. The previous records of the engineers concerned and their performances in connection with the design, fabrication and erection of this remarkable bridge have been so truly notable that their complete exoneration from any suspicion of professional dereliction would be hailed with profound satisfaction by their professional brethren.

What Caused the Initial Failure at Quebec?

CIRCUMSTANTIAL evidence presented at length in this issue seems to fasten responsibility for the loss of the suspended span of the Quebec Bridge on one of the castings of the rocker-joint bearing of the southwest lifting girder. This being conceded, the question immediately rises, What caused the initial failure? The detailed dimensions of the castings of the rocker joint are shown on page 370 of this issue. Data are not at hand as yet as to the composition of the metal; the results of breaking tests of bars from the same heat as the castings; the evidence afforded by microscopical photographs, if any; and the heat treatment to which the castings were subjected—all matters that will throw light upon their strength and reliability. A defect in one of the castings is, of course, one of the most obvious explanations.

Of the three castings, the two upper ones have disappeared, and of these the intermediate member, rather than the upper one, is open to suspicion. An examination of the design suggests at once the possibility of a large tensile stress due to bending of the projection. The wing resting upon the longitudinal pin, parallel to the main trusses, would be subject not alone to bending due to assumed uniform distribution of loading on the pin, but to added bending due to friction on the transverse pin, which would be induced by the deflection of the span and by the elevation of the south end 2 ft. higher than the north, which occurred during the lifting operation.

Furthermore, it will be noted that the parallel transverse pins through the diaphragms in the supporting girders (see sketch in last week's issue, page 366) and the transverse pin of the rocker-joint bearing, supporting the trusses, place the support in unstable equilibrium, except for the stiffness of the bolted connection between the stub link and the supporting girder. This connection is composed of a plate on each side of the stub link and connecting angles. While they appear to be sufficient to prevent any movement, the inquiry naturally comes as to the reason for using a pin for this connection. Any displacement of the upper pin with respect to the lower, resisted entirely by the friction on the pins and the connection just mentioned, would at once induce a twisting moment and a tipping of the girder. Had such movement occurred—and the photographs of the girders at hand do not show any distress in the connection between the stub link and the supporting girders—the casting would undoubtedly have failed to resist such overloads. The resulting diagonal motion of the supporting stirrup would follow very probably in exactly the manner indicated by the circumstantial evidence cited elsewhere.

As was said in this journal last week, now that the accident has occurred, it is easy to suggest some other detail for this important support. While the stirrup was for temporary use only, the manner in which it was required to lift, as on knife edges, a total load of 5100 tons subject to lateral and longitudinal forces surely calls for the use of the most reliable known material, high factors of safety and every precaution to insure stable equilibrium. Cast steel, while reliable in compression, is unreliable in bending, especially for such thick castings as were here required, for which the heat treatment is such a vital factor.

Further study of the details of this casting—so far as their composition and manufacture are concerned—is necessary before the engineering public will be fully satisfied that it has learned all possible lessons from last week's disaster.

Prosperity Follows Western Highway Construction

TOURIST travel in the Western States by automobile has reached almost unbelievable proportions. Even in such out-of-the-way sections as Western Colorado the hotels are crowded to overflowing by the motorists. The highway officials of Colorado estimate that the 100,000 visitors this year left $9,000,000 behind them. This is based on an expenditure of $3 per day by each person for the average period of thirty days during which each of the 25,000 cars was in the State. As a result of the traffic—and the gold it leaves behind and may bring in future seasons—all the wayside inns and the abandoned mining towns of former boom days are clamoring for good roads into their sections. It is indeed a diplomatic engineer who can keep harmonious relations among all the advocates of rival roads when a tempting slice of the $9,000,000 State-aid fund is in sight.

The situation occasionally has an angle of importance to railroads little appreciated. The southwestern section of Colorado, with its historic cliff dwellings, has recently been made accessible, at a comparatively small expenditure, by a pass road over the Continental Divide, as described on page 378. The section is rich, also, in minerals and lumber and has a large grazing acreage. To get to it by rail from Denver or Colorado Springs formerly required a trip into New Mexico and six hours more in time than is now required by automobile. The possibilities are inviting for the establishment of an auto stage. Already the railroad has lost as passengers many commercial travelers; they now travel in motor cars and carry their stocks and samples with them. Cattle and sheep can easily be driven to a station on the other side of the range, saving the ranch owner $26 per car in trans-

portation, in addition to giving him access to government range for fattening his stock. The prospective competition, due to the expenditure of a sum which will hardly build a mile of heavy railroad construction, is sufficiently strong to have made the railroad survey a new line paralleling, in part, the highway.

Similar topographic conditions, unfavorable to railroads, but not forbidding to highways on which motor trucks and automobiles can operate with economy, are to be found in many sections of the country.

Lost—20 Per Cent of City Water Supplies

CAN the present condition of pipe lines, so far as leakage of joints is concerned, be considered satisfactory? This, in effect, is the question raised by Frank A. Barbour, chairman of the committee on pipe joint leakage, in his statement (see page 385) at the annual convention of the New England Waterworks Association in Portland, Me., last week. The apparent apathy of the association's membership, which was the reward of his effort to analyze the problem and reach conclusions of value—only one in five of the members replying to the questionnaire issued by the committee—would lead to the inference that the subject was not considered of particular importance. Yet this assumption is obviously wrong, for Mr. Barbour's figures show that even under the best possible conditions—in fully metered cities—20 per cent of the total water supply is, as a rule, unaccounted for.

What becomes of this waste? It must be charged either to faulty meter registration or to leakage from pipe joints in mains or service connections. Reduced to a basis of dollars and cents Mr. Barbour's findings demonstrate that a town of only 10,000 people would be justified in spending $20,000 to prevent a water loss of only 14 gal. per capita per day. These figures present the case in a decidedly interesting light. Yet, in spite of them, water departments appear to be entirely in the dark when it comes to their ability to make even an approximate estimate of losses from leakage. Ninety-nine of the 131 departments sending in replies make no attempt to state this loss in definite terms. Ostrich-like, they bury their heads in the sands of conjecture when trouble threatens. Strategy of this sort will not help much in the fight to reduce water leakage. Before conditions can be improved complete and reliable information regarding present practice must be presented. Then remedial measures may be intelligently planned.

As the initial step in the work, the chairman of the committee on pipe joint leakage sent a list of 37 questions to 430 members of the New England and to 124 members of the American Waterworks Association. From the 554 circulars sent out 131 replies were received, 46 of these being from American and only 85 from New England members. This discouraging response led Mr. Barbour to remark: "It may be that leakage from pipe joints is not generally an important factor and that the present type of joint, driven and tested, or not tested, as may be the practice, is entirely satisfactory." Possibly the subtle sarcasm of this statement did not exert its full force upon the members at the Portland meeting. Mr. Barbour might have fared better if he had discarded the rapier in favor of the bludgeon—if he had said, for instance, that the traditional excellence of the committee work upon which the New England Association prides itself would be a thing of the past if such lack of co-operation by the members in the work of one of its own committees were permitted to become general.

A task such as the one devolving upon the chairman of the committee on pipe joint leakage is not a one-man job. The success of all work of this kind depends upon the full co-operation of the association's membership in supplying the information needed by the committee. The members must realize that the chairman of such an investigating body is called upon for an enormous volume of gratuitous work. In fact, his sacrifice is measured not merely by his own time but often by a very substantial expense account paid out of his own pocket. It is clearly unjust to expect a man to make this personal sacrifice without affording him, at the same time, the solid backing of the association's members who are in a position to supply the data needed in the committee's work.

From the committee's preliminary report it is clear that the evidence already collected does not justify a conclusion as to whether or not it is economically possible to reduce pipe-joint leakage by a better type of joint, better workmanship, or testing at pressures above normal. To these questions definite answers should be made. The information most needed to reach a conclusion is that giving the results of leakage surveys, of actual tests made after the pipes have been in service some years, of experimental work showing the relation between pressure on the joint and leakage and, particularly, data from those departments where accurate tests have shown leakage in mains to exist.

The Man from Home—Again

IT IS NOT UNCOMMON to hear complaints when engineers are called in from a distance to study local problems. Generally the dissatisfaction exhausts itself in a few vocal protests, and the onlookers quote the adage, "A prophet is not without honor," etc., or attribute the complaints to the narrowness of the protestors.

Canadian engineers are now objecting to the employment of a distinguished American to take charge of the valuation of the railways of Canada. "Canada for the Canadians," is their principle, especially, they declare, when there are Canadians capable of supervising the work. The protest, were it individual, might be overlooked. It is made, however, by the council of the Canadian Society of Civil Engineers. Whether the circular sent out by the council, and reprinted on page 380 of this issue, represents the views of the majority of the society's members this journal does not know. It would be interesting, indeed, to find out.

It cannot be denied that the protest is natural. National pride is a sufficient explanation — particularly at this juncture when all elements in Canada are pulling together as never before to do their "bit" to support the empire in its great conflict.

Moreover, "people who live in glass houses" should be careful of their criticisms. In most of our states the civil service laws bar residents of other commonwealths from examinations. Even cities have a residence requirement which disbars the non-resident from competing. True, in most cases the residence rule is waived in examinations for technical positions. Even the United States government takes a narrow view of the matter of employment; save for technical positions, appointments are made on the basis of apportionment to the various states. Only recently (in the issue of Aug. 19, 1916, page 218) the Engineering Record in an editorial entitled "The Man From Home" had to disagree with one of its correspondents who objected to the employment of non-resident consulting engineers.

That we, too, as a people, consider employment as a local matter does not, of course, justify either our position or that of the Canadian society. We can understand the reason for the latter body's position. But as we wish that our own people may take a broader point of view, so do we hope that our Canadian brethren will change their attitude. We can readily conceive that there might be justification for protest in individual cases, but to erect sectional or international lines and characterize their maintenance as a principle is, in the judgment of this journal, an indication of a narrowness that is not in keeping with the dignity of a professional body.

Even though there may be sympathy on this side of the border with the Canadian body's position in general, in the particular case in question the society finds itself in a most unenviable position. The American engineer whose appointment has brought about the present protest happens to be a member of the Canadian society. He has been welcomed into the fraternity of Canadian engineers, though that fraternity wishes now to deny him the right to practise in Canada, at least when government service is in question.

What, then, does society membership mean? Is it an empty thing to be appraised by the way the wind may be blowing at the time? Is an engineer to be welcomed at the front door and have hands raised against him after he is in?

The Canadian society will have little trouble—on the broad ground of keeping its engineering appointments at home—in justifying its position to many American engineers. Even among those who deplore the protest and the stand taken there will be a sympathetic understanding of the reason for the action. There will be few, though, who will believe that the society can square its admission of an alien engineer to membership with its effort to prevent him from practising his profession, even if the limitation is to apply only to Canadian government work.

Breakage of Casting of Rocker-Joint Bearing Responsible for Quebec Bridge Disaster

Evidence of Damage on Lifting Girders Points in That Direction—Span Did Not Slip from Hanger—Condition of Girder at Southwest Corner Tells Graphic Story

THE EXPLANATION offered in the Engineering Record last week as to which detail failed at the Quebec Bridge and precipitated the suspended span into the river on Sept. 11 has been corroborated by the evidence afforded by a further inspection of the lifting girders. In fact, it is reasonable to say that all theory must now be dismissed. The circumstantial evidence is conclusive.

To understand fully what occurred the reader needs to comprehend clearly the detail of the rocker-joint bearing between the lifting girder and the suspended span. Reference is made to the accompanying drawings, Figs. 1 and 2, and to the photograph, Fig. 3. The main features of the bearings are three steel castings and two forged pins. The latter are at right angles to each other and, with the castings, form a universal joint. It should be understood that the bearing as shown in the photograph, Fig. 3, does not represent the detail as it was when the span was being hoisted. Previous to floating and after this photograph was taken, two hitch connections, indicated in Fig. 1, were added. These hitch connections carried the lifting girder when the span was being floated up the river. Then when the span was on the barges, centering plates, shown in the lower right-hand sketch of Fig. 2, were added. These plates insured the absolute centering of the lifting girder on the bearing when the load of the span was transferred to the hoisting chains. These plates were shop-fitted and bore against a chipped surface on the arm *C* of the intermediate casting (Fig. 3). A black streak at *D* shows plainly where the chipping was done in one of the angles of the casting. The plates and castings were match-marked. It was therefore impossible to put them in place until the girders were accurately centered on the intermediate casting. Once in place they prevented movement in a direction parallel with the length of the span. Their use permits one to dismiss immediately any theory that the load was placed eccentrically on the girder and caused it to cant.

What the Lifting Girders Show

As recited in this journal last week, and as shown by the photograph of the falling span there published, the southwest corner was the point of initial failure. The hanger at this point will therefore be first studied. The condition after the span had fallen is shown in Fig. 4. The picture was taken looking in a southwesterly direction. In other words, the face of the girder shown is toward the channel, while the hanger is the westerly, or upstream, one of the pair. It will be noted that the centering plate that had been bolted on at *M* has been sheared off. The plate attached at *N* is ripped loose and lies twisted in front of its former position. The plate that was at *O* has disappeared, while the remaining plate *P* lies crushed against the pin, with the hitch connection of that side lying over it. The pin is scored in a diagonal direction, and has been rotated through a circumferential distance of 1½ in. toward the reader.

It is certain from this photograph that the span did not "slip" off the pin. If it had, the plate *P* would have disappeared, the scoring of the pin would not have been diagonal, the pin would not have been rotated, and the damage to the angles at *Q* would not have occurred. In no way, except by the falling of the span through the breakage of one of the castings or of a pin above, could the damage shown have been wrought. The failure of a pin is unlikely. Something broke and precipitated the span outward toward the river and toward the longitudinal axis of the structure. The angle of movement was about 30 deg. with the bridge axis, as is indicated by the break at *Q*, the scoring of the pins and the position of the hitch connection resting on the plate *P*.

The conditions at this corner, therefore, corroborate the explanation offered by this journal last week, save that an erroneous impression may have been conveyed by the use of the word "slip." The span moved not longitudinally over the long pin but in a diagonal direction. This could only have occurred if something above broke. The breaking of a main truss member—which has been dismissed by every engineer for obvious reasons, as well as on the basis of the evidence afforded by the photograph and by those who saw the span fall—would

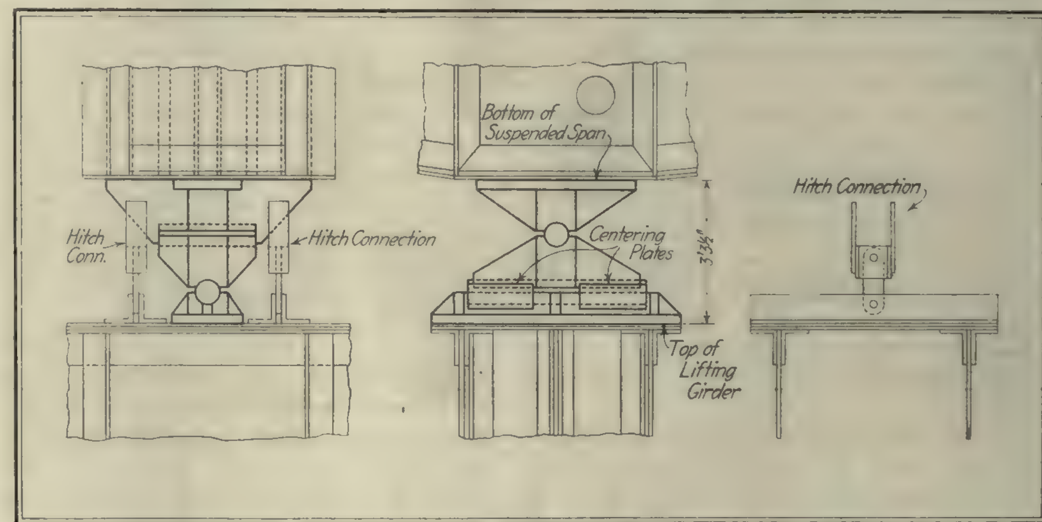


FIG. 1—ROCKER-JOINT BEARING ASSEMBLED—HITCH CONNECTION AT RIGHT

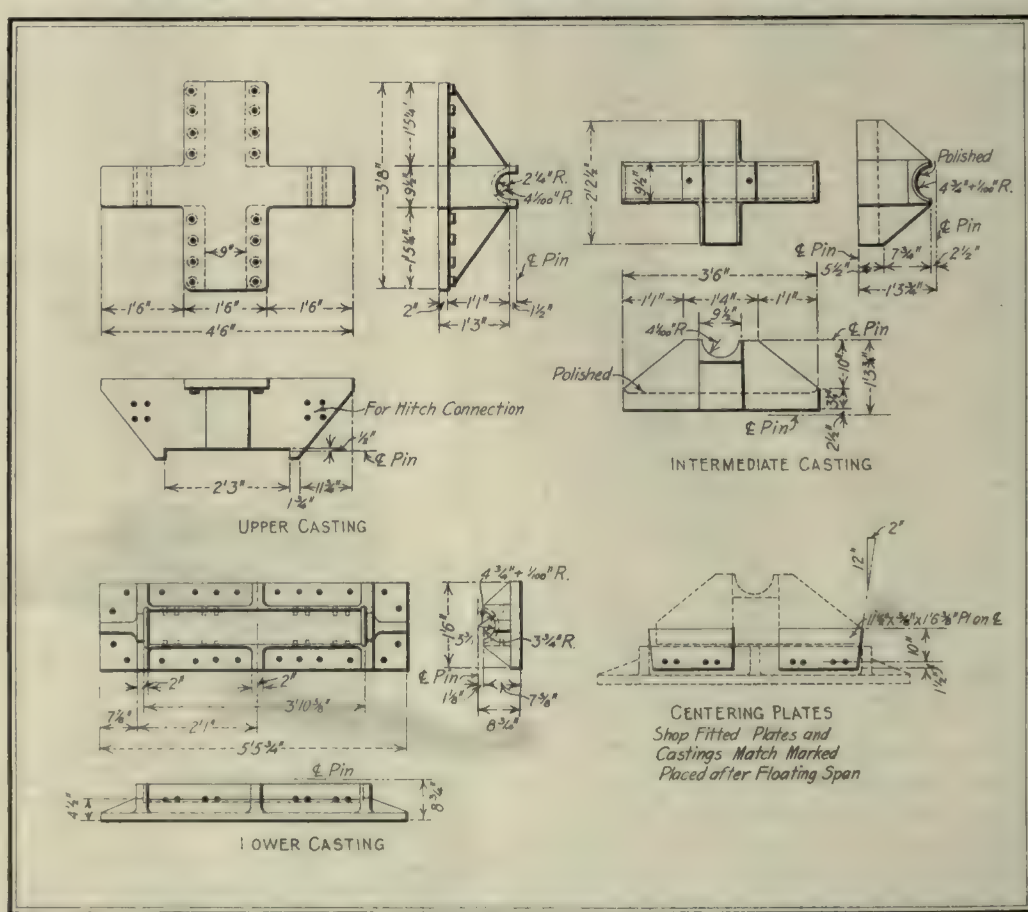


FIG. 2—CASTING DETAILS, SHOWING CENTERING PLATES THAT GAVE KEY TO ACCIDENT

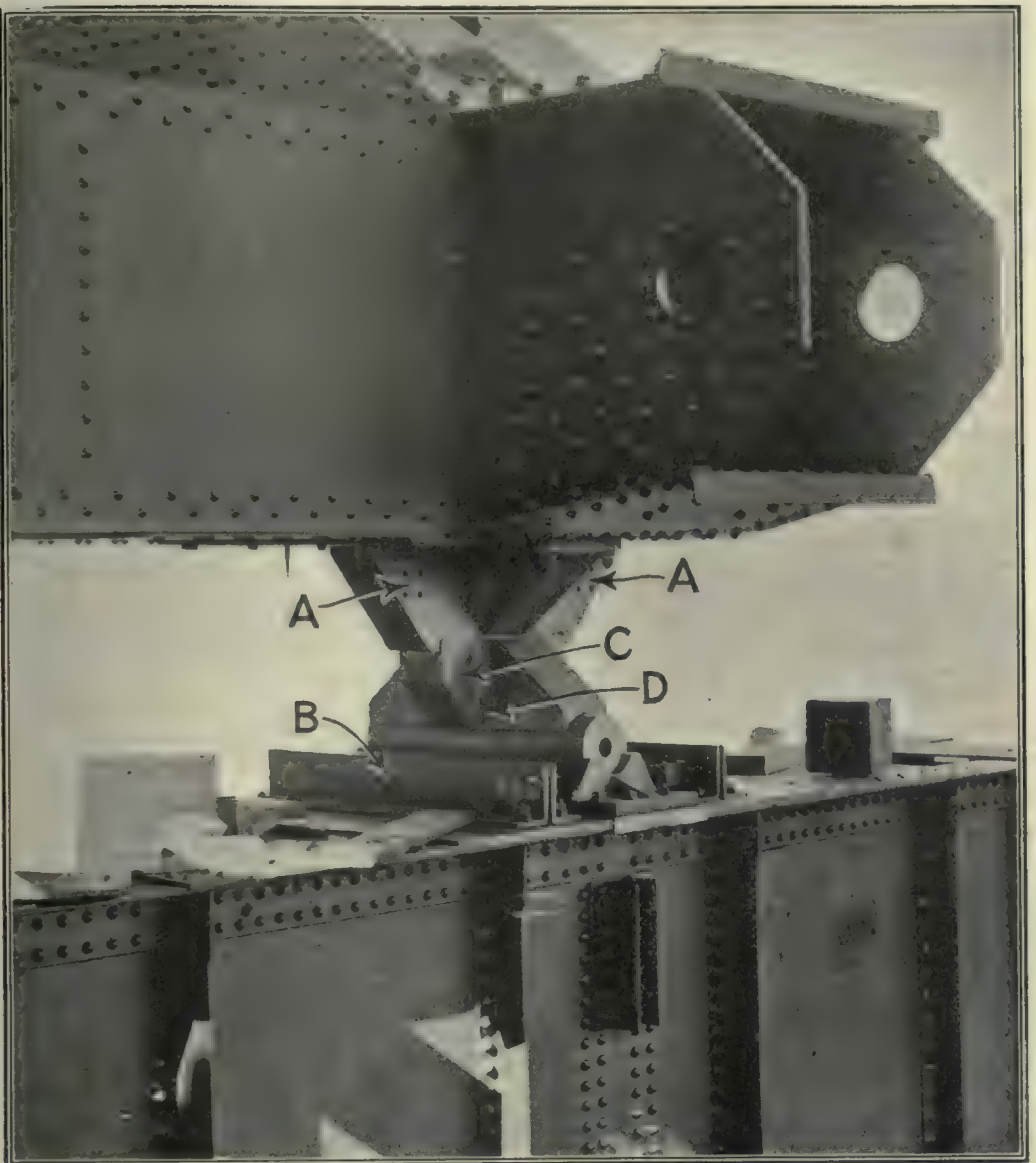


FIG. 3. ABOVE—ROCKER-JOINT BEARING CARRIED SPAN LOAD TO LIFTING GIRDER

have probably carried the end off in a direction parallel with the pin. A study of the other three lifting girders also tends to corroborate the conclusion drawn from the southwest girder.

The southeast lifting girder is shown in Fig. 5. The view is taken from the channel side looking eastward, or downstream. It will be noted that the centering plates are, all four, still bolted to the lower castings. All of them are flared outward, while the one nearest the reader in the view has been battered down in the crash. The pin shown is not, as was reported in this journal last week, the broken half of the longitudinal pin of this bearing but the shorter transverse pin which carried the load from the upper to the intermediate casting.

It is apparent from this view that the falling of the southwest corner twisted the southeast corner of the span in a counter-clockwise direction (looking at it in plan) and at the same time carried it in a clockwise direction, considered in a vertical plane parallel with the lifting girder. The counter-clockwise movement accounts for the flaring of the plates. This movement also explains how the transverse pin came to fall into the longitudinal bearing, after the longer pin had disappeared.

The crushing of the angles on the side toward the inside of the span indicates that this corner, too, went off in a diagonal direction—toward the center and the inside of the span.

Fig. 6 is a view looking downward upon the lifting girder at the southeast corner—the one shown in the larger photograph, Fig. 5. This view is reproduced in order to show the kink in the stub end connecting the lifting girder with the hoisting chain. This hanger had to tear through a strut at the end of the span.

It should be noted here that this same kinking is found at the bottom of the inside hanger on each lifting girder. In every case the inside chain had to tear through the strut referred to. The distortion is greatest, however, in the case of the southeast girder, pictured here.

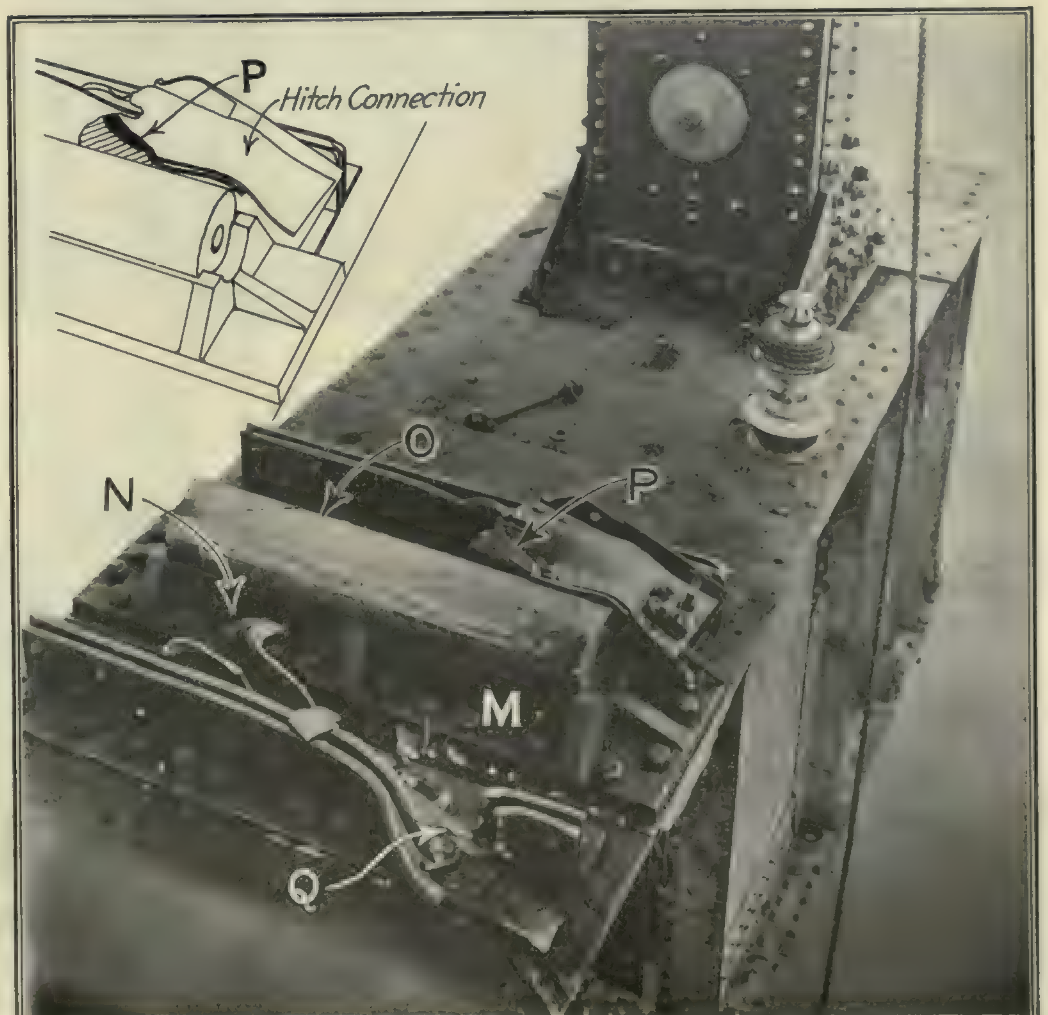
Fig. 7 shows the girder at the northwest corner, and Fig. 8 the girder at the northeast corner. Both views are taken from the channel side. It is apparent from an examination of them that the span pulled off in a direction parallel with the longitudinal axis of the span. The rear centering plates in each case stand untouched. The forward ones have been ripped from place. In Fig. 7 the forward one on the far side appears still to be standing and merely to be flared backward. As a matter of fact, it was torn loose and lying down, but was blocked up (as shown) after the accident and before this photograph was taken.

Further examination of the structure and of every feature of the hoisting equipment carries out the remaining statements made in this journal last week.

The number of lifts taken with the jacks was erroneously reported in this journal last week. Five lifts were taken at the north end and six at the south end.

(Figs. 5 to 8 appear on page 372)

FIG. 4. BELOW—INITIAL BREAK OCCURRED IN CASTING AT S. W. CORNER HERE SHOWN



Revolutionary Methods Used to Float and Hoist Center Span of Quebec Bridge

Six Barges Carry Span from Erection Site to Bridge, Where Suspender Links at Each Corner and Heavy Jacking Equipment Raise It Clear

ORIGINAL and, but for a sheer accident, entirely successful was the method devised for completing, by hoisting its central span 145 ft. from six barges on the river, the record cantilever bridge across the St. Lawrence at Quebec. The smoothness and precision with which the operations moved according to program up to the moment of the fatal accident excited the admiration of the foremost erection engineers of this continent, most of whom were present to witness the work.

Rapid Erection of Suspended Span

During the season of 1915 the north cantilever and the south anchor arms of the bridge had been erected, and the north traveler, its work at the site finished, had been taken down to be sent to Sillery Cove, 3½ miles below the bridge, for erecting the suspended span. This work was finished during the past summer while the south cantilever arm was being completed.

At Sillery, on a nearly level rock ledge bare at low tide and covered to a depth of 13 ft. at high tide, foundations for erection falsework for the suspended span had been prepared during 1915. The first work of the present season at this site, the building of a deck-girder trestle some 400 ft. long from the railroad tracks connecting with the bridge site to the point at the west end of the span where the traveler was erected, was begun with a locomotive crane on April 16. Before Aug. 1, not three and a half months later, the 5100-ton span of nickel steel stood ready for the removal of the falsework. The traveler as used here was put up minus one of the panels below the level of the boom seats and without the top panel and gantries, the four booms handling the entire work. Falsework, floorbeams and main posts were erected from west to east, using for the third time the interior falsework which had supported each anchor arm in turn. This falsework, planned for the purpose, also supplied girders for the traveler tracks, bearing on the floorbeams of the span. These girders, after serving three, and in some cases four, times, are still in perfect condition for use as standard bridge girders, for which they were designed.

Returning from east to west the traveler completed the center span, the inclined top-cord members in the next to the west panel being the last erected. Except for the center panels, where they supported the "quarter deck" from which the handling and placing of the span were directed, and the end panels, where they carried two hoists, the permanent track girders were left out till after the span was in place. Steel was delivered by rail during this operation. When it was complete the falsework beneath the span was released by sand jacks under the panel points, and most of it removed by the locomotive crane. This left the 640-ft. span resting on the lifting girders and rocker bearings at each corner, which in turn bore on four heavy falsework bents.

Meanwhile there had been built near Mon-

Stirrups at Corners of Suspended Span After Failure—*Photographs Illustrate the Preceding Article*

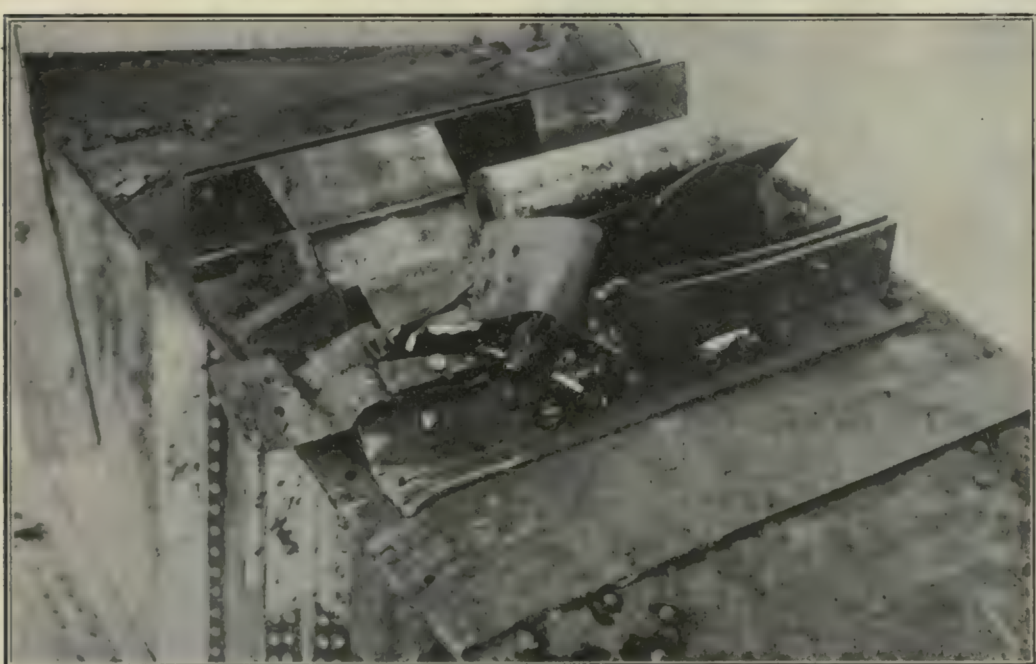


FIG. 5—FLARED PLATES, S. E. CORNER, SHOW INTERMEDIATE CASTING ROTATED IN GOING OFF

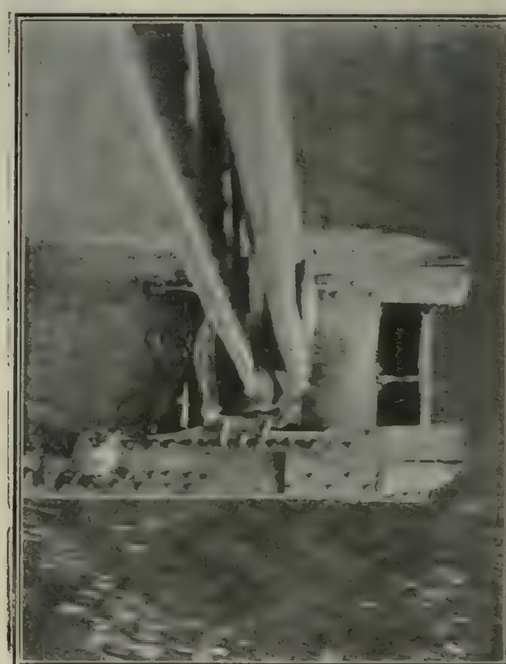
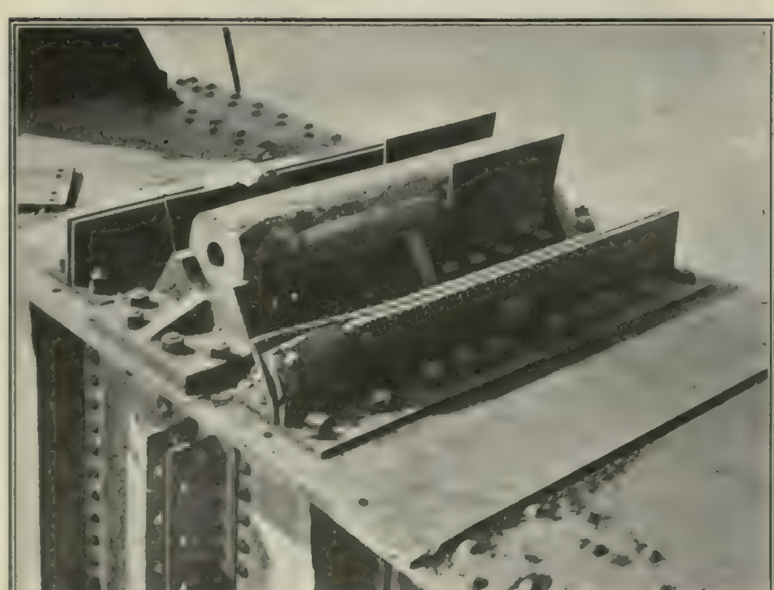
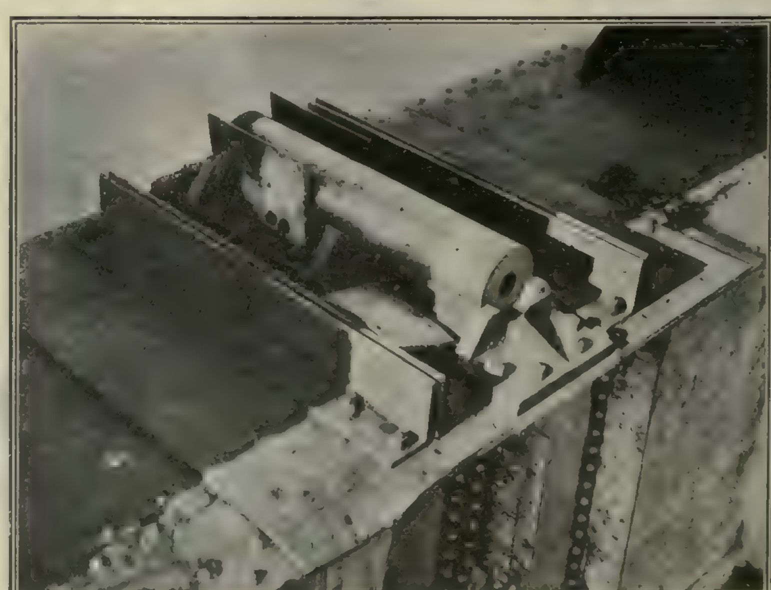


FIG. 6—BENT INSIDE LINK, S. E. STIRRUP





FIGS. 7 AND 8—PINS AND REAR CENTERING PLATES IN PLACE ON NORTH STIRRUP GIRDERS—LEFT, N. W. GIRDER; RIGHT, N. E. GIRDER

treal six steel-frame barges, 32 x 165 ft. and 11 ft. 6 in. deep, able to float the span on a draft of 8 ft. 2 in. Each barge had three longitudinal steel trusses to distribute the load from the span, in addition to transverse steel bulkheads. Each was built with a width equal to one panel length of the span.

Three of the barges, tight together and fastened at each end by two falsework posts laid flat and pinned down to angle uprights riveted to the barge trusses, were floated under each end of the span and brought to rest at low tide on concrete and timber seats. Over the center of each barge was a panel point under which an I-beam grillage parallel to the span rested on permanent floor girders of the span, arranged as shown in the drawings. These girders distributed the load to the trusses of the scows. The scows were wedged down underneath the span and left in place while final arrangements were made for floating. Each of them had six 12-in. valves in its bottom, controlled from the deck. These were left open and permitted the water to rise and fall inside the barges with the tide. The scows were tested out, however, one at a time, to 1 ft. more than their required draft by closing the valves and allowing them to bear against the span.

To moor and align the floating span two comparatively light trusses, 130 ft. long, were suspended vertically, one from the end of each cantilever arm. That on the south arm was erected before the traveler was down, and each of its trusses was assembled on the bridge deck and lowered as a unit, suspended from what would be, in a bridge

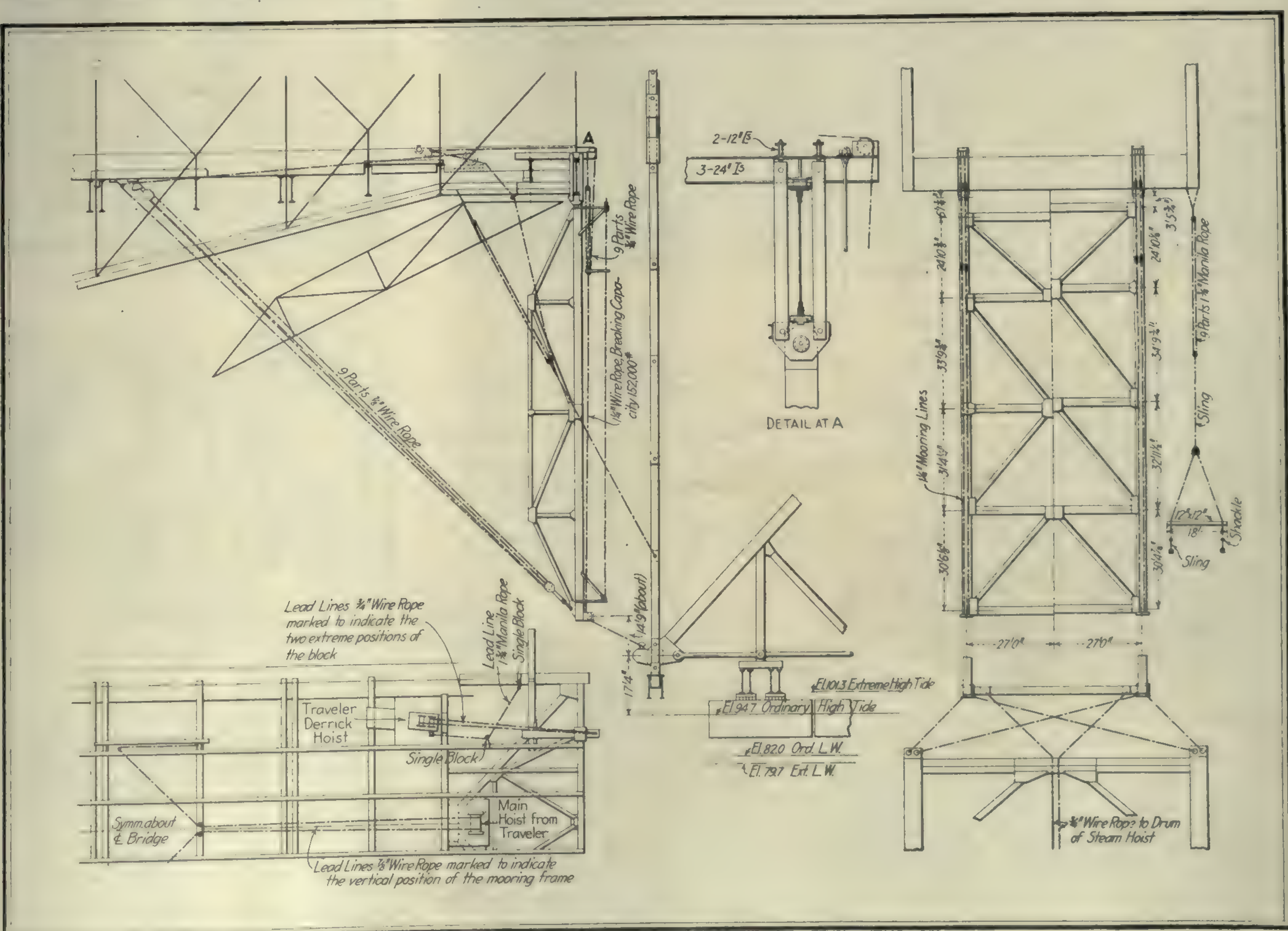
BLOCKING FROM BARGE TO PANEL POINT

truss, the intersection of the inclined post and the top chord. This caused each truss to hang with its face, corresponding to the bottom chord, at an angle and made it easy to swing it into place for entering the hanger pins.

The erection of the north truss was not so easy, as it had to be handled in sections with locomotive cranes. One crane lowered each face member inside the floorbeam till a line outside the floorbeam from the other crane could be attached. With the two lines the member could be hung vertically and raised up to position for connecting with the last piece erected. Both trusses will have to be dismantled in the same way, but in inverse order. From the two lower corners of each were rove 12-part ⅞-in. wire rope falls leading to one of the big electric traveler hoists mounted for the purpose between the bridge tracks. In this way the trusses were swung out far enough to give wide clearance when the span was floated in.

As these trusses were erected, four girders were set across the top-chord members of the cantilever arms, from each of which another girder was hung by heavy rods at the level of the tracks. Resting on each of these girders were two 1000-ton hydraulic jacks bearing a third and movable girder, between diaphragms in each end of which passed long suspender links. These links, each 30 ft. long, had 12-in. elongated holes on 6-ft. centers, and in the bottom of the last one was a 12-in. by 5-ft. slot for slipping over pins in stub links at the corners of the center span. The diaphragms in the movable girders and similar ones in the lower set of girders were provided with three pinholes on 2-ft. centers, so that at any stage of the raising the end of a jacking stroke would bring a hole in the links opposite one of the holes in the diaphragms. The pins thrust in these holes were mounted on long 3-in. rods weighted on the end opposite the pin and counterweighted at the balance point by a weight attached to a wire rope led through a block above. There were 16 of these pins, one for each end of both upper and lower jacking girders at each corner of the span. To prevent any sudden drop or shifting, two heavy screw jacks, shown in the illustrations, were provided to follow up the main jacks. The heavy screws of these jacks were so carefully counterweighted that they could be rapidly turned by one man.

On the outer end of each cantilever arm between the tracks were set two 18 x 2 x 16-in. single-cylinder plunger pumps supplied through independent lines with air at 100 lb. pressure. These pumps drew water from a 60-cu. ft. box into which the jacks discharged. Each pump at each end was able



MOORING TRUSSES AND HANGER CHAINS WERE RIGGED SO THEY COULD BE PULLED BACK TO CLEAR SPAN AS IT ENTERED GAP

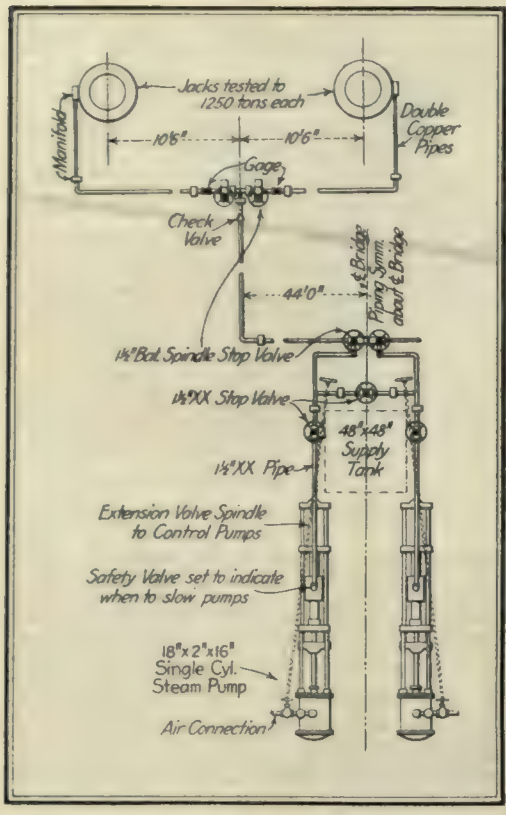


DIAGRAM OF HYDRAULIC EQUIPMENT

to run all four jacks in case of necessity, and the piping arrangements shown in the accompanying sketch made it possible not only to cut out either pump but to operate one pair of jacks at a different pressure from that supplied the other pair by the opposite pump. This arrangement was for use in case wind pressure put an unbalanced load on the upstream or downstream side by shifting the hanging span. The control valves at the center in front of the pumps regulated the quantity of water sent to each pair of jacks, thus governing the speed of raising the corners of the span. Similar control valves at each pair of jacks were used to regulate the amount of water sent to each jack, and thus keep the movable jacking girder at each corner level. All pressure control, however, was secured by regulating the throttle valves of the pumps themselves. The entire equipment, furnished by the Watson-Stillman Company, was tested out, a pair of jacks at a time, to 5000 lb. per square inch, 25 per cent overload, by inserting both pairs of pins in the links so as to clamp the lower and upper jacking girders together, and putting a load of 1000 tons on each jack. In addition, each jack had been tested at the shops to 1250 tons.

In front of the operator at each corner was a vertical telltale, with a pointer for each jack, rigged to double the rising and falling motions of the upper girder. Thus it was possible to keep the ends of the girder exactly even. In front of the central control valves on each cantilever arm was a similar telltale showing in the same way the relative position of the adjacent corners of the span. Two pump runners and three control-valve operators on each cantilever arm were required in raising the span, although extension-valve wheels had been provided to enable the operator of the central control valves to regulate the pump throttles, and thus the pressure supplied each pair of jacks, in place of regulating the quantity of water, if this should seem desirable.

In addition to the electric hoist used to pull back the mooring truss on each side, and to the hydraulic equipment, two other hoists were set outside the tracks on each cantilever arm to handle two sets each of the four vertical falls at the corners of each mooring truss, attached to the heavy mooring lines.

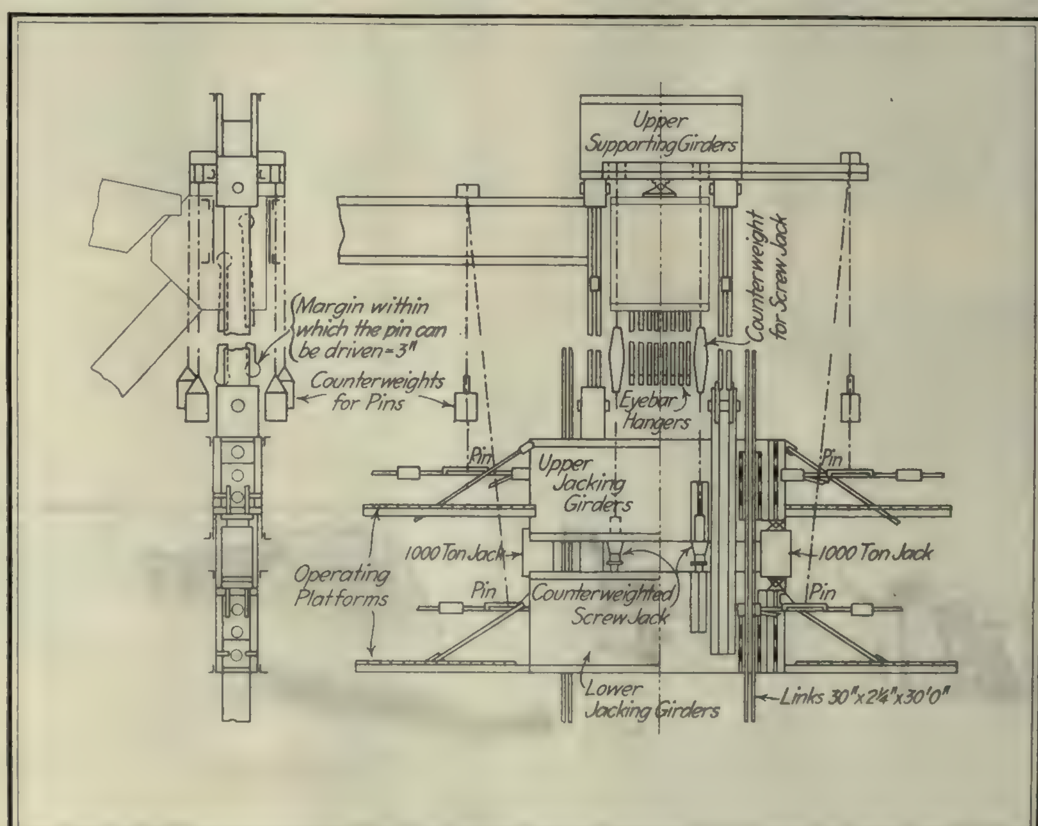
Rigging Carefully Planned

For starting out the suspended span from its moorings at Sillery a set of falls was run from the west inshore corner of the west barge group the length of the end barge to the west outshore falsework tower. To the east inshore corner of the span was attached a 1000-ft. wire cable anchored to a crib downstream from the site. This cable was kept taut and given a square pull on the span by a set of falls run from a point 150 ft. from the corner of the barge to the center of the east end of the span. These falls and the light mooring lines described below were handled by two steam hoists, the only steam equipment besides the locomotive cranes used on the work. One of them was mounted at each end of the span on its center line.

As the span was swung out, snubbing falls on the inshore side were used to control it till clear of the erection site, when they and the pulling falls mentioned were cut away with axes. Swinging about the downstream anchorage of the long cable then continued until the span reached midstream in a position at right angles to the current, by which time a large tug had been attached to the downstream towing shackle, lashed to the center post of the span on that side, two smaller tugs at each corner had taken up lines attached to the downstream towing bitts at each end, and one small tug at each corner had taken up a line attached to the upstream towing bitts at each end. On the trip up the river the downstream tugs backed water most of the time, the two small tugs on the upstream side guiding the span in the center of the channel and keeping it square with the current. As the span reached the site, its center was lined up approximately with balloons hung on the upstream and downstream sides of the bridge midway between the ends of the cantilevers. The five downstream tugs at this point went ahead on their lines, checking the span in the desired position with ease and precision, and without the necessity for any pulling back and forth.

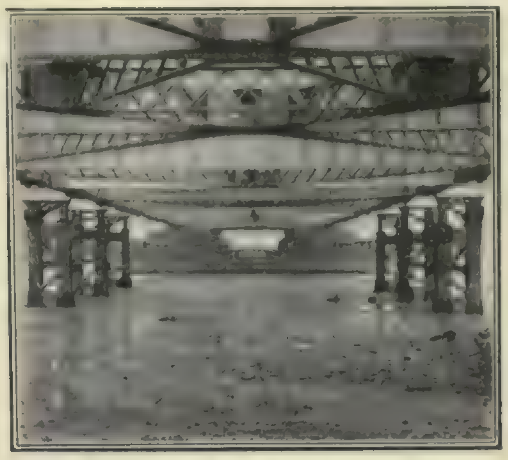
Mooring Lines Painted to Avoid Confusion

The span reached the site at slack water on the high tide, which lasts under conditions existing at the time about an hour. As it was about 400 ft. from position and drifting slowly upstream a ⅞-in. line from each end was pulled out ahead and thrown over a pin on the upstream side of each mooring truss. As the span, guided by these lines and the tugs, neared the gap, a second light line from the hoist on each end was thrown over a pin on the downstream side of each truss. These lines led through single blocks located near the center line of the span. As the second lines began to lose their slack the 1¼-in. white main mooring line on each end, leading from one of the vertical sets of wire rope falls on the downstream side of each truss, was pulled aboard and thrown over the white mooring bitt on the upstream side at each end of the span. Next the red mooring lines from the upstream side of the mooring trusses to the red bitts on the downstream corners of the span were placed. These heavy lines were crossed beneath the light lines and tightened to assist the tugs in bringing the span to rest in approximate position. During these operations the mooring trusses were swung back to give ample clearance for the entry of the span. They were now lowered slowly as the white and red lines were tightened. A pair of 1¼-in. yellow cables from the upstream side of each mooring truss to the upstream white bitts and a pair of black lines from the downstream side to the downstream red bitts were placed as this was done. This left the truss held with two crossed lines and two straight lines at each

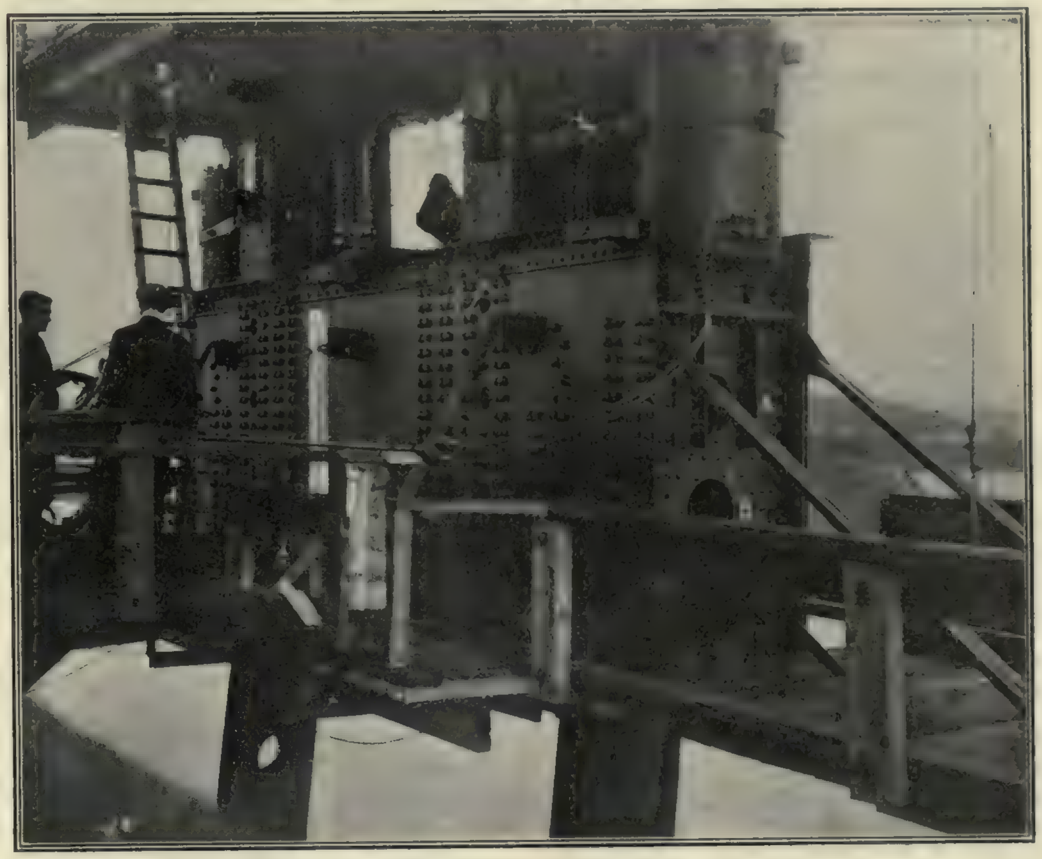


COUNTERWEIGHTING PINS AND SCREW JACKS GREATLY INCREASED SPEED OF JACKING

FLOATING SPAN, GUIDED BY SEVEN TUGS, NEARS GAP BETWEEN CANTILEVER ARMS



ERECTION SITE BARE AT LOW TIDE



LEFT CENTER—DETAIL OF SUSPENSION AT CORNER OF MOORING TRUSS

RIGHT CENTER—LOWER JACKING GIRDER, JACKS AND TELLTALE TO KEEP THEM LEVEL

LOWER LEFT—MOORING TRUSS PULLED BACK AS SPAN NEARS POSITION—FIRST LIGHT LINE IS OUT

LOWER RIGHT—CANTILEVER ARMS RAISE SUSPENDED SPAN FREE OF LAST BARGE GROUP AT SOUTH END


end, and released the first pair of 7/8-in. lines, which were no longer needed. These lines were used because the falls controlling the heavy lines could be made no longer than the height of the mooring truss, and because it was desirable to have lines out to help the tugs when yet more than twice this distance from the gap.

The falls attached to the four heavy cables at each corner were taken up by the hoists on the cantilever arms and the span was pulled into exact position in a very few minutes. These mooring lines were able, with the tugs, to hold the span in safety against a current of 4 miles per hour acting with a wind pressure of 2 lb. per square foot. The mooring lines and trusses were designed to resist a horizontal pull of 300,000 lb. As previously noted in this journal, elaborate precautions in the way of meteorological observations greatly reduced the chance of any more severe conditions occurring.

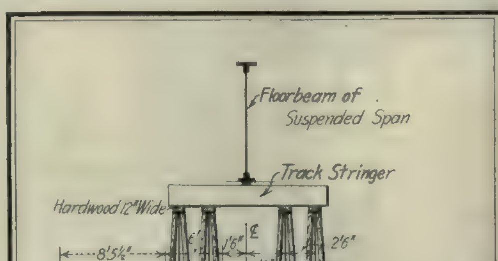
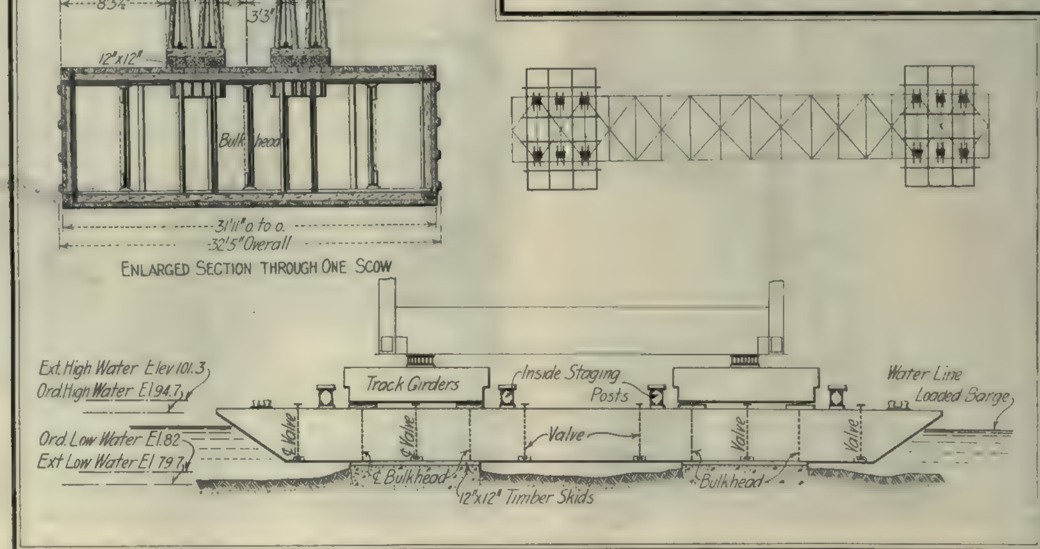
Span Raised on Rocker Bearings

The slotted suspender links fitted outside those on the corners of the span and were slipped over the pins in the lower set of links while the caps were removed. The links having a 1/2-in. horizontal clearance in the body of the slot, no pilots were needed for these pins.

Each pair of the stub links was pinned to a box girder of similar design to the girders on top of the corners of the cantilever arms. Beneath the latter girders and on top of the girders under the corners of the suspended span were rocker bearings amply illustrated on another page of this issue. Such bearings were required because it was possible for the span to be swayed as much as 6 in. out of line by wind pressure, and it was necessary to provide for this motion without stressing any part of the lifting mechanism. The stub links and lower girders were suspended by straps between the upper and lower rocker castings, bolted respectively to the span and lower girder, when the span was floated. This arrangement permitted the rocker bearings and girders to center themselves by gravity under the top casting as soon as the span was free of the falsework. While on the trip up the river centering plates holding the castings in this alignment were attached.

After the links were connected—which was accomplished shortly after the turn of the tide—the span was allowed to settle until the pins at the connections dropped 2½ ft. and came to a bearing at the lower end of the slots. Jacking was then begun and the span raised clear, allowing the barges to float out. Breakfast was then served to the men, who had been on duty since 1 o'clock in the morning. Lifting operations were then resumed, and an additional lift completed at each end, making a total of six lifts on the south end and five on the north end up to the time of the accident. The full jacking cycle—including the insertion of the upper pins, the 8 minutes allowed for lifting 2 ft. with the hydraulic jacks and following with the screw jacks, the insertion of the lower pins, the lowering of the jacks, reduced to an estimated 2½ minutes by the use of double copper supply pipes, and the replacing of the upper pins—was estimated to take 15 minutes. This was made on a reduced estimate of the capacity of the main compressor plant, which was relied on to supply air at 100 lb. pressure only fast enough to maintain a pressure of from 3800 to 3900 lb. per square inch during actual raising. As a matter of fact, the main compressor plants in operation proved capable of supplying sufficient air to maintain a pressure in excess of 4000 lb. during the entire upward stroke, and several of the jacking cycles were completed in 10 minutes.

Had the span continued rising, for every 30 ft. a set of suspender links would have been detached above the upper jacking girders and lowered to the deck of the span by the locomotive cranes. It was planned that the permanent eyebar links on the corners of the suspended span would rise during the final stages of the operation between the jacking girders, which were far enough apart to allow the two sets of bars to move away from each other. This motion could of course be followed by the upper links hanging from the cantilever arms. This provided a small vertical variation which would have taken up any slight inequalities in the lengths of the links and made it easy to drive the final pins.

FALSEWORK STEEL REUSED TO STIFFEN BARGES AND FLOOR STEEL TO BLOCK SPAN

A panel length of floor system, half in the center span and half in the cantilever arm, would then have been placed to connect the floor system between the three spans. Expansion has been provided for at the north end of the center span, where these floor girders are to slide in seats riveted to the last floorbeam of the north cantilever arm. In addition there are to be four members connecting the lower end panel points of the center span with the ends of the bottom chords of the cantilever arms, and four redundant members, used for the sake of appearance, connecting the upper chord members of the cantilevers with the upper chord members of the center span. When the bridge is completed the stresses in the lateral system will be transmitted at the ends of the center span by pins placed horizontally below the track level with their long axes coinciding with that of the bridge.

Deflection in Raising Center Span

When the two cantilevers had been erected, there still remained a camber in the bottom-chord members of the anchor arms, leaving them from 0 to 2½ in. below true position. The main posts, which had been erected in vertical position and tipped back 14 in. to permit the last top-chord pins of the anchor arms to be driven, were within 5 in. of vertical. All of the exterior falsework had been released, disconnected from the structure and removed except for two posts under the panel point nearest the anchor pier of each arm. Here the line of camber would have caused a sharp dip in the track grade, to avoid which these two posts were jacked up till the panel point almost reached its final elevation, and wedged with steel plates. This put the vertical tension members from these panel points to the subpanel intersection above in compression. These members were stiffened with posts from the falsework detailed for that purpose. With the two cantilever arms erected and the bridge in condition to raise the suspended span it is said that the distance between the cantilever arms was found to check within ¾ in. the distance calculated for this condition. As the full weight of the suspended span came on the cantilever arms with the final upward stroke of the jacks before the barges were released, the main posts were again pulled over to vertical position, the outer ends of the cantilever arms deflected the calculated distance of slightly more than 8 in. and the bridge assumed its normal dead-load position. In this position the laterals are not stressed. Therefore it was not possible to rivet them until the weight of this suspended span had been taken up. They are now bolted from 50 to 100 per cent at gusset plates and intersections, and will not be riveted until the new suspended span is in place, though it will be necessary to complete this work before the bridge is put in service.

The suspended cages, ample railed runways and platforms which have played so important a part in the speed of this work by relieving the workmen of the strain resulting from working in dangerously exposed positions were again in evidence during the final operation, and must be credited with the saving of many lives at the time of the accident. From the wooden bridge in the center of the suspended span the work of floating and mooring was directed by telephones to each end. As soon as the span was in place these lines were connected to the general telephone system of the job. Perfect co-ordination through central control of the operations was thus made easy.

Tennessee River Hydroelectric Installation Being Completed with Modern Turbines

Special Head Conditions and Power Requirements at Site Govern Original Design and the Present Adoption of Single-Wheel Turbines

REPLACEMENT of two units of the original three-wheel turbine design and the installation of the final four units of the plant with single-runner reaction turbines of the Francis type resulted from the special conditions required for the future operation of the generating plant of the Chattanooga & Tennessee River Power Company at Hales Bar on the Tennessee River. Unusual variation in flow and operating head and uniform power requirements originally determined the design with three wheels on each shaft in order to insure uniformity of output irrespective of variations in head and rate of flow. Ten of the total of fourteen units were manufactured before 1910, but were not put into actual operation until November, 1913, the delay being caused by serious difficulties in the deep foundations of the dam.

A business deal involving an outlet for a large percentage of the plant capacity was recently consummated whereby the current from this plant will augment the capacity of another hydroelectric system, especially during low-flow periods. Hence followed the adoption of single-wheel units of higher efficiency under low-flow conditions for the new installation.

The following short description, with illustrations of the old and the new turbine installations and of the changes necessary in the concrete construction, supplements the description of the work on the original dam and powerhouse foundations given in the Engineering Record of June 10, 1911, page 641.

OLD INSTALLATION

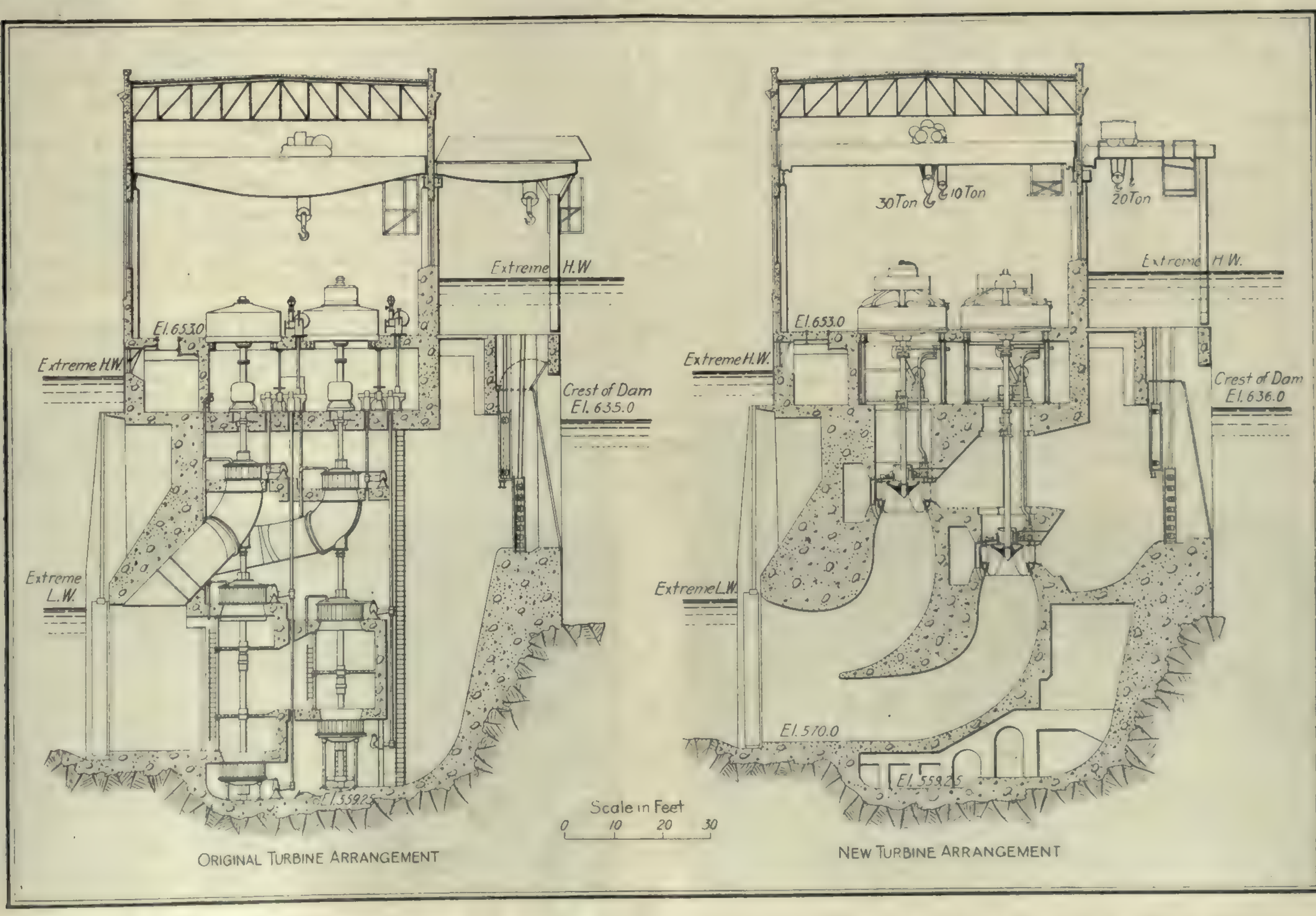
The Tennessee River is subject to the most extreme variations in rate of flow—from a minimum of 6000 sec.-ft. up to a maximum of 600,000 sec.-ft. As the original design was made for the purpose of furnishing the greatest possible uniformity of output even under varying hydraulic heads, ranging from 39.5 ft. at low water down to only 19 ft. under conditions of extreme flood, an arrangement of three waterwheels on each shaft was selected, as shown. These were designed to enable the plant to maintain relatively high output throughout the 20-ft. variation in hydraulic head, and especially under low heads occurring at flood periods. Under normal conditions the two lower 72-in. turbines are used, the third or upper 63-in. unit coming into operation when high water reduces the operating head.

The new conditions which caused the modification of this design when the new units were planned have already been suggested. In brief, the situation involved the delivery of current by the Hales Bar station to increase the capacity of another hydroelectric system, especially during low-flow periods. As the available head at Hales Bar varies inversely with the stream flow, and as the other system is operated under conditions where hydraulic head increases with flow, the linking of the two systems is obviously beneficial, and the main requirement of the new installation is high efficiency under the high heads occurring at low stream flow.

After a number of models had been constructed and tested at the Holyoke station, with particular reference to the special conditions to be met, the new turbines were designed and installed. As indicated by the drawing, in place of three turbines on each driving shaft, a single-runner inward and downward flow reaction turbine of the Francis type, of 82-in. diameter, is used. These single turbines have less capacity than the 5090-hp. three-runner type originally planned, and the output at low heads is very much less. At high heads occurring under low stream flow, however, the new turbine efficiency is very much greater. Although the capacity of the new turbines is less, the capacity of the new generators was retained at 3750 kw. as originally contemplated, giving a liberal margin for operation at low power factors.

CHANGES IN CONSTRUCTION

Comparison of the concrete construction shown in the drawing herewith indicates the nature of the remodeling necessary to install the new units. Much of the original concrete was cut out, and wooden forms were used for the new carefully molded concrete scroll cases and the reinforced-concrete draft tubes leading to the tailrace. The new wheel-pit is thus of monolithic construction, designed to guide the



SECTIONS SHOW ORIGINAL AND NEW ARRANGEMENTS OF TURBINES OF TENNESSEE RIVER POWER DEVELOPMENT

water from intake to tailrace with the least possible friction losses.

The efficiency of the new turbines was demonstrated in tests recently made. They give outputs at all stages better than the manufacturers were willing to guarantee. Both output and efficiencies are equal to those deduced from the Holyoke tests. They give the results desired under the new conditions as indicated above, not only at the high heads, but down to as low heads as have occurred since these wheels were installed. These new turbines, with the monolithic water passages and the new generators, afford one of the best recent examples of hydroelectric development.

The turbines were built by the S. Morgan Smith Company, the generators by the General Electric Company. The hydraulic and mechanical installation was designed and supervised by John Bogart, New York City, consulting engineer of the Chattanooga & Tennessee River Power Company, the electrical work being done under the direction of T. E. Murray, of New York City, consulting electrical engineer of the company.

Railroads Rework Car Lumber

Following the example of the Chicago, Burlington & Quincy Railroad, which has been able to realize $20 per car by resawing the lumber in condemned rolling stock, the Baltimore & Ohio Railroad has established a resawing plant at Cincinnati. The mill, which cost $7,500, will rework lumber reclaimed from dismantled freight-car equipment, old bridges, trestles and other railroad structures. It is estimated that the plant will save $50,000 a year. The worked-over lumber is used for buildings, platforms, bins and other railroad structures.

Open Scenic Highway Over Continental Divide in Southwestern Colorado

Highway Mileage to Los Angeles Shortened Materially and a 30,000 - Square Mile Area of Scenic and Economic Value Made Easily Accessible at Small Cost

WOLF CREEK PASS over the Continental Divide in southwestern Colorado, the last connecting link in the Spanish Trail, was opened to automobile traffic in August. The construction of the 16 miles up the South Fork of the Rio Grande and 14 miles down Wolf Creek on the west slope involved many heavy cuts, fills, bridges and sharp curves, and three years' time. The southwestern corner of the state where Utah, New Mexico and Arizona also join is particularly rich in mountain scenic beauty, cliff dwellers, mines and Indian country, to say nothing of mineral and agricultural resources—all hitherto quite inaccessible. The new road makes all this available to the tourist by automobile, the railroad time to such places as Pagosa Springs across the range being cut by six hours. It also completes a diagonal 600-mile state highway almost directly from the northwest corner to the southwest corner of the state, connecting up Julesburg, Denver, Colorado Springs, the San Luis Valley or Pueblo, and the Rio Grande Valley. It also shortens the road to Southern California about 300 miles —a feature that means much to tourists, particularly as the scenery is said to excel that on any other transcontinental route.

Much Road Above Water Grade

Choice of alignment over the pass was dictated in most cases by topographic conditions and the 6½ per cent ruling grades. On the east side, however, water grade was left in two cases and the alignment placed from 200 to 500 ft. above the stream level to keep it out of prospective reservoir sites. Nine miles down from the top is a particularly heavy section cut from the sheer rock as the road rises to traverse a natural park 4 miles long where the construction was simply grading. In the last 4-mile stretch up the east side the necessity of gaining the top involved almost a constant adherence to the 6½-per cent ruling grade, with occasional short stretches up to 7½ per cent and eight hairpin curves with a 30-ft. radius. Long wheel-base machines cannot turn easily on a smaller radius. At a dozen points boggy spots of black humus 30 to 150 ft. long make heavy roads the first season, especially since rainstorms are the rule every afternoon.

Starting from the west side, elevation was sought at once from the comparatively flat San Juan Valley by two switchbacks. For construction reasons and because of the series of waterfalls in the creek the road on this side rarely is near the water grade. As it is, there are numerous cuts through sheer rock.

At the top for 2 miles the road is on light grades through a grassy park in the saddle of the water shed at 10,860 ft. above sea level. The total rise is 2360 ft. On account of the boggy nature of the center of the saddle the alignment follows a winding contour along the north side, where good material is available.

HAIRPIN OF 30-FOOT RADIUS TURNS AFFORDS AMPLE TURNING ROOM

SWITCHBACKS GAIN ELEVATION FAST ON WEST SIDE OF DIVIDE

QUEEN-POST BRIDGE WITH CRIB ABUTMENTS BUILT ON GROUND

EACH RAVINE, HOWEVER CLOSE IT COMES, MUST HAVE ITS BRIDGE

ROAD ALIGNMENT IS ALONG UPPER PART OF 40-FOOT CLEARING

ROAD FOLLOWS SIDE OF SADDLE OF PASS TO AVOID THE MORASS

Available funds precluded the construction of a road wider than 14 ft., including the drainage ditch, and in some of the heavier sections the west side is only 10 ft. All of the east side is 14 ft. Turnouts at intervals of at least 1000 ft. will be constructed with the first available money, particularly on the narrower sections. As the rules of the road generally adhered to in the mountains is for the driver coming up to wait at turnouts and to back to one if he is caught between them, this work will be demanded at an early date.

The road is graded flat toward the bank side, where a longitudinal ditch carries the hillside seepage and surface water falling on the road to culverts spaced about 500 ft. apart on the steepest slopes.

Log Bridges Used

For economy all bridges are of log construction. Everything had to be packed in. There are no bridges longer than 40 ft., and these are at the junction of the Middle Fork and the South Fork, about 9 miles from the top on the east side. They are of the queenpost type, 20 ft. wide, with a deck of 4-in. plank hewn from red spruce resting on six log stringers having about 12-in. butts. One-inch rods support the cross-logs at the panel points.

Two smaller bridges were carried out last winter by a 7-ft. snowfall, and many of the other bridges had the handrails broken by slides down ravines. In most cases little damage was done the road as the slides went over it. From Dec. 1 to April 15 the roads will be closed on account of snow, and even at the latter date it will require a gang of men to clear the road. Log culverts only have been placed, although the engineers realize they will not last more than a few years, when they will likely be replaced by corrugated-iron pipes buried at least 12 in.

About 60 per cent of the road is surfaced from rock found *in situ*, but as more money is available the remainder will be covered with 3 to 6 in. of disintegrated granite, which is easily obtainable.

Clearing Right-of-Way

Clearing of the 40-ft. right-of-way was the first operation after the engineers got the line staked out. The road is built on the upper contours of the right-of-way, for the felled trees were easiest pulled downhill, where ultimately they will be piled and burned to conform to the requirements of the Forestry Service, through whose domain the road traverses.

Maintenance of the road is paid for by the state and will be handled by a man and team with road drag on each side. The road will be dragged often. Soft spots will be resurfaced with broken stone or else dug out, drained and filled in with crushed stone. The black muck from the humus absorbs water like a sponge, and underground drainage or entire removal is essential to make a permanent all-weather road.

It is proposed this fall to permit, and even to encourage, the driving of sheep over the road to compact it. A saving of $26 per carload can be effected by driving over the divide to the railroad at South Fork, and about 100,000 sheep will be shipped out this fall. Permission from the Forest Service to pass these animals and feed en route is necessary, as the Service has now restricted the herding of sheep for some distance back from the road and has given citizens the privilege of renting cabin space for 10 years at desirable points. This is in line with the department's efforts to make the forests of fullest use to the public.

Construction Methods Simple

Three contractors carried out the construction on the 30 miles of pass proper—C. J. & L. J. Chapman and A. G. Fassett, Logan & West, and Harry Hokasano. No unusual methods were used, the greatest difficulty being to get in supplies for the small crews employed. On heavy rock work on the east side a Sullivan steam drill was used. At one point a block as large as a freight car was precipitated 100 ft. to the river bed by 150 lb. of black powder in five holes 12 ft. deep. The grade had purposely been adjusted to come at a seam at the base of the block so that the powder practically built a finished stretch of road. Just above

WALLS 2 FEET WIDE AT BASE ARE LAID DRY AS HIGH AS 25 FEET

PROFILE OF HIGHWAY IS ADJUSTED TO COME AT SEAMS IN ROCK

the rock cut occurs the heaviest fill, 25 ft., back of a dry stone wall 2 ft. wide at the bottom and sloping in at the top 1½ in. per foot. All embankments are of similar construction.

Construction necessitated maintenance as soon as the road was completed, and the contractors put on a team with drag for this purpose.

The condition of the road Aug. 21, the day of its formal opening by the governor and 500 road enthusiasts at a point half way up the east side, was good. There was low-gear pulling on the grades and in the short soft stretches, but there was always bottom, and the Denver Chamber of Commerce official car—in which a representative of the Engineering Record rode—made stops only for the photographs shown herewith. This season's traffic and the proposed sheep drive will make a boulevard surface for the 5000 out-of-state tourists who will travel over it next year. The cost of the 30 miles to the state averaged only $3,000 per mile. The heaviest mile involved 6000 cu. yd. of rock excavation and about 4000 cu. yd. of earth handled.

The road was built under the supervision of a board of construction, R. A. Chisholm, Fred Catchpole and A. L. Moss, representing the four counties interested. W. W. Reilly was the resident engineer, and all plans and work were approved by the engineer of the State Highway Commission, J. E. Maloney. Lon Mitchell, Mr. Reilly's predecessor, was drowned in 1913 while making surveys. The work was financed entirely from the state road fund under apportionments made by the commission, of which T. J. Ehrhart of Denver is the state highway commissioner. C. E. Herr of Durango, a former member of the advisory board for the district in which the road is situated, had much to do with the completion of this important link. Fred Goble of Silverton is at present the advisory board member from this district.

Canadians Object to Choice of American Engineer

Engineers' Society, to Prevent Recurrence, Urges Members to Protest to the Government and Men of Influence

RECENTLY a commission was appointed to study the railway situation in Canada. Its members are A. H. Smith (chairman), president of the New York Central Railway; Sir Henry Drayton, chairman of the Railway Commission of Canada, and Sir George Paish, the eminent London financier. The commission, as was noted in this journal for last week, has selected George F. Swain, professor of civil engineering in Harvard University and chairman of the Boston Transit Commission, to take charge of its valuation work. This appointment has been criticised by the Canadian Society of Civil Engineers on the ground that a Canadian should have been elected. The council of the society is sending to all members a circular urging them to protest to the government and to others of influence in order to prevent the recurrence of similar instances.

The circular is printed here in full:

Circular of Canadian Society

"The council of the Canadian Society of Civil Engineers desires to call your attention to a matter of vital interest to the society, and requests your personal action in connection therewith for the benefit of the civil engineers of Canada.

"The Canadian Government, as you are aware, recently appointed a commission to advise upon certain phases of the railway situation of the country. It is understood that the government wishes to determine whether it should continue to assist private ownership as in the past by additional loans, or take over for itself the ownership and operation of certain railways, or allow them to go into receivership. The commission consists of Mr. A. H. Smith, president of the New York Central Railway; Sir Henry Drayton, chairman of the Railway Commission of Canada; and Sir George Paish, financier, London, England.

"The above commission immediately appointed an American enginer as its adviser, and instructed him to organize a corps of engineers for valuation and advisory work. We wish to record our strong condemnation of the policy of placing in the hands of aliens the engineering work of a commission appointed by the Canadian Government to investigate Canadian railways for which the Canadian community has paid.

"The inferences to be drawn from the employment of aliens in the above connection are that the federal government considers:

"1. That the Canadian engineers who built the railways are not competent to report upon them.

"2. That the Canadian universities, in many cases enjoying government subsidies, are not producing competent engineers; and

"3. That the Canadian Society of Civil Engineers, although embracing a membership of about three thousand, is not considered worthy of consultation on an important engineering question.

Not First Occurrence

"The above-mentioned appointment of alien engineers is not by any means the first of its kind, as many similar but possibly less flagrant cases have preceded it, and it is not improbable that the recurrence of such appointments may be due to the fact that Canadian engineers neither assert themselves nor demand recognition.

"In order to impress upon the federal government the fact that one of its first duties is to encourage and develop the engineering profession in Canada in every possible way, the council has selected this gross violation of a vital principle to initiate a campaign and impress the fact that Canadian engineers must receive due consideration. The Canadian railways, canals, public works and other engineering attainments are a proof that Canadian engineers stand in the front rank, and it should be quite unnecessary for them to have to appeal to their own government for recognition.

"It may be argued in support of the present alien appointment that Canadian engineers are not acceptable because many have been in the employ of the railway companies. To this we would reply that, as the commission itself is to advise the government, basing itself upon the engineering data given to it, any experienced engineers are competent to collect and submit the necessary information to the commission.

To Whom to Protest

"It may also be argued that the government gave the commission a free hand in the appointment of an engineering staff, and since this freedom of appointment is essential, our protest should be to the commission itself. To this we reply:

"1. That when a particularly flagrant case arises such as this, where competent constucting and operating engineers are passed over in favor of alien engineers, the question of the suitability of the commission appointed by the government for the work in hand comes into question.

"2. A protest to the commission itself would probably prove futile, and, even if successful, would not in any way impress the government, the creator of commissions, in regard to future procedure in matters of this kind.

How to Protest

"The council of the Canadian Society of Civil Engineers, therefore, asks you to use your influence in every way to diffuse a knowledge of this matter throughout your community, and to place before those with whom you may come in contact the facts of the case and the position of engineers in relation thereto. Specifically, the following is recommended:

"1. That you write to your representative in the Dominion Parliament, whether Government or Opposition, setting forth the facts of the case in a strong way, and pointing out that this is merely an incident in a long course of similar procedures.

"2. That you write in a similar vein to those having influence with the government in your own community or elsewhere.

"3. That wherever similar incidents are brought to your attention you voice a protest, giving the facts to your local branch of the Canadian Society of Civil Engineers or to the secretary at Montreal in such a manner that the council may deal therewith.

"4. That you do not delay acting in this matter as above outlined, but proceed today to do what you can to bring every pressure to bear in every direction for the good of the engineering community in Canada.

"The council requests that you will be good enough to fill out and return the accompanying blank to your branch or to headquarters if you are not a branch member, in order that they may be fully aware of what has been done by the membership at large toward strengthening such representation as it may seem desirable to make to the Dominion Government."

Character of Blank

The blank inclosed with the circular provides space for the names of federal representatives to whom the member of the society has protested, and also the names of men with influence in Ottawa with whom the member has taken up the matter. There is a division also for the listing of instances of the engagement of "outside engineers" which the member considers "not fully justified."

Fluorescein Used to Trace Seepage

Fluorescein has been successfully used by the engineering department of the city of Portland, Ore., for tracing the course of seepage through the pipes in the western parts of the city. It has been found that fluorescein will not oxidize as readily as dye material or permanganate, usually used for this purpose. The method of using the fluorescein is identical with the common methods used with the other chemicals, and its only advantage is said to be the fact that it oxidizes less when the underground flow involves a considerable lapse of time.

WEST END OF HOPPLE STREET VIADUCT COMPLETED OVER BALTIMORE & OHIO RAILROAD

Hopple Street Viaduct, Cincinnati, Is Built with Cantilever Beams of Arch Form

Skew Reinforced-Concrete Superstructure Supported by Concrete-Pile Foundations—Layout and Reasons for Design Presented

By EDGAR K. RUTH
Assistant Professor of Civil Engineering, University of Cincinnati

HOPPLE STREET VIADUCT, now nearing completion in Cincinnati, is an example of the cantilever principle applied to the design of an arched reinforced-concrete bridge. A few large bridges, notably the Washington Street bridge, Norwalk, Conn., and the Hanover Street bridge, Baltimore, have been built with structural-steel cantilever ribs incased in concrete. The Hopple Street viaduct, however, contains no structural steel; its cantilever ribs are true reinforced-concrete girders.

The viaduct proper is about 2000 ft. long between end abutments, and rests upon twenty-six reinforced-concrete piers, spaced from 65 to 80 ft. apart, all skewed from 59 to 78 deg. The superstructure, consisting of a 46-ft. roadway with two street-railway tracks in the middle, is carried on four lines of longitudinal girders, or ribs, with arched soffits, so that the viaduct appears to be a succession of true arch spans on rather slender abutments. Actually, however, a joint cuts completely through the structure at the crown of each apparent arch, thus dividing the viaduct into a series of monolithic cantilever units, each consisting of a pier and its balanced cantilever ribs. These joints are designed to distribute concentrated loads from one cantilever to the adjacent one, and to take care of expansion and contraction in the concrete. At these points double cross-beams connect the ends of the ribs on each side of the joint. A 9 x 10½-in. block projects from the side of one cross-beam along its full length into a corresponding recess in the side of the adjacent beam. Horizontal movement is allowed for by a 1-in. space between vertical surfaces filled with a layer of tarred felt. The horizontal surfaces of the joint are separated by three layers of heavy tar paper.

HISTORY AND LAYOUT

Before taking up the reasons for the adoption of the cantilever design, the details as to the loads assumed, and the allowable working stresses used in the computations, a brief description and history of the viaduct will be given. It is the longest of three large reinforced-concrete structures built by the city of Cincinnati since 1911 in connection with its extensive program for the elimination of all dangerous grade crossings within the city limits. It eliminates the grade crossing of the several tracks of the Baltimore & Ohio Railroad at Hopple Street, and is being built by the city in co-operation with the railroad under a joint agreement in accordance with the provisions of the state grade-crossing elimination law, which at the time the agreement was signed provided for an equal division of cost between the railroad and the municipality. This law, however, has since been amended so that the railroads must pay 65 per cent of the total cost of all such projects. The custom had previously been established that the municipality should prepare the plans and have charge of construction wherever it was found necessary to raise the street over the railroad, the railroad to have charge where conditions were such as to require the elevation of its tracks or the lowering of the street, or both.

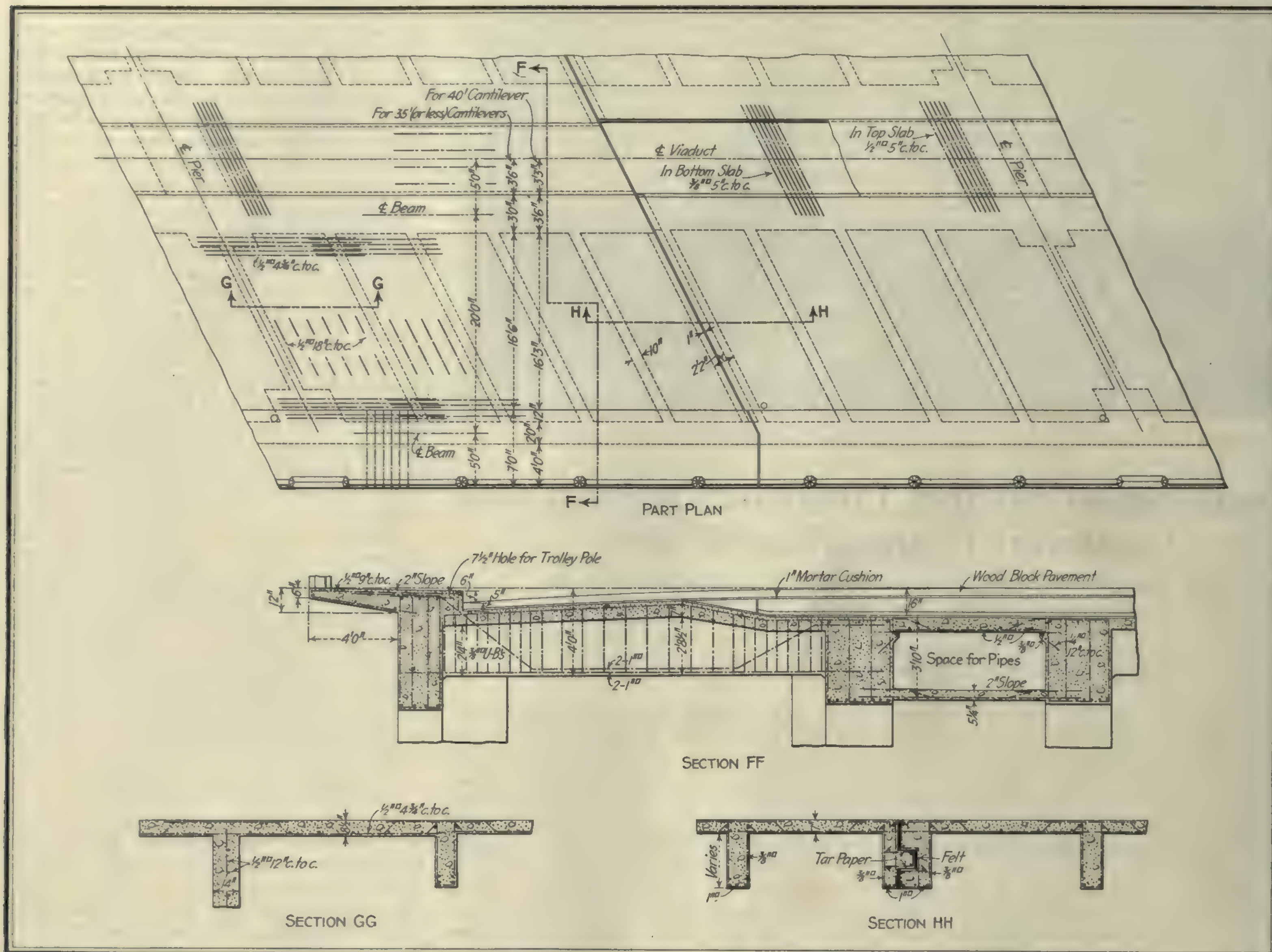
The existing width of Hopple Street being 40 ft., the Baltimore & Ohio Railroad agreed to pay 50 per cent of the cost of a viaduct 40 ft. wide. The city, however, desired to widen Hopple Street to 60 ft. so it could be used as the connecting link between the extensive park and boulevard systems projected by the Park Board for the eastern and western portions of the city, as well as to allow future street-railway extension out of Hopple Street as an emergency route in time of high water, when all existing lines to the northwestern suburbs are put out of service.

The plans as finally agreed upon by the city and the railroad called, therefore, for the widening of Hopple Street from 40 ft. to 60 ft. between Meeker Street and Beekman Street, the city to pay the entire cost of the necessary property, and the construction of a reinforced-concrete viaduct 60 ft. wide, of which the city was to pay two-thirds and the railroad company one-third of the total cost. Damages to abutting property were shared equally.

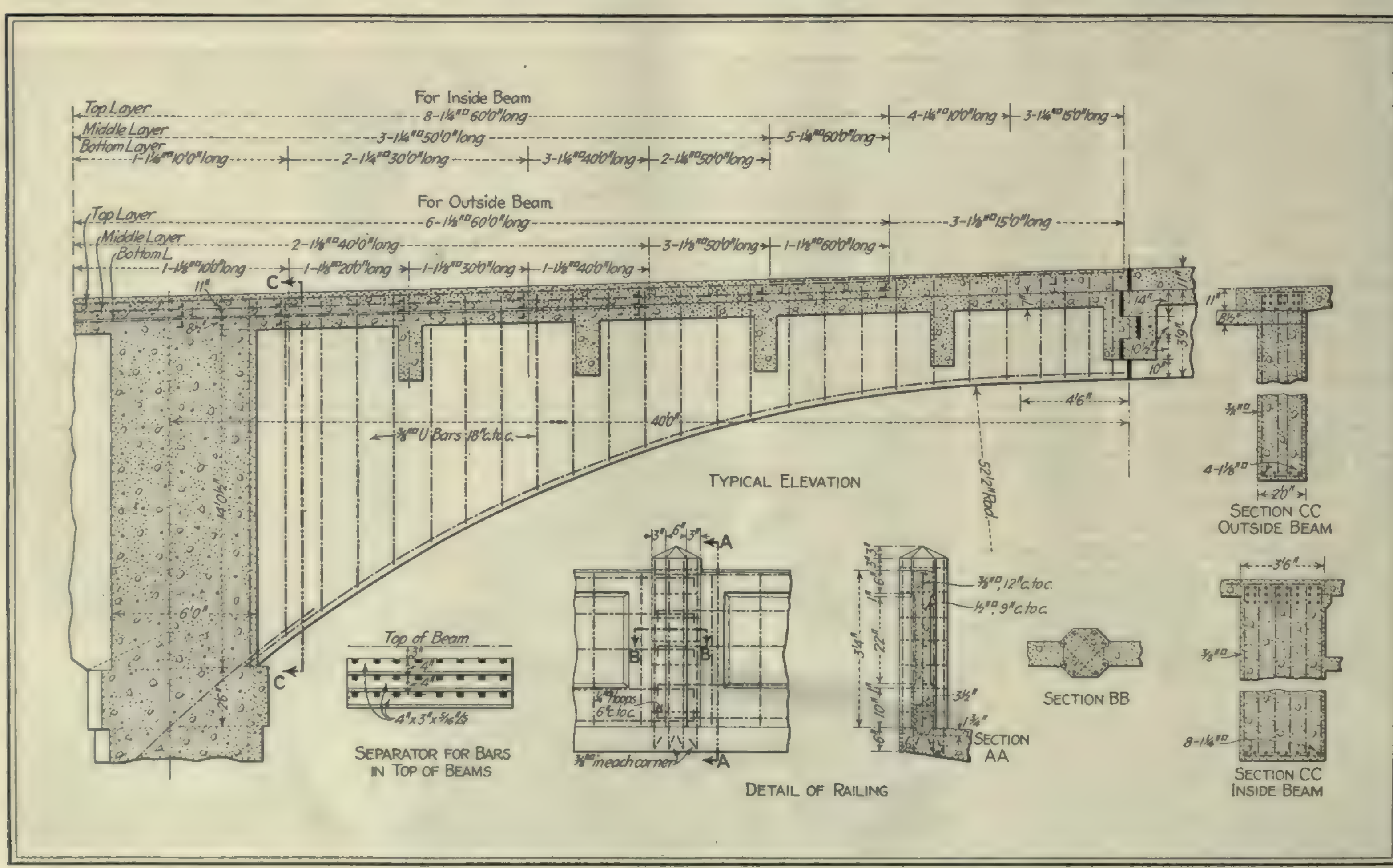
GENERAL DESIGN REQUIREMENTS

The general design of the viaduct was determined by the character of the pier foundations, indicated by wash borings taken along the site, and by the fact that the railroad already had well-developed plans for extensive storage yards west of its present tracks, over which the viaduct must pass for more than 1000 ft. A maximum grade of 2.7 per cent was required to obtain the necessary clearance over the

STEEL FORMS USED IN PIER CONSTRUCTION—REINFORCEMENT PROVIDED FOR UPPER SECTION



PART PLAN AND CROSS-SECTION OF BEAM-AND-SLAB ROADWAY, SHOWING SKEW CONSTRUCTION AND REINFORCEMENT



TYPICAL ELEVATION OF HALF CANTILEVER RIBS, WITH SECTIONS OF INSIDE AND OUTSIDE BEAMS

future hump tracks of the yard. It was necessary to carry four piers at the west end down for more than 50 ft. below the ground surface in order to go below the proposed new channel for Mill Creek, which the railroad plans to divert about 500 ft. west of its present location. These four piers, as well as three others at the present location of Mill Creek, rest on solid rock about 10 ft. below the creek bed. Rock being so far below the surface of the ground, and the soil being mostly either soft blue or yellow clay, it was decided to support all the other piers on concrete piles.

CANTILEVER DESIGN

The cantilever design was decided upon as the one which would best eliminate damage to the structure in case of unequal settlement of the piers resting on piles. Also, for architectural effect, it was desired to retain the arched form of the superstructure, which the cantilever design made possible without having to contend with the effects of arch thrust, temperature change, rib shortening, etc.

Pier spacings of 70, 75 and 80 ft. were selected as best conforming to the railroad company's track layout. A 70-ft. span was made by combining two 35-ft. cantilevers, a 75-ft. span by 35 and 40-ft. cantilevers, and an 80-ft. span by two 40-ft. cantilevers. This arrangement was necessary in order to keep the cantilever ribs of each pier balanced as to dead load and keep it symmetrical about the pier center line. The center of gravity of all dead loads was thus kept at the center of the pier, and all bending stresses were eliminated from the piers except those resulting from unbalanced live loads.

LIVE LOADS AND ALLOWABLE STRESSES

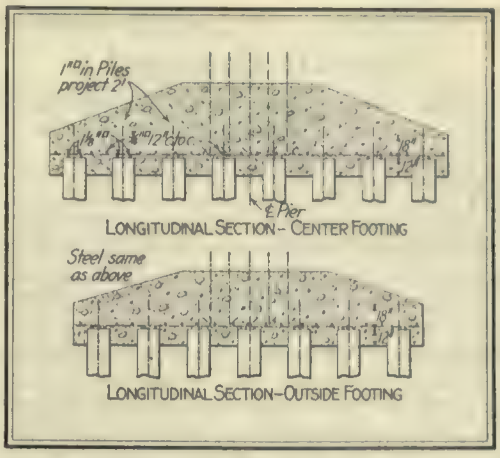
The live loads were assumed as follows: Each of the interior cantilever beams was designed for the maximum stresses produced by a moving load of two 40-ton electric cars entrain, each car being 45 ft. long overall, with two four-wheel trucks 19 ft. 6 in. on centers, 25 per cent being added for impact. The outside cantilever beams were designed for 100 lb. per square foot on the sidewalk and 150 lb. per square foot on the 8-ft. strip of roadway adjacent to each curb. The roadway slab was designed for 600 lb. per square foot, and the cantilever sidewalk for 100 lb. per square foot. The beams were designed for the maximum stresses produced by a 20-ton road-roller, with 20 per cent added for impact, two-thirds of the load resting on the rear rollers, 7 ft. center to center, the front and rear axles being 11 ft. apart.

In designing the piers and footings, maximum stresses were obtained by assuming the superstructure supported by any one pier as loaded with its full live load on one side only. The piers and footings were heavily reinforced to resist the bending-moment stresses produced by this extreme unbalanced condition of the live load.

The maximum unit stresses allowed in proportioning the various parts of the viaduct are given in the accompanying table.

ROADWAY AND WATERPROOFING

The roadway of the viaduct is paved with wood block laid on a cement-mortar cushion, mortar being used instead of sand, as originally specified. Street railway tracks bolted to steel ties were laid in a depression of the roadway slab and surrounded with concrete ballast.



TYPICAL SECTIONS OF PIER FOOTINGS

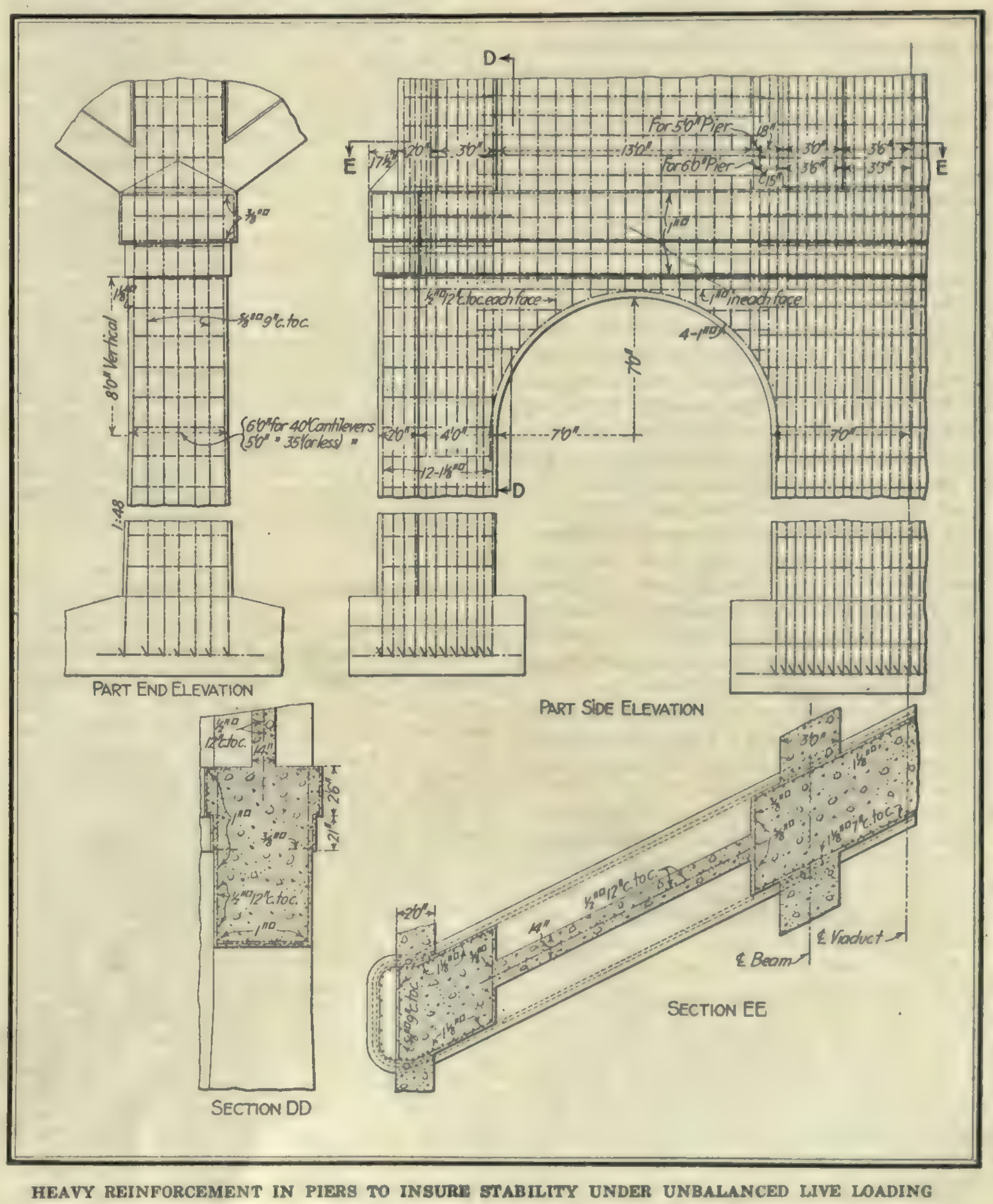
The specifications called for a three-ply waterproofing of alternate layers of burlap and felt, saturated and laid in hot asphalt, to be applied to the top of the concrete roadway slab, and extending continuously from curb to curb underneath the paving and track ballast, and flashing up against the curbs to end in a V-shaped longitudinal groove in the curb at the elevation of the top of the pavement. However, before the paving was laid it was decided to omit the waterproofing, in view of the excellent quality and density of the concrete in the roadway slab, and because experience with wood-block pavement showed that, when laid on a reinforced base, it soon provided an impervious surface under ordinary traffic and did away with the necessity for a waterproofing membrane. About $3000 was saved by this omission.

Between the interior cantilever ribs and directly below the roadway slab a pipe gallery for service pipes and conduits was constructed. Man-hole entrances to this gallery from the roadway occur about every 100 ft. Drainage for the roadway surface is provided by cast-iron gutter inlets about every 350 ft. East of Mill Creek these inlets are connected to the sewer in the street below, but to the west there was no existing sewer, and the drainage is set free at the surface of the ground.

ALLOWABLE UNIT STRESSES

	Pounds per Sq. In.
Tension in reinforcing steel:	
Piers and footings	20,000
Superstructure	18,000
Compression in all concrete—extreme fiber	700
Shear taken by concrete	65
	Tons
Average dead load on concrete piles	23
Average total load on concrete piles	27
Maximum load on piles, unbalanced live load	35
Maximum footing pressure on—	
Rock	8
Earth	3

The sidewalk railing is of solid panels with a smooth surface, brushed to expose the finely crushed aggregate. Expansion joints occur in the railing over the corresponding joints in the sidewalk, tarred felt and tar paper being used between the surfaces in a manner similar to that described for the roadway joints. The railing was so de-



HEAVY REINFORCEMENT IN PIERS TO INSURE STABILITY UNDER UNBALANCED LIVE LOADING

signed that its panels could be poured separately, as units, in a horizontal position, using the same forms many times, and then hoisted into position between the post forms and concreted rigidly into the posts. The contractor did not follow this method, however, but used a set of steel forms and poured posts and panels monolithically in short sections, upright.

The fill approaches at each end are retained between reinforced-concrete cantilever walls. These walls were originally designed with counterforts, but at the request of the contractor were redesigned as T-walls. This design increased the yardage somewhat, but the contractor figured a saving in forms to more than offset this extra concrete and steel. At the railroad tracks a steel staircase permits pedestrians to descend to the Hopple Street station. This was designed of steel with bolted connections in order to facilitate its removal in case the station is moved to another point when the proposed storage yard is built. Two concrete stairways lead down at diagonal corners to Spring Grove Avenue, an important traffic-way. They are supported on double-column bents, independent of the viaduct.

VIEW OF FINISHED HANDRAILING

The plans for the viaduct were completed and the contract let in the fall of 1913. Construction was started in April, 1914. The total cost of the viaduct and approaches, exclusive of land and damages, will be about $450,000. The cost of land and the damages awarded to adjacent property will be close to $100,000, making the total cost of the entire grade-crossing elimination $550,000.

The plans and specifications were prepared in the city engineering department, of which H. M. Waite was then chief engineer; F. L. Raschig, engineer of structures, the writer being in charge of design, and J. R. Biedinger, assistant engineer, working out the details and computations. The construction was supervised by F. S. Krug, chief engineer; F. L. Raschig, principal assistant engineer; Paul Laur, assistant engineer, and P. R. Kirstein, resident engineer. The Kirchner Construction Company is the contractor. For the Baltimore & Ohio Railroad the plans were approved by F. L. Stuart, chief engineer, and the construction was supervised by A. M. Kinsman, engineer of construction, and C. W. Milholland, resident engineer.

Connection Between Subways in Service

The connection between the Grand Central Station, the Interborough subway station and the Queensboro subway in New York City has been placed in service. This makes it possible for passengers to transfer between the two subway lines without going on the street.

Two Breaks in Barge Canal Quickly Repaired

Concrete Power House on New York Canal Fell Ten Feet Without Breaking—May Be Placed on New Superstructure

DURING the early part of July two breaks occurred in the New York Barge Canal which, though serious, delayed navigation only a few days. The first was at Palmyra, the second at Little Falls. Their quick repair is described in the monthly Barge Canal *Bulletin*.

Around the south side of lock 29 at Palmyra there is a bypass channel in which the power plant had been located. Just below the power house a stream comes in from the south and flows along the bypass into the canal prism a short distance farther east. This creek undermined the structure to such an extent that the southeast corner of the power house settled about 10 ft. As a result of this failure the 3-mile level west to Macedon was drained and traffic suspended.

To restore navigation a cofferdam was built across the bypass channel above the site of the power house. The nearby lock was affected only in its loss of power. As this plant supplied power for both the Palmyra and Macedon locks the latter was likewise affected.

Concrete Practically Unharmed

Despite the unusual stresses to which it was subjected the power house remained intact, no cracks showing in the concrete, the windows being unbroken and the door in good working order. Much of the substructure also held together. The side walls of the power house had horizontal and vertical reinforcing bars and the roof electrically welded wire cloth. To take the roof thrust, two ties of structural steel were stretched across the house and anchored in the concrete near the cornice line. The roof was covered with tile.

The settlement of the foundation brought into play severe and peculiar stresses, which the concrete withstood remarkably well. An examination showed that such breaks in the concrete as did occur were mainly caused by tension, although some were due to shear. There were practically no failures by compression. The house may be raised and moved aside while a new substructure is being built.

Break at Little Falls

Just west of Little Falls lock the north bank of the canal and a part of the bottom consist of a heavy rockfill. This embankment is used to fill what was once a river channel. The eastern portion of the level above the lock lies near the Mohawk River and at a considerable elevation above it. The lock has a lift of 40½ ft., and consequently there is that difference between the two channels. They are separated chiefly by rock in its natural state, but at the place mentioned this artificial embankment had to be built. To protect the prism the fill was covered by a course of riprap then by one of lining. Above this a layer of concrete covered the bottom and inside bank slope. To prevent leakage puddle was used where the prism ran through the natural rock.

This level was filled for the first time May 16. Gradually a small leakage appeared, which increased until on July 9 a disturbance of the water in the canal showed where the trouble was. The guard gate was closed and the water drawn, and as the water lowered small leaks in the puddle and seams of the rock were located. When the concrete was uncovered it was found that there had been a marked settlement and that cracks and breaks extended over a considerable area.

Repairs were made by grouting the fill through holes in the concrete, filling the main leak with concrete, placing a layer of concrete over the cracked portion on the slope and grouting the smaller cracks and seams. After repairs had been made to the gratings which had become displaced at the lock culvert entrance the level was filled and navigation resumed with less than five days' interruption.

The cause of the break has been attributed to a settlement of the rockfill into the silt of the old river bottom. There is about 19 ft. of water in the prism at this point, and this added weight, together with the washing away of the finer material in the fill, seems to account for the occurrence.

Drive Roosevelt Drainage Tunnel Rapidly

Monthly Record of 437 Feet Penetration Made in 27 Days of Three Shifts Each in Wet Cripple Creek Bore

A RECORD of 437 ft. penetration was made in August in the Roosevelt drainage tunnel being driven to drain the Cripple Creek mining district. Only twenty-seven days of three shifts of eight men were worked. The best previous record was 400 ft., made in January, 1909. The tunnel is 4 miles long now and 1800 ft. below the surface. Its width is 9 ft., and it is 8 ft. high in the clear. There is a ditch or waterway at one side 4 ft. wide and 2 ft. deep in the center. The material is a hard volcanic breccia, with occasional dikes of basalt and phonolite, also very hard. Usually it requires at least thirty holes to break a round. From 5 to 7 ft. only is broken per round. Little timbering is necessary. The rock is hauled from the face by mules and hoisted out of the Elkton shaft. Water is coming out of every fissure and crevice in the rock, the total flow at the portal now being 10,300 gal. per minute. This makes it necessary for the workmen to wear heavy rubber boots and clothing.

The drills used are the Ingersoll-Leyner Model 18, with 2¼-in. bits for starting. Two drills on a horizontal bar are worked in each shift.

It is intended to drive the tunnel 6400 ft. farther to the Golden Cycle shaft, although it is now rapidly draining the entire district.

The force of skilled tunnelmen doing the work is handled by Charles F. Fuller, superintendent. T. R. Countryman is chief engineer.

Motor Trucks to Value of $90,000,000 Exported Since Outbreak of War

Motor trucks to a value of $90,000,000 have been exported by American manufacturers since the outbreak of the European war, according to figures given by Harry Wilkin Perry, secretary of the commercial vehicle committee of the National Association of Automobile Manufacturers, in the *Literary Digest*. Many of those shipped to Europe, particularly to Great Britain, were for private use in industrial and commercial establishments. The total number of trucks shipped is 32,000.

Waterworks Practice Discussed at New England Association's Convention Last Week

Abstracts of Some of the Papers and Committee Reports Presented at the Annual Meeting, Held in City Hall, Portland, Maine, September 13, 14 and 15

Leakage from Pipe Joints Warrants Investigation

Without Co-operation of Members in Supplying Information Committee's Work Will Prove Futile

By F. A. BARBOUR
Chairman of Committee on Pipe Joint Leakage

ON Sept. 7, 1915—as a result of a paper read by Arthur H. Smith before the New England Waterworks Association—a committee was appointed "to investigate experience in the leakage of pipe joints." This committee consists of C. E. Davis, S. E. Killam, C. M. Saville, H. B. Machen, A. H. Smith, E. G. Bradbury and the writer as chairman. The present statement is not a progress report from the committee; rather it is made for the purpose of inducing a more active interest in the investigation by the members of the association, and particularly with the hope that a discussion may result which will be of value in the further work of the committee.

How Information Was Obtained

As the best method of obtaining the results of experience in joint leakage, a circular containing 37 questions was mailed to 430 members of this association and to 124 members of the American Waterworks Association. From the 554 circulars sent out 131 replies have thus far been received, 46 of these being from the members of the American Waterworks Association. Only 85 replies were received from the 430 circulars sent to the members of the New England Waterworks Association. When only one in five members takes any notice of such a circular it is evident that either the subject of the investigation is of little moment or else the members do not appreciate the value of co-operation if any results of value are to be obtained.

It may be—and in regard to this it is hoped that members will to-day express their opinion—that leakage from pipe joints is not generally an important factor, and that the present type of joints driven and tested, or not tested, as may be the practice, is entirely satisfactory. It also may be, and probably is, true that such leakage from mains as does occur is not general, but is rather located in a few imperfectly made joints, or, in other words, that the average present standard of design and workmanship is good enough. While this may be true, it comprehends the subject chosen for investigation, and thus far little information of definite value in reaching any conclusion has been received by the committee.

One fact, however, stands out: Even in the fully metered systems about 20 per cent of the total water supply is unaccounted for by sale to the consumers. Thus, of the 131 replies received, 10 per cent report the services to be entirely metered and 30 per cent more than 85 per cent metered, and the average water unaccounted for, as estimated in these systems, is 21 per cent. This loss is chargeable to leakage from mains or services, or to failure of the meters to register. It would seem to be worth while to attempt to locate the cause of a 20 per cent loss of the water furnished. If slippage of meters is the explanation, this simply means that consumers are getting more than they are nominally paying for; but if leakage from the mains and services is responsible, the result is an absolute loss of water, which costs money to develop and deliver to the distribution system.

Meters Would Prevent Loss

The average consumption in the 40 systems in which 85 per cent or more of the services are metered is, as reported, 68 gal. per day per capita. The average estimated unaccounted for water was therefore equivalent to about 14 gal. per day per capita, or a loss of 5000 gal. per year per capita, which, if the cost is estimated at $25 per 1,000,000 gal. of water delivered to the distribution system, is equivalent to a yearly cost per capita of 12½ cents, or approximately the interest on $2. In other words, a town of 10,000 people could afford to expend $20,000 in order to prevent this loss of 14 gal. per day per person.

If, then, in these fully metered systems, which undoubtedly represent the best conditions, only 80 per cent of the water supplied is sold to the consumers, the question arises as to whether this should be accepted as the highest standard of efficiency which can be reasonably attempted. If, in any considerable part, the unaccounted-for water is chargeable to slippage of meters, then it would seem desirable that increased attention should be given to the subject of maintained accuracy and sensitiveness of meters. If meter slippage is not the explanation of the unaccounted-for water, then the loss must be through leakage from the mains or services.

Loss from Services

As to the loss from services, 80 per cent of those replying to the circular estimate this to be small or none. As to the leakage from mains, 99 of the 131 answers received do not attempt to estimate this loss; 18 state it to be very small or none; and 14 estimate it in percentage of the total amount supplied, the average of these few figures being 15 per cent.

From the replies already received, therefore—and these presumably are from those departments best able to answer the several questions, or most interested in the problem—it is evident that while undoubtedly a considerable portion of the water supplied is not sold to the consumer, there is little or no definite knowledge of the actual conditions of the pipe joints. The general impression, as indicated, is that the mains are fairly tight and that the leakage from services is small. It may also be inferred from various notes in the replies received that such leakage as may occur in mains is located at certain isolated joints and is not general.

One phase of the investigation as conceived by the committee was that in reference to the practice of testing pipes when laid. Believing that in the majority of cases local conditions would not permit the trenches to be kept open until the pipes were tested, the question was asked as to the reasonable allowable leakage in testing after backfilling, as determined by the measured water necessarily introduced to maintain the test pressure. Such a method of testing is of course not to be compared with the visual examination of the joints under pressure, but it is necessary in many cases.

Testing of Pipe

Of the 131 replies received in reference to testing pipe when laid, 76 state that such tests are made, 36 that no tests are attempted, and 19 that sometimes the pipes are tested and sometimes not. The interesting and rather surprising feature in these replies is that all but six of those who state that the pipe is tested report that the test is made before backfilling the trench. Further, of the 75 who replied to the question as to the standard of tightness required before putting the pipe in service, 63 state this requirement to be "absolute tightness." Of those who report that it is customary to test the pipe when laid, 85 per cent state that the test is made under the working pressure which the pipe is to carry in service. Only 18 report tests in excess of working pressure, the test pressures ranging from 30 lb. excess to double the working pressure.

From the information received to date it therefore appears that it is quite the general practice to test before backfilling and to require absolute tightness under the working pressure. If these replies can be accepted as expressing the general practice of water departments it is evident that the present standard is high, and the only question which might profitably be asked is as to what happens to the joints when the higher pressures due to water ram, and more or less incident to the operation of every system, are applied, and whether therefore pipes should not be tested at some pressure above that of working conditions. It is noticeable that but very few of the statements made in reference to leakage from mains and services are based on any actual tests after the pipes have been in use for any period of time, and the opinions expressed are generally formed from observation of such joints as have from time to time been exposed. Only four definite statements of tests for leakage of pipe after periods of use are reported, and these

indicate only a small loss from the joints.

No information has been obtained in reference to the relative leakage from lead wool, leadite and cement joints. Ten per cent of those replying to the circular have had some experience with leadite joints—the majority of those using this material reporting it to be satisfactory. About 10 per cent have had some experience with Universal pipe joints, but these only on the smaller systems. Eight per cent of those replying to the circular have had experience with machine-driven joints, opinions differing as to the value of these joints as compared with hand-driven.

Naturally only those systems where a high percentage of the services are metered can make any accurate estimate of the water not delivered to consumers. Where less than 75 per cent of the services are metered, waste by carelessness inside the premises of consumers is undoubtedly the great factor in determining the amount of water supplied—a condition which clearly stands out in the replies received, by comparing the water furnished per capita with the per cent of metered services. Thus, with due allowance for special industrial demands, the relation between meters and amount supplied is approximately as follows:

Per cent metered	Gallons per day per capita
100	68
75	75
50	90
25	110
0	125

It is therefore evident, as would be expected without the evidence of the present investigation, that, in the conservation of our water supplies, metering of the services is the great factor, and leakage from mains, except in particular instances, is of minor importance. While this is true, however, there remains the fact that in completely metered systems the average unaccounted for water amounts to about 20 per cent of the total quantity of water delivered to the distribution pipes.

More Information Needed

Whether it is economically possible to reduce this loss by a better type of joint, better workmanship, testing at pressures above the normal, cannot be determined by the evidence thus far made available to the committee. The information most needed to reach conclusions is that giving the results of leakage surveys, of actual tests made after the pipes have been in service some years, of experimental work showing the relation between pressure on the joints and leakage, and, particularly, data from those departments where accurate tests have shown leakage in mains to exist. There is no doubt that in many cases there is a large loss from the pipe system, even though in the replies received to date to the circulars of the committee the great majority regard this loss as very small, or refuse to make any estimate.

The object of this brief preliminary consideration of the subject is to ask that members who have not replied to the circular do so at once, and particularly that any member who has at hand the results of definite leakage tests submit such information, which will of course be considered confidential. An expression of the opinion of members on the general question as to whether further investigation of joint leakage is worth while would be of interest.

Emergency Water-Service Gangs Find Weak Spots

Besides Making Speedy Repairs Special Force Keeps Office Advised of Sections in Need of Repair

By GEORGE H. FINNERAN
General Foreman, Water Service, Boston

THE NECESSITY for a water-service emergency gang of high moral, mental and physical standards in these days of high-pressure service and increased number of pipes is evident to all waterworks men. The old causes of trouble—defective material, water ram and frost—have been supplemented by breaking of hydrants by carelessly driven automobiles, the increased number of hydrants projecting above the surface, and other causes attributed to subways, underground wires, pneumatic tubes, deeper buildings and other modern constructions.

The men of the emergency gang should be selected carefully. They must know the locations of the city's pipe lines so thoroughly that they can tell the exact location of any part of the system, its connection with the main pipe, and the location of the controlling gates. Methods of making quick or temporary repairs must also be a part of the knowledge they should have ready for instant application.

Equipment Affects Efficiency of Gang

Proper equipment is the next consideration in securing the maximum efficiency from the emergency men. Heavy wrenches are needed with which to operate large gate valves and lighter ones should be on hand for the smaller valves. Wrenches for corporation and curb cocks, hydrants and air valves should also be carried. Calking tools, hammers, crowbars, picks, shovels, brooms, hand pumps, spoons to remove dirt from gate boxes, and lanterns of different kinds should also be carried. A gasoline or kerosene torch to thaw out gate covers, a force pump, connection pieces, rubber boots, and a gate finder will be found handy accessories. A useful piece of equipment is a powerful jack to help in extricating the heavily loaded wagon or auto from a soft spot in the road. Plans showing the pipe system should also be carried with the emergency outfit and kept up to date.

Speedy transportation is another important factor in giving the best emergency repair service. This requirement is best met by the automobile in the form of a truck. With seats extending lengthwise storage space is available underneath, and a rear entrance can be provided easily.

Boston's Emergency System

The emergency gang as operated in Boston is divided into three 8-hour shifts, each in charge of a leader. The day shift consists of four men, including the leader. Each of the night shifts consists of six men. There is also a man on duty in the office during each of the night shifts and on Sundays and holidays. He takes all messages and notifications and directs the emergency gang to the point of trouble.

Owing to the 8-hour law men cannot be worked more than six days a week. It is therefore necessary for each man to suspend his work one day in seven. This is so arranged that there will be but one man off on each shift each day. This practice of laying the men off one day in seven reduces the number of men available by one the greater part of the week. To offset this, one more man is added to each shift to serve as a substitute during the absence of a regular man on his night off or during his vacation. Some risk is attached to laying off the leader, as he is the most capable man, and the most serious break is likely to occur the night he is off.

Most of the calls could be attended to by one or two men, but it is necessary to have a sufficient number of men on hand at all times. During the day it is always possible to get assistance in handling large gates, but at night it is practically impossible. Therefore, in the event of a break in the lines of large diameter with water flowing at a great velocity through the valves, it is necessary to have at least five men to close the 36-in. gates. Arrangements are made so that in the event of a very difficult shutdown, where several large gates have to be operated against a strong head, other men on duty in the stable and fire room may be called out to assist.

Method of Procedure

When the emergency car is dispatched to answer a call, one man is left behind at headquarters unless the notification makes it plain that a serious job is at hand. The man at the telephone can usually judge the seriousness of the trouble by the number and rapidity of the telephone calls. Where there is a break of large dimensions, the average citizen considers it his duty to inform the water, police or fire department, whichever in his judgment is the proper one, and the result is an avalanche of notifications directed to the water department. As a rule, there is no mistaking real trouble by this sign alone.

The man left behind at emergency headquarters is available in the event of another call coming in after the car has left in response to the first call. Sometimes the gang is sent out on a trivial matter and a few minutes after its departure notice is received of a serious leak. The man at quarters responds with a horse and light wagon and, if possible, controls the situation himself. If it is beyond his ability, he telephones to the office. In the meantime the office man has been getting in touch with the emergency car and has in all probability directed it to the scene of the second leak by telephone. The occupant of a house or store in the vicinity where the car was called is asked to summon one of the men to the telephone. If this is not possible the men are reached through the police.

It is a rule of the emergency service that as soon as practicable after arriving on a job the man in charge of the gang is to telephone the office his whereabouts, and the nature of the trouble, and receive instructions as to his next move. In this way time and travel are saved by moving the car from job to job, rather than have it return to quarters after each one.

Render Aid at Large Fires

It has been customary, during the last few years, to have the emergency gang report at all large fires, the object being to render any aid that it can in connection with the water supply. In the case of a very large fire where the supply is insufficient it may be possible to reinforce it by opening division gates that are usually kept closed to separate high and low pressure systems. If the fire is in the vicinity of the boundary line of the city, gates may be

opened admitting the supply from some adjacent town or city.

The well-organized and properly conducted emergency service in a water department of any large city of to-day is a valuable asset. Beyond its efficiency in its own special line, whereby it saves money by minimizing property losses and public inconvenience, it serves as a stimulant to the department of which it is a part to keep its system up to a high standard of efficiency. The emergency gang in the course of its regular work is constantly uncovering weak spots in the system, and thereby aiding in the general work of the water department.

Opinions on Service-Pipe Practice Summarized

William S. Johnson, Chairman, Submits Committee Report Based on 300 Replies from Water Departments

THE committee on service pipes began its investigations by sending to every water department in New England a request for information in regard to the materials and methods used in service-pipe construction, the troubles experienced, and other matters which appeared to be of interest in this connection. Replies were received from over 300 water departments. There were, however, many things which the committee felt should be further explained, and at two meetings a number of superintendents were questioned in regard to the details of their practice and experience. There still remain, however, many points which should be further discussed, and this report, from which the following extracts have been taken, is therefore made as a preliminary report, with a view to getting a general discussion of the matters presented, so that in making the final report the committee may have the benefit of the views of the members.

MATERIALS FOR SERVICE PIPES

The use of plain wrought iron or steel is becoming rare, while nearly one-half of the places sending in reports now use galvanized wrought iron or steel exclusively; in 56 per cent of the places galvanized iron is used either exclusively or in part. In 95 places lead or lead-lined pipes are used, and cement-lined pipes in 48 places. It is noticeable that the use of cement-lined pipe is largely confined to Massachusetts and New Hampshire, 46 of the 48 places using it being in these two states.

Of the new waterworks systems—those constructed within the past 10 years—the following materials have been used for services: Galvanized, 24; plain wrought iron, 1; lead, 2; cement lined, 9.

CHANGES IN MATERIAL USED

The disfavor with which plain iron and steel are regarded is shown by the fact that 22 places have changed from these materials to some other, while only one place has reported as having taken up this material. Galvanized pipe, on the other hand, has lost only 17 while gaining 46. Lead and lead-lined pipes have gained 18 and 16 places respectively and lost 6 and 8. Changes to cement-lined pipes have occurred in 11 places, and changes from cement-lined pipes to some other material have occurred in 27 places.

A comparison of the number of places now using the different materials with the number of places where this material has been abandoned shows that 63 per cent of those formerly using plain iron or steel pipes have changed to some other material. Eight per cent have changed from galvanized iron; 19 per cent from lead or lead lined, and 42 per cent from cement lined.

Of those places where changes have been made from galvanized pipe to some other material, 13 are supplied from surface sources, 1 with ground water, and 3 with filtered water. Of the places changing from lead or lead-lined pipe to some other material, 5 are supplied from surface sources, 13 from ground-water sources, and 4 from filtered sources. Of the places abandoning cement-lined pipes for other material, 18 are supplied with surface water, 7 with ground water, and 1 with filtered water.

REASONS FOR CHANGE OF PIPE

The reasons reported for the changes are varied. The changes from plain and galvanized pipes are almost entirely on account of rust. The changes from lead pipes are largely on account of the possibility of lead poisoning, although in some cases it has been on account of expense or because of the bursting of the pipes under pressure. Lead-lined pipe has been abandoned on account of lead poisoning and trouble from bursting and because of the difficulty in making joints which will not corrode. Of 20 places reporting the abandonment of cement-lined pipes, 8 were on account of trouble at the joints, 6 for convenience, 2 on account of expense, 1 on account of the difficulty in getting good work, 1 because of rust, 1 because the cement broke off, 1 because of outside rust.

A large proportion of the places where the works have been in operation for a sufficient time report trouble with service pipes no matter what the material used, except in the case of cement-lined pipes. With cement-lined pipes, 54 per cent of the places replying report little or no trouble. With galvanized pipe, 36 per cent of the places report little or no trouble, and with lead pipe 10 per cent so report. The trouble with iron and steel pipes, both plain and galvanized, appears to be through the entire length of the pipe. The trouble with lead pipes appears largely at the corporation cock. The trouble with cement-lined pipes is very largely corrosion of the outside of the pipe just inside the cellar walls, with some trouble at the lead gooseneck.

LIFE OF SERVICE PIPES

The data in regard to length of life of a service pipe and the period that elapses before it begins to give trouble are very unsatisfactory. The averages of the figures given in the returns are as follows:

	Years before trouble begins	Life of pipe, years
Plain iron or steel	12	16
Galvanized	15	20
Lead	10	35
Lead lined	10	23
Cement lined	14	28

The main sources of trouble from corrosion are largely inside the pipes, due to the action of the water. In certain soils, however, there is a rapid corrosion of the pipes on the outside, and, in case the inside is protected, as in the case of cement-lined pipes, this is the main source of trouble. Pipes laid in salt marsh or in cinder fill are certain to be acted upon rapidly. Pipes in clay are much more subject to corrosion on the outside than those in sand or gravel. One of the common places where trouble occurs is at the corporation cock, or where a gooseneck is used at the junction of the gooseneck with the service pipe. Some of the troubles at the corporation cock are due to the tuberculation of the main pipe, which tends to cover the corporation cock. This can be overcome in a large measure by inserting the corporation cock well beyond the inside of the main.

PLAIN WROUGHT IRON AND STEEL

The committee believes that there are very few cases where the use of either wrought iron or steel pipes without some protective coating for services is justifiable. They are certain to become filled with rust, and the expense of cleaning or renewing them will much more than offset the extra first cost of construction. Covering the metal with some protective paint seems to increase its life but slightly.

In the compilation of the returns, wrought iron and steel have been grouped together, as it is evident that the words are used interchangeably in many cases. Of those making returns, however, very few have said that steel pipes were used, and a considerable number have called attention to the fact that only genuine wrought iron was used. Others have stated their belief in the superiority of wrought iron over steel, deeming it of sufficient importance to call for special remark.

The relative merit of steel and wrought iron has been a matter of controversy ever since steel pipe has been on the market. The steel pipe has the advantage of greater strength and lower cost, but the advocates of wrought iron claim that the steel corrodes more rapidly, has a much shorter life, and is more difficult to work. The advocates of steel contend that the life of steel is as long as, if not longer than, that of wrought iron. Both sides produce evidence to support their claims, much of which appears to be trustworthy. The claims of both sides, also, are supported by competent experts.

CONDITIONS GOVERN BEHAVIOR OF PIPE

The behavior of pipes under different conditions is so different that the greatest care must be exercised in drawing conclusions. The action of the different waters on both steel and wrought iron is quite different, so that the results obtained in different places cannot be compared. The action of the water on the pipes depends to a considerable extent on the quantity passing through it, and a pipe which contains dead water much of the time will corrode much less rapidly than one which has a continuous flow. For these reasons conclusions based on the appearance of occasional samples are worthless. The character of the metal should also be taken into consideration, as there is wrought-iron pipe, for example, which is of inferior quality and will not resist corrosion as well as genuine wrought iron, and there is undoubtedly much steel pipe sold as wrought iron.

The experience of waterworks superintendents as indicated by the returns and as shown by previous discussions in the meetings of the association is decidedly unfavorable to steel pipe, and while, undoubtedly, many of those who argue in favor of wrought-iron pipes may be unfamiliar with anything else, and believe in it because they were taught to believe in it, there is certainly a large number of reliable men who have had an extended experience with both

materials who are firmly convinced that wrought iron is much superior to steel, and there must be some good reason for this belief.

In regard to the working of the steel, there seems to be no doubt that the same tools used for wrought-iron pipes cannot be satisfactorily used for steel pipes, but that with suitable tools the steel pipes can be worked without any difficulty.

The feeling against steel pipes appears to be chiefly confined to New England, for it is undoubtedly a fact that a majority of pipes used in other sections of the country are of steel, and it is apparent that no more trouble is experienced from the use of steel in these places than is experienced from the use of wrought iron in this vicinity.

Galvanized Pipe

The action of water on zinc is comparatively slight, and if the pipe—whether of steel or wrought iron—is completely covered with zinc the life of the service will be very materially lengthened. The chief trouble with galvanized pipe is in the joints, where the water gets directly at the iron, and in the imperfect covering of the iron.

As pipes are manufactured, there is a large quantity of scale left on the pipe, especially on the inside. In the galvanizing process this scale is simply covered with zinc. When the scale becomes loose, as it invariably will, the metal of the pipes is exposed in spots directly to the action of the water and corrosion begins, which tends to loosen still further the scale, and soon the pipe is little better than an uncoated pipe. The wrought-iron pipe advocates claim that the greater roughness of the wrought iron insures a greater quantity of zinc, but the extra zinc in this case is obviously not so distributed as to be of any material value.

If the pipe could be freed from scale before galvanizing, leaving a comparatively smooth surface, the effects of galvanizing would be much greater, as there would be little opportunity for the direct action of the water on the iron. One of the steel companies has now perfected a method of removing scale from the pipes which would seem to be of enormous advantage both in decreasing the friction in the pipe and in making it possible to obtain a much more durable coating of zinc when galvanized. This process, which is applicable both to wrought-iron and steel pipes, is likely to result in the production of very much better galvanized pipe.

Galvanized pipe appears to be the cheapest practicable material for services where the class of street surfacing is not such as to make the renewal of the services a matter of great expense. They will give trouble, especially with waters which attack metals readily, but there is no possibility of danger to health in their use.

Whether steel pipe is as durable when galvanized as is wrought iron is a matter which is open to discussion. If the galvanizing is perfect, it would make little difference whether the metal under the zinc resisted corrosion more or less. With the process for removing scale above referred to, it would seem that a long step had been made toward getting a perfect galvanized pipe.

Lead Pipe

Lead is in many respects the most satisfactory material to use for service pipes. Its pliability and its comparative freedom from corrosive action make it almost ideal from a mechanical standpoint. The cost of lead pipe of sufficient thickness to safely withstand the pressure is more than the cost of many other materials used for services, but in a paved street the greater duration of life probably more than compensates for the extra cost, and in places where the streets are occupied by other pipes and conduits the ease of getting over and under these obstructions with a flexible pipe is a great advantage. The most serious objection to the use of lead pipe for services is the possibility that the water may dissolve enough lead from the pipe to cause lead poisoning.

Cause of Trouble

The reason why trouble has resulted in some places and not in others is found in the different character of water supplied in these places. With soft water which contains considerable carbonic acid, the action of water on the lead is very rapid. Waters obtained from reservoirs are not likely to have carbonic acid, and instead of a corrosive action the water tends to form a coating of an insoluble lead compound on the inside of a pipe. With such waters there is no great danger in the use of lead. The danger in such cases lies in the possibility that at some future time the character of the water will change either by the introduction of new sources of supply or by filtration of the old supply.

It seems to be practically impossible to determine definitely in advance what the effect of any water on lead pipe will be, as the laboratory results fail in many cases to show the action which will occur in actual practice. Tests of service pipes in use for a considerable period are the only safe guides.

Lead-Lined Pipe

Lead-lined pipe as manufactured several years ago gave much trouble from the separation of the lead lining from the iron, leaving the metal exposed to the water. The pipe as manufactured to-day, however, appears to be durable and prevents the corrosion of the iron or steel very effectively. It would seem that the life of such pipe would be limited only by the corrosion of the outside of the pipe. The expense of the lead-lined pipe is much less than that of lead pipe. All of the dangers from the dissolving of lead which have been enumerated in the case of lead pipes apply equally to lead-lined pipes. The health authorities of several of the New England states advise most strongly against the use of lead for service pipes, even where the character of the water now in use is such as to indicate that there would probably be no injurious effects.

Cement-Lined Pipes

Cement-lined pipes, if properly constructed, make ideal service pipes as far as the interior of the pipe is concerned. The cement is not acted upon by water and the interior of the pipe will remain smooth for an indefinite time. There are many places where cement-lined pipes have been in use for many years without any trouble, and there are many others where they have given so much trouble that their use has been discontinued. The reason for the troubles which have been experienced are found to be generally the improper lining of the pipes or the use of fittings which did not prevent the water from getting to the metal.

Much information has been secured in regard to the methods of making cement-lined pipes and of joining them so as to prevent corrosion at the joints. This information will be given in the final report of the committee, but need not be given in detail here.

Trouble with cement-lined services occurs most frequently from corrosion on the outside of the pipe, and especially where the pipe enters the cellar. Various methods have been suggested for remedying this. A short piece of the pipe where it passes through the cellar wall may be incased in cement. Another suggestion is that a coupling be placed just outside the wall, so that the corroded piece may be readily removed and replaced. Still another method is to put in a short section of brass pipe where it passes through the wall.

The use of galvanized pipes for lining with cement undoubtedly gives the pipe a much longer life, as the outside is in this way protected from corrosion to a large extent. Painting the outside of the pipe is resorted to in some places with good results.

Size of Service

The standard size for services is ordinarily ¾ in., but in several cases this size has been increased to 1 in. or even to 1¼ in. for the purpose, chiefly, of lengthening the life of the service. Where plain or galvanized steel or wrought-iron pipes are used, the pipes soon fill up with rust, but the service which they render is fairly satisfactory until the pipes become nearly choked, when they must be cleaned. A 1-in. pipe has about twice the area of ¾-in. pipe and will probably last at least twice as long before it will require cleaning. Where meters are not used, there is some objection to the use of large service pipes, as the waste of water from leaks and from carelessness, and especially the use of water through garden hose, is considerably larger with the larger service. Where meters are used, this objection does not apply, and it seems to the committee that much trouble and expense might be saved, where pipes are used which are liable to corrode, if the services should be made of larger size.

Goosenecks vs. Rigid Connections

Rigid connections with the main and the omission of the goosenecks are used in a large number of places, and in some places such connections are used exclusively. The advantages of the rigid connections are obvious. They make a considerable saving in the first cost, and they are much more readily cleaned. On the other hand, the gooseneck permits the dropping of the service below the main and away from frost, and it is possible to make the service take any direction from the main. The fact that 83 of the towns reporting use rigid connections to a greater or less extent, and that 56 of these report no trouble, and many others "little trouble" or "some trouble," would indicate that the use of rigid connections is thoroughly practicable.

The almost universal opinion among superintendents, especially in New England, is that the water department should lay and maintain all the services from the main to the stop and waste in the cellar whatever portion of the expense may be borne by the department. The cities and towns in which this is not now done are comparatively few, and in these places the superintendents in many cases have expressed the opinion that it would be wise for the department to take charge of the entire service.

Insurance Rates Call for Grading of Cities

Charles W. Sherman Presents Committee Report Dealing with Waterworks Features of Fire Protection

THE following progress report was presented by the committee on grading waterworks for fire protection, consisting of Charles W. Sherman, F. A. McInnes, C. M. Saville, H. V. Macksey and R. J. Thomas.

It is obvious that in any attempt to fix fire insurance rates equitably some scheme of classifying or grading of cities must be adopted, in which all features which affect liability to fires and the facilities for extinguishing them should be taken into account. In the past, methods of grading for insurance purposes seem to have been of a haphazard character, at least in so far as waterworks were concerned, and it has been impossible to obtain any definite information which would enable one to judge in advance what modifications in grading would result from establishing, or from a radical improvement of, a waterworks system. It has therefore been impossible, as a rule, for waterworks engineers or superintendents to indicate what saving in insurance premiums might be expected as the result of any particular improvement in fire protection resulting from improved waterworks.

It is obvious that the formulation or adoption of a system of grading will not of itself adjust insurance rates. These rates are established by local boards or commissions, not all of which base their grading upon the same subdivisions into groups or classes, and of course the rates fixed in various districts are often widely divergent. The adoption of a scientific uniform scheme of grading is nevertheless the first step toward a systematic and scientific scheme of establishing rates, and after the adoption of a standard scheme of grading it would be possible to estimate what improvement in grading would result from any contemplated change in the waterworks system, and thus compute, at least approximately, what saving in insurance rates can be obtained in view of the rates locally in force.

GRADING PROPOSED BY UNDERWRITERS

The first attempt at a scientific schedule for grading cities and towns with reference to fire defense and physical conditions was prepared by the engineers of the National Board of Fire Underwriters in 1915. This was done as a necessary preliminary to the attempt of the actuarial bureau of that board to classify fire losses and from the study of data thus obtained to establish a basis of scientifically fixing insurance rates.

The grading schedule proposed by the national board is based on several years of careful investigation, by their engineering staff, of the fire-protective features of cities throughout the United States. It is based upon a plan of assigning to the various features of fire defense points of deficiency depending upon the extent of variance from standards formulated by a study of conditions in more than five hundred cities, the natural and structural conditions which increase the general hazard of cities, and the lack of laws or of their enforcement for the control of unsatisfactory conditions. The sum of the maximum points of deficiency is 5000, divided in accordance with the relative features considered, as fixed by the engineers of the national board, as follows:

RELATIVE VALUES

		Points	
Water supply:			
Engine stream basis			1,700
Hose stream basis	2,000		
Fire department:			
Engine stream basis			1,450
Hose stream basis	1,150		
Fire alarm		550	
Police		50	
Building laws		200	
Explosives and inflammables		200	
Electricity		150	
Natural and structural conditions		700	
Total		5,000	

The classification based on this schedule is as follows:

Class of city or town	Points of deficiency
1	0 to 500
2	501 to 1,000
3	1,001 to 1,500
4	1,501 to 2,000
5	2,001 to 2,500
6	2,501 to 3,000
7	3,001 to 3,500
8	3,501 to 4,000
9	4,001 to 4,500
10	More than 4,500 points, or without any fire protection

The detailed schedule in its present form is appended to this report as far as it relates to waterworks features. It must be remembered that this schedule is tentative, having been revised several times, and it is subject to further revision as experience may show it to be desirable.

INTEREST IN INSURANCE GRADING

It may be that some question will arise as to the propriety or desirability of the New England Waterworks Association interesting itself in a manner which, on the face of it, has to do only with the grading of cities for insurance purposes. The manner in which waterworks men may utilize schedules for grading has already been suggested. It must not be forgotten, too, that the engineers of the insurance companies are as a rule hydraulic or waterworks engineers who are devoting themselves to advising their employers, the insurance companies, with relation to the efficiency for fire fighting of the waterworks systems, so many of which are in the control of members of this association. To be sure, the insurance engineer studies also the effect of many other features upon fire hazards and fire protection, but almost all of them have to do with the facilities for quickly and advantageously utilizing the protection afforded by our waterworks systems.

It is obviously desirable, therefore, that the engineers grading these systems with a view to their value for fire protection, and the men in control of the waterworks, should agree as to the methods and points by which rating shall be arrived at. Constructive criticism on a standard grading schedule should therefore be obtained, not alone from the engineers engaged in making such rating, but also from the men having to do with the construction, operation and maintenance of our waterworks systems.

With this idea in view the New England Waterworks Association passed a vote in February, 1916, authorizing the appointment of the present committee.

PROGRESS REPORT OF COMMITTEE

This committtee wishes at the outset to call attention to the notably friendly spirit manifested by the National Board of Fire Underwriters, which has welcomed our criticism and has co-operated with us in every way, sending its chief engineer, George W. Booth, and his principal assistant, Clarence Goldsmith, to confer with us in Boston. In short, the national board has shown an open and above-board policy, and a willingness to recognize the New England Waterworks Association, and the assistance which it could afford, that augurs well for a better future understanding between the waterworks and the insurance interests.

PROPOSED SCHEDULE

The committee has given the proposed schedule careful study, and, considering it as a whole, is satisfied that it is a long step in the right direction. In view of its tentative character, criticisms of the detail, and particularly of the number of points of deficiency assigned to various features, are not of controlling significance at the present time. The classification, when effected, will in the nature of things have a direct bearing upon the actual insurance rates, particularly when studied in connection with the data relating to actual losses now being classified and arranged by the actuarial committee of the national board. It is inconceivable that the rates should continue to be assessed in the present illogical and ofttimes unfair manner. The practical and most desirable result fairly to be expected to follow the adoption of the schedule, as was noted above, is the possibility of determining with reasonable accuracy the saving in insurance that will result from a given expenditure for improvements in a waterworks system. In other words, it will be possible in designing a new system or improving an old one to estimate upon probable insurance rates, just as comparative construction costs are now figured.

In the meetings of the committee considerable criticism developed in regard to certain fundamental provisions of the schedule. After full and free discussion with the engineers of the national board we found that many of the questions raised by us were the same as those which they had met and discussed in their earlier study of the problem, and we are now satisfied that the schedule in its present formative stage is a well-considered one.

CHANGES SUGGESTED

Certain modifications have been made at our suggestion, and others are now under consideration. In two respects, however, we have been unable thus far to agree fully with the engineers of the national board or to convince them of the equity, from their point of view as well as of ours, of certain changes which it seems to us should be made. First, no penalty is assigned to too frequent or unduly large fire pipe connections from distribution systems, nor are rules which should obtain in regard to the granting of such connections considered in the schedule. We fully recognize the imperative need of connections of sufficient size for fire defense, but we equally recognize the necessity of adequately safeguarding them. Water in our mains should be used for fire protection just as poisons are used in medical practice—to cure and not to kill the patient.

The second issue is in regard to the right to existence of the so-called 4-in. hydrant. As submitted to us, the grading schedule would penalize this hydrant under all conditions, since none of the 4-in. hydrants can meet the stipulations as to capacity and friction loss. We fully recognize that the 4-in. hydrant has no place in urban conditions, but we are unable to agree that the

same is true under all conditions, and we feel that the logical course is to recognize that the small hydrant, like the smaller sizes of pipe, has its proper sphere. The 4-in. hydrant should be severely penalized in city practice; but in districts where the pipes are properly small and where the necessity of anything more than a single comparatively small fire stream is practically non-existent, it is believed that no deficiency should be charged on account of the use of the 4-in. hydrant.

The vote under which this committee was established instructed it to report whether or not it was desirable for the association to indorse this or any similar schedule. Your committee is fully in accord with the principle of the schedule under consideration, but does not think it wise or desirable to pass any vote of endorsement at the present time, particularly in view of the tentative character of the schedule and the modification which it is likely to undergo before reaching its final form. No action of the association is therefore recommended at the present time. It is believed, however, that members of the association confronted with problems of this nature will be materially assisted by the schedule, even in its preliminary form.

The report is accompanied by an appendix of proposed standard grading schedules.

Pounding Prevented in 100-Foot Santa Fé Turntable

Special Cast-Steel Track Blocks and Rail Locks Eliminate Pound in Tables Designed for Heaviest Locomotives

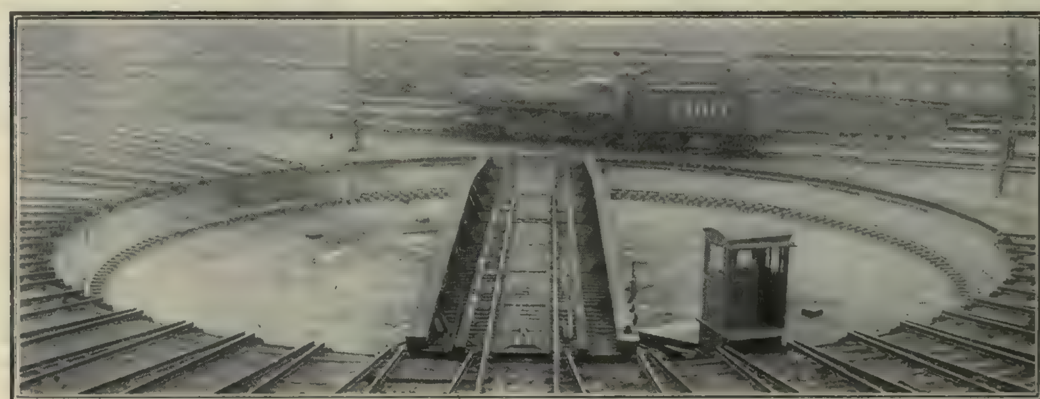
INCREASE in length of turntables required to meet heavy power has emphasized the fact that the pounding at the ends of 75-ft. tables or larger is much more troublesome than for smaller sizes. For tables 75 to 90 ft. in diameter of pit, constructed in the ordinary manner, it costs from $400 to $500 per annum for repairs to the end wheels and center. Turntables having a pit diameter of 100 ft. have recently been designed for the Santa Fé Railway System. As the drop at the ends is more serious than for the 75 and 85-ft. tables, special study was given to the one item of overcoming the pound when engines run on or off.

HEAVIEST TYPE OF ENGINE ON TURNTABLE AT WELLINGTON, KANSAS

The 100-ft. turntable is designed especially for handling prairie Mallet engines, which have a length of about 90 ft. between centers of extreme wheels for the engine and tender coupled. The table itself weighs a little more than 90 tons, while the cast-steel radial blocks on the circle walls for forty-six tracks at Albuquerque, N. M., weigh about 19 tons. For the double prairie Mallet engines with tender loaded the distance from center of forward wheel to center of gravity is 46 ft., and with the tender empty this distance is 39 ft.

At Albuquerque a four-wheel shifting engine is employed around the yard and is used for placing dead engines in the engine house. This shifting engine has about 63,000 lb. on one axle and 45,000 lb. on the other, and, together with the large Pacific-type passenger engine known as the 3500 class, is commonly turned on the table at Albuquerque. While the Mallet engine can be centered approximately on the table when the tender is loaded, the two engines mentioned cannot be centered. This lack of balance has not been found to interfere with the handling of the table, which is operated by an electric motor nominally rated at 20 hp.

The track rails on the table project nearly to the center of the circle wall, where they meet the radial tracks, which are supported by heavy cast-steel radial blocks. The projecting ends of the rails on the table are also supported on these blocks by the use of shoes which are suspended from the bottom flanges of the track rails. When the end wheels in the table are in contact with the top of the circle track these sliding wedges will just fit tight on the top of the radial blocks on the projecting ends of these rails. By this arrangement the locomotives will run on or off the table without any pounding effect. They are operated by a yoke and lever, the details of which are indicated on the accompanying drawing.

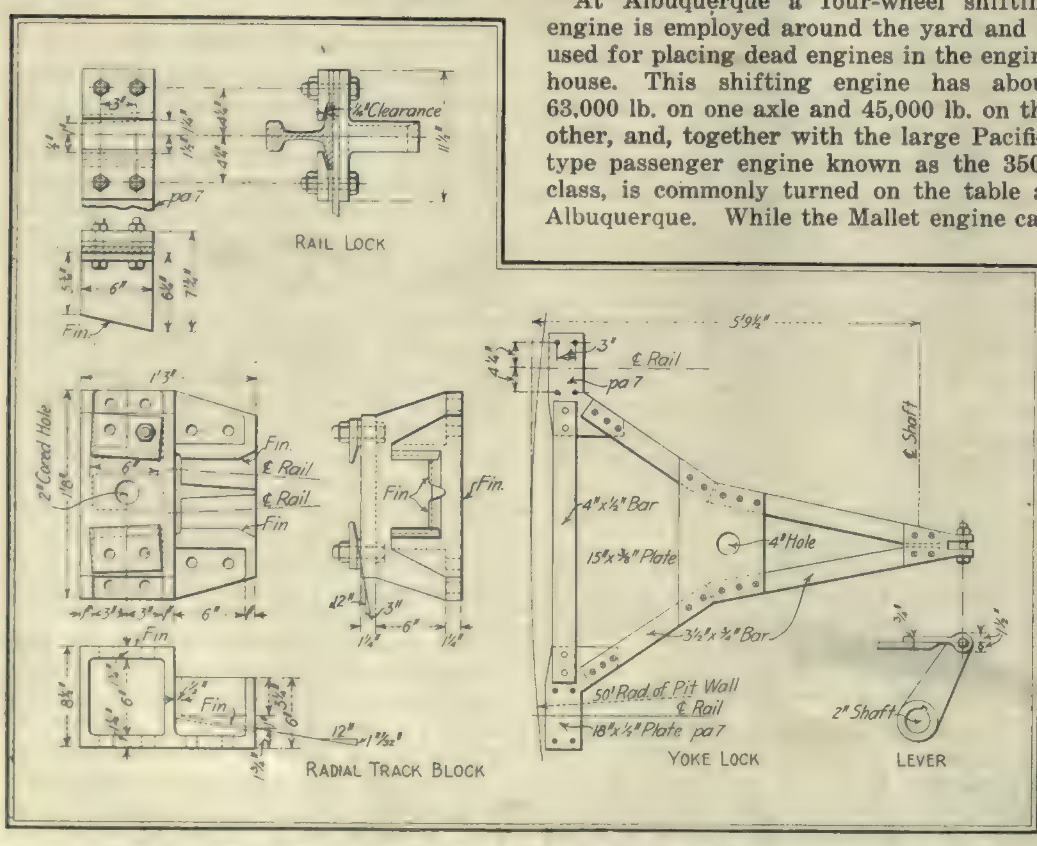


VIEW SHOWING THROUGH-GIRDER FLOOR SYSTEM AND BRACKET STAYS

A counterweight is used on the floorbeam at the motor end so that when the table is empty that end is always down on the pit rail. In order to allow engines to run on the high end, an eccentric or cam was used at the motor end; and to prevent breakage of this eccentric a tripping device was used which released the load on the eccentric when the first wheel of the locomotive passed on the table.

This eccentric and the tripping device were applied to the first table only, but were only used a short time. The other tables were ordered without the tilting device or the tripper, and orders have been issued that the motor end of the table is always to be turned to meet the oncoming load. This arrangement does not cause any appreciable delay in handling power and is found to be more satisfactory.

Heavy end trucks with two 30-in. wheels for each corner are used at each end of the main girders. The Santa Fé standard center designed for 500-ton swinging load, similar to the American Bridge Company's type D center, was combined with the through type of plate girders and steel floor.



DETAILS OF CAST-STEEL TRACK BLOCK AND RAIL LOCKS, SHOWING YOKE

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Pump Boat Washes Cofferdam Fill to Place from Barges

By GEORGE W. McALPIN
Junior Engineer, Ohio River Dam No. 35, New Richmond, Ohio

DECK BARGES were loaded with material and towed to position alongside a pump boat, which discharged on to their decks and washed the material into the river to fill a channel scoured at that point to a depth of 28 ft., so that a cofferdam could be built to inclose the remaining parts of the work at government dam No. 35 on the Ohio River. The method proved successful after the ordinary one of scowing in material excavated by dredge had failed to produce satisfactory results. The barges were towed to position alongside the pump boat at a point the right distance above the line of fill to allow the material washed off to settle into place with the current. An old pump boat, equipped with a 12-in. pump and boiler, was used. The discharge from the pump was first directed at material on the downstream end of the barge, and the latter was slowly dropped downstream until all the material had been washed off. The force of the stream from the pump discharge was sufficient to hold the barge away from the pump boat. The stream was directed to the deck of the barge from the ordinary discharge flume, which, as is usual with these boats, was built over the pump discharge across one end of the barge, at a considerable height above the deck.

Three derrick boats were used to load the barges. These carried an average of 150 cu. yd. of material each. The derrick boats each averaged five barges in 8 hours, thus placing about 2300 cu. yd. of fill a shift. The pump boat was, however, able to wash the material from the barges faster than they could be loaded and towed to position, it requiring only 25 minutes to clean off a barge.

The scheme has proved very successful, as the sand and gravel which composed the material were easily moved by water. The same general method has been used in placing banking alongside cofferdams, the material in this case being washed directly against the cofferdam sheeting. The dam is being built for the United States government by the National Contract Company. L. H. Prell, assistant engineer, is in charge for the government.

Outside Template Used Repeatedly in Building Steel Cofferdams

By F. P. KEMON
Superintendent, Robert Grace Contracting Company, Harrisburg, Pa.

THE OUTSIDE template shown in the photographs was built by the writer, and used repeatedly in setting up and guiding the new steel sheeting for successive cofferdams required in constructing the piers for the Susquehanna River bridge recently completed by the Robert Grace Contracting Company for the Philadelphia & Reading Railroad at Milton, Pa., and described in the Engineering Record for May 20, 1916, page 676.

The new bridge was built parallel to and directly above the old bridge, and great quantities of large riprap stone, placed to protect the old piers, were encountered in the 8 to 15 ft. of soft material that overlay the rock beneath the river bed. This made it difficult to set the steel sheeting to correct line before driving, and obliged the writer to devise the template shown.

This template was an outside frame of timber 6 in. larger all around than the cofferdam bracing itself. The bracing, assembled with the frame of the template, was built on the work trestle and set in place by a 30-ton locomotive crane. The wales of both the bracing and template were made of doubled 6 x 8-in. oak timbers, with lengths of round wood piling as upright supports and 2 x 10-in. yellow-pine cross-braces.

The template not only made it possible to set up and drive the steel sheeting true to line, but furnished a good foundation for working platforms. After all the sheet piling at one pier had been driven the template frame was removed by the crane and used again at the next pier site. One frame was used successively on all of the 20 x 40-ft. cofferdams. Being set plumb, and driven inside a rigid guide frame, the sheeting itself was little warped, and proved unusually easy to pull.

TEMPLATE SHOWN AT LEFT OUTSIDE COFFERDAM BRACING WAS ASSEMBLED WITH BRACING FOR EACH PIER IN TURN ON WORK TRESTLE

Winding Cables on Drive Wheel Converts Tractor Into Hoist

By H. S. CARPENTER
Cobleskill, New York

A TRACTION engine was recently converted into a hoist in connection with some of the writer's work by jacking one wheel off the ground and using it as a cable drum. It was necessary to place a 35-hp. locomotive boiler in a location which required that the boiler be transported across a very wet field which would not hold up the traction engine being used to handle the boiler. The latter was mounted on wide skids, but it was not possible to use a single block and a long line to pull it across the soft ground by operating the tractor in the ordinary manner, because there was no room in which to maneuver. Therefore, the engine was anchored down by clipping a wire line to one drive wheel and to the frame so that it could not turn and jacking up the other wheel until it cleared the ground a couple of inches and could be used for a drum. Using for deadmen a couple of stumps near the intended site of the boiler, tackle was rigged up, the lead line wound around the free wheel of the tractor, and the boiler pulled to place in short order.

How Variety of Sheet-Pile Structures Can Be Made Watertight

SIR: In answer to the question appearing in the Engineering Record of Aug. 19, page 242, under the head, "Asks How Variety of Sheet-Pile Structures Can Be Made Tight," the experience of the writer in building two dams of both Lackawanna and Carnegie steel sheeting may be of use. Both dams, built within the last two years, were constructed with single walls of sheeting. Each was about 4800 sq. ft. in area, and each was built in 15 to 25 ft. of water. Excava-

tion inside the dams extended to a depth of 20 ft. over all, and wells were sunk inside them to a depth of 90 ft.

If second-hand sheeting could be driven at all, it was found practically as good as new. There is no advantage in stretching steel sheeting at joints. Watertightness is produced by side pressure of sheet against sheet in the joints caused by the pressure resulting from the head of water outside the dam.

Steel sheeting joints should never be calked. It is better to use a large pumping plant for the initial pumping out in order to get about 1 ft. difference of head as quickly as possible. After pumping is started, men should go around outside the dam with fine cinders, pouring these outside of and against the steel sheeting. The cinders are carried into the joints by the water. The writer has stopped leaks passing as much water as a 1-in. hose with a single shovelful of cinders. After a foot to 18 in. difference in head between the inside and outside of the dam has been established, 75 per cent of the pumping capacity may usually be dispensed with.

The writer used 6 and 8-in. Nye steam pumps, and prefers direct-acting pumps of this type to centrifugal pumps when the latter are mounted on the sheeting, as it has been his experience that the vibration produced by the centrifugal pumps keeps the sheeting in the neighborhood from becoming tight.

CARL O. JOHNSON,
Assistant Engineer, Department of Public Works.
Chicago, Ill.

Spar Tree for Logging Topped with Dynamite

IN LOGGING by the high-lead system, masts 150 to 200 ft. high are made by using a growing tree from which the small part of the top and the necessary branches are removed. Removing these tops with an axe and saw is likely to prove dangerous, and the Manley-Moore Lumber Company of British Columbia has devised a method of shooting the tops out with dynamite.

After the branches have been removed, a rigger climbs the tree, with a set of irons, to the point where it is necessary to cut off the top. Here the trunk is usually about 12 in. in diameter. The rigger ties a string of dynamite cartridges, fastened end to end like sausages, around the trunk at this point, inserts a blasting cap with about 20 ft. of fuse in one of these sticks, lights the end of the fuse, and is then able to descend to the ground and reach a place of safety before the explosion takes place. The tree top jumps into the air with the explosion, and the trunk is left ready for attaching the rigging for dragging in and loading the logs.

Mixer Mounted on Trucks Paves Street-Railway Tracks

CONCRETE foundations for pavements between street-railway tracks have been laid on several streets in Kansas City, Mo., during the past summer at the rate of 20 cu. yd. an hour by the ½-yd. Foote mixer shown mounted on wheels in the accompanying photograph. The mixer, mounted on small car wheels, backs away from its work, and is supplied with material from piles along the street. A plank platform for the wheelbarrows to discharge from rests on the rails on the charging side of the mixer, opposite the point where concrete is being poured. It is reached by plank runways, the whole arrangement being moved in a few minutes by four men.

MIXER ON TRUCKS BACKS AWAY FROM WORK BETWEEN STREET-CAR TRACKS

The mixer is in charge of John Denman, foreman for the Kansas City Railways Company.

Hitch Motor to Steam Mixer to Cut Running Cost

AN ELECTRIC motor bought at a cost of $65 and installed on a steam mixer of 10 cu. ft. capacity at a further cost of $6.10 saved this entire cost for Ryberg Brothers of Salt Lake City in reduced operating expenses in the first month of its use. Although electric current enough to operate the 10-cu. ft. mixer at the rate of 60 yd. per 8-hour day costs $1.80, as against $1 a day for coal when using the boiler and steam engine with which the mixer was originally equipped, no special attendant was required for the electric motor, and the wages of the engineer formerly employed to fire the boiler and run the steam engine were saved. At Salt Lake City this amounted to $3.50 per day, making the cost of steam operation per 25-day month $112.50, as compared with $45 for electric operation in the same period.

MOTOR RUNS STEAM MIXER AT SAVING

The low cost of installation is explained by the ingenious manner in which the motor was mounted. The old boiler was, of course, removed, but the vertical engine was not. The motor was belted to its flywheel after the piston rod and eccentric had been disconnected from the crankshaft of the engine. The pulley on the motor is 5½ in. in diameter and the engine has a 24-in. flywheel. The motor is mounted on 8 x 8-in. timbers which extend across the bed frame of the mixer so that an 8-ft. belt center is secured.

Extended Use of Motor Vehicles Brings Increase in Road Construction

A recently completed study of roads in Pennsylvania, New Jersey and New York by the U. S. Department of Agriculture shows that in 1914 roads treated with bituminous preparations made up 15.4 per cent of the improved highways in those states, as against 1 per cent in 1909. Approximately 9 per cent of the improved road mileage of the three states is now surfaced with concrete brick and similar materials, while in 1909 roads of that type constituted only 1 per cent of the improved highways. In 1904 neither bituminous nor the other kinds of roads were found in the three states, and untreated macadam and gravel roads predominated. In 1914 the three states named spent $40,864,831 for road improvement. New York appropriated more than $23,000,000; New Jersey, about $7,000,000; Pennsylvania, $10,000,000. In addition, county, town, and township bonds voted in New York totaled nearly $12,000,000; in New Jersey, $14,000,000; in Pennsylvania, $27,500,000. Altogether the road mileage in the three Middle Atlantic states on Jan. 1, 1915, was 185,770.84, of which the approximate state mileages were: New York, 79,000; New Jersey, 15,000, and Pennsylvania, 91,500. This is exclusive of practically all streets in incorporated cities and towns.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

New England Waterworks Men Hear Report

Service Pipes, Leakage, Standardized Meters and Insurance Rates Discussed at Annual Convention in Portland Last Week

Following the traditions of former years, the thirty-fifth annual convention of the New England Waterworks Association, held at City Hall, Portland, Me., Sept. 13, 14 and 15, was notable for the reports of its technical committees. This year's contributions were of a type which made a direct appeal to waterworks superintendents, for they dealt not with the fine-spun theories understandable only by a small group of specialists, but with such homely subjects as leakage from pipe joints, service pipes, standardization of meter specifications and fire-insurance rates—all making a direct appeal to the rank and file of waterworks men. In the technical papers, too, there was reflected a desire to serve the man whose job is to run the water department of his own town rather than design large-scale new work for some other locality. In addition to Superintendents' Day, a familiar feature of former meetings, an innovation this year was the allotment of an entire session to a discussion of waterworks accounting. This move, apparently, was made to impress upon the members the necessity for business methods of cost-keeping and general administration, as well as skill in the handling of the purely engineering features of water-department work.

Program Well Arranged

The program, on the whole, was well arranged and was carried out practically as scheduled—an unusual occurrence at any engineering convention. There was no mass of unfinished business piled up at the close of the final session. The committee had very shrewdly gaged the time available for the technical and business sessions, as well as the entertainment features, and had adjusted the program accordingly, instead of merely listing an impossible number of papers and committee reports according to a devil-take-the-hindmost policy. The only hitch in the schedule, in the opinion of many of the members, was the unfortunate curtailment of discussion following Frank A. Barbour's incisive presentment of water waste through pipe-joint leakage, a subject which, according to the data offered, seemed to be of the most vital importance to waterworks departments throughout the country.

Through the courtesy of the municipal administration Portland's new city hall was placed at the disposal of the association for its convention meetings and the exhibit of waterworks equipment and appliances. While the facilities there were all that could be desired, the site was at some distance from the several hotels at which the delegates stayed.

The secretary's figures indicate an attendance of about 600 members, associate members and guests—figures which rival, if they do not actually surpass, those of last year's convention held in New York City. Of the 600 registered about 200 were active members. Secretary Willard Kent announced the election of 52 additional members at last week's convention.

Report on Service Pipe

After the customary addresses of welcome, a response by President William F. Sullivan, and a short speech by Rear-Admiral Robert E. Peary, discoverer of the North Pole, the convention opened its technical sessions with the report of the committee on materials and methods used in making service connections, presented by William S. Johnson, chairman. This report, reproduced at length on page 387, was based upon replies to questions received from more than 300 water departments. The results showed that the use of plain wrought-iron or steel for service pipe is becoming rare, while nearly one-half of the places covered by the report use galvanized wrought-iron or steel. Lead or lead-lined pipe also has its advocates, and a number of waterworks men believe that cement-lined pipe gives the best results. The committee is of the opinion that there are very few cases where the use of either wrought-iron or steel pipes, without some protective coating, is justifiable. Galvanized pipe, according to the report, appears to be the cheapest practicable material for services where the class of street surfacing is not such as to make the renewal of the services a matter of great expense. Lead pipe was characterized as the most satisfactory material to use, but its cost is high and its use is accompanied by the possibility of lead poisoning. Cement-lined pipes, if properly constructed, are said to make ideal service pipes so far as the interior of the pipe is concerned. Trouble with cement-lined services, the report stated, occur most frequently from exterior corrosion.

Choice of Pipe Governed by Conditions

In the discussion of the report Desmond Fitzgerald, consulting engineer, of Boston, said that with lead service pipe a water is often of a character as to produce a slight incrustation on the interior of the line and thus eliminate the possibility of lead poisoning. Cement-lined pipe, he has found, has given excellent service, but the chief objection to it is that it cannot be bent. W. C. Hawley of Wilkinsburg, Pa., pointed out that no general rule can be adopted for the selection of material for service pipe. This question, he stated, depends upon the chemical character of each individual water supply. In Auburn, N. Y., according to a statement by J. Walter Ackerman, flange connections are employed on all service pipe lines and have been found satisfactory during eight years of use. No leaks have developed, while with wiped joints frequent leaks were detected.

A rather animated discussion of the relative merits of wrought iron and steel for service pipes was participated in by Dr. F. N. Speller, metallurgical engineer of the National Tube Company, and James Aston, representing the A. M. Byers Company, manufacturer of wrought-iron pipe. Dr. Speller pointed out that recent improvements had been made in protecting the exterior of steel pipe by means of bituminous wrapped coatings, which, he said, add about 1 cent per foot per inch of diameter. There is, according to Dr. Speller, little difference between wrought iron and steel insofar as the life of the metal, under waterworks conditions, is concerned. He asked the members who had a preference for wrought-iron pipe to consider whether the evidence available justified them in their selection. Mr. Aston championed wrought-iron pipe, saying that if it did not possess intrinsic merits it would never have gained the popularity which it now enjoys among waterworks men. He described the process of manufacture of this material, explaining how filaments of slag in the metal formed a network of fine lines which resisted corrosion. Robert Spurr Weston, consulting engineer, of Boston, closed the discussion with the statement that the decision in favor of one metal or another must be governed by the character of the water to be handled. Present practice, he said, favors the use of

(*Continued on page* 394)

War Department Approves Drainage Plans

First Stage of Work to Reclaim Lands in St. Johns Valley, Florida, Concluded When Permit to Begin Work Is Granted

Plans for draining about 265,000 acres of land in the St. Johns valley drainage district, on the east coast of Florida, were recently approved by the U. S. War Department. The action ends a long dispute between the department and property owners and marks the first step toward beginning work on the project, which involves an expenditure of about $3,000,000.

250 Miles of Canals

The plans prepared by Isham Randolph, consulting engineer, of Chicago, provide for draining the flood district ino the salt waters of the Indian River. According to present information three main canals are to be projected from the St. Johns River to the Indian River, each to be about 14 miles long, 125 ft. wide and from 14 to 35 ft. deep. The total length of canals and laterals is given as approximately 250 miles. It is said that work will not be started for six or eight months and the job will require about two years for completion.

This information was supplied by C. E. Henderson, city engineer of St. Augustine, Fla.

Dam in Bohemia Fails—300 Bodies Reported Recovered from Flood

The failure of a dam this week near Gablenz, Bohemia, is said to have caused more than 300 deaths and heavy property losses. Several villages are reported inundated and, while no bridges have failed, many are said to be in danger of collapse. The cause of the accident is apparently not known.

The structure that failed is probably one of the old dams built several hundred years ago, as the newer structures are of excellent design and well constructed. The dams in Silesia are in a mountainous district. They are used only to safeguard life and property and to make the streams navigable.

Illinois Central Terminal Problem Discussed at Chicago Conference

Tentative plans to show what is needed in the way of terminal facilities at the Twelfth Street station were discussed at a meeting, held Sept. 20, of the Chicago Railways Terminal Commission and officials of the Illinois Central Railroad. The meeting was a preliminary one and the plans are along general lines only. The conference was for the purpose of enabling the city to draw up an ordinance which will confirm the agreement between the South Park Board and the railroad company, allow the city to go ahead with the work of improving the lake front and permit the railroad company to proceed with the assurance that they will not be held up by the city. A double-deck track system in the layout indicates partial electrification.

Building Collapses in Toledo, Ohio

Many persons narrowly missed death Sept. 13 when a four-story brick building on Summit Street, Toledo, Ohio, collapsed. The walls tumbled into the crowded street without warning. Nobody was killed or seriously hurt. The failure is said to have been caused by removal of supports used while the structure was being remodeled.

Give Dinner in Honor of Alfred Craven on His Seventieth Birthday

On Sept. 16 Alfred Craven, chief engineer of the Public Service Commission, Second District, New York, was 70 years old. One hundred of his friends, both engineering and lay, entertained him at dinner at the Harvard Club, New York City, on the evening of Sept. 15. Many of those present had known Mr. Craven for forty or fifty years, and some of them had been boyhood friends. Jules Breuchaud presided and William Barclay Parsons made a brief address, presenting to the guest of honor a silver tea service.

Springfield (Mass.) Garbage Plant in Bankruptcy

The Springfield (Mass.) Merg Reduction Company has filed a petition in bankruptcy at Boston following unsuccessful efforts to operate the garbage-reduction plant at Springfield without the dissemination of odors. The plant has been shut down since July 1 as the result of an injunction issued on behalf of neighboring residents. The garbage division of the city streets and engineering department has been burying about 50 tons of offal daily in the vicinity of the plant and elsewhere. It is uncertain whether the plant will be taken over by the city, as sanitary experts have severely criticised its location. As garbage, coal and supplies must be hauled 2 miles up hill to reach the plant, a downhill site with railroad connections is favored.

Institute $100,000 Suit Against Staten Island (N. Y.) in Garbage Fight

As the result of opposition to erecting on Staten Island a garbage-disposal plant for New York City, suit has been filed by James E. Gaffney, president of the Metropolitan By-Products Company, against officials of the Borough of Richmond. It is alleged by Mr. Gaffney that his company has lost at least $100,000 by the delay in building the plant caused by what he terms "an unlawful conspiracy" to prevent the location of the works on the island.

National Safety Council Meet in Detroit, Oct. 17-20

The annual meeting and congress of the National Safety Council took place in Detroit, Oct. 17-20. A 40-page program contains the names of 140 speakers. The development of the work has indicated the need for intensive study of the problems of various industries, so that the main feature of the meeting this year was sectional conferences. For instance, the electric light and gas industry members assembled in the public utilities section; the foundry members in the foundry section, and the cement members in the cement section. A new feature of the congress this year was a mammoth safety exhibit, where the latest style types of safety devices were shown.

Amend Reclamation Extension Act

The reclamation extension act of Aug. 13, 1914, was recently amended to allow further time to accept its terms, which permit payments of water charges to be made in twenty instead of ten years. Those who failed to accept the terms of the act of 1914 and still desire to take advantage of its provisions should write to the manager of the project in which their lands are situated for a circular of instructions.

Smoke-Prevention Convention Sept. 26

The eleventh annual convention of the National Smoke Prevention Association will be held Sept. 26 to 29 at the Planters Hotel in St. Louis.

New England Waterworks Men Hear Committee Reports

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cement-lined, galvanized or lead pipe for services. Corrosion, Mr. Aston explained, is the result of acid in the raw water and can be corrected by the addition of lime.

Pipe Joint Leakage

Frank A. Barbour, consulting engineer, of Boston, chairman of the association's committee on leakage from pipe joints, presented a statement, which is published in full on page 385, and commented upon in an editorial on page 369. Although the statement contained startling figures as to the amount of municipal water supplies ordinarily unaccounted for, presumably because of pipe leakage, no opportunity for the discussion of this subject was afforded, because the remaining time available at this session had to be devoted to announcements of trips to a local amusement park, a tea for the ladies and lantern slides of pipe breaks. Charles W. Sherman, however, considered Mr. Barbour's statement important enough to warrant publication as a separate pamphlet, to be distributed to every member of the association. He offered a resolution to this effect and it was carried unanimously.

The committee on the Dexter Brackett memorial submitted its final report accompanied by a medal designed by Theodore Spicer-Simson, which is to be awarded yearly for the most meritorious paper presented to the association. For the memorial the committee received in donations the sum of $1,281.50 from 101 contributors. After paying all its expenses the committee had remaining a sum of $197.34, which was turned over to the association. This sum, kept as a fund, will produce an income approximately sufficient to pay the annual cost of the medal, case and engraving.

Standard Meter Specifications

The reading of the committee report on grading waterworks with reference to their value for fire protection (see page 389) was followed by a statement from Robert J. Thomas suggesting that the association appoint a committee to prepare standard specifications for water meters. In this work Mr. Thomas sees a great opportunity for the association to be of service, for the majority of present specifications, he said, contain simply a few broad requirements which all meters can fulfill. Mr. Thomas' remarks led to the passage of a resolution creating a committee to consider and report on the feasibility of a standard specification for water meters and on the advisability of attempting the collection of test and repair records in such a way as to determine the relative durability and continued accuracy of meters.

Of the technical papers several dealt with Portland's water-supply system and with waterworks-administration questions in Maine and neighboring states. Judge Cleaves, chairman of the Public Utilities Commission of Maine, explained the benefits to be derived by a state body with powers to supervise matters affecting public health, such as water-supply and sewerage systems. Breaks in main pipes formed the subject of a paper by S. E. Killam of the Metropolitan Waterworks, Boston, while George H. Finneran, general foreman of the Boston Water Service, discussed emergency trucks and repair gangs. An abstract of this paper appears on page 386.

Another of the technical papers dealt with the application of coagulants intermittently in excess amounts at Springfield, Mass. This contribution was by Elbert E. Lochridge, chief engineer of the Springfield Water Department. Discussions by Morris Knowles and Weston E. Fuller brought out the point that the constant watching of filter plant will disclose methods of better operation and, at the same time, reduce costs.

According to a statement by Edward S. Cole, the American and the New England Waterworks associations will co-operate in producing a standard form for reporting water consumption statistics.

The morning session on Sept. 15 was designated as Water Registrars' Session, and was devoted to papers on accounting by Albert L. Sawyer of Haverhill, Mass., A. W. F. Brown of Fitchburg, Mass., and E. L. Pride, public accountant, of Boston.

The entertainment features of the program included boat and automobile trips to Casco Bay and Sebago Lake and a recital on the great City Hall organ, a gift to Portland from one of her distinguished sons, Cyrus H. K. Curtis, the Philadelphia publisher. A vaudeville show by members of the Portland Water District also was scheduled for the last day of the meeting.

The general arrangements for the convention were in the hands of William S. Johnson, consulting engineer, of Boston, while James W. Graham of Portland acted as secretary to the committee and had charge of many of the local features of the meeting. William F. Woodburn was chairman of the committee on exhibits.

Following its custom of last year, the Engineering Record, during the three days' session, published *The New England Waterworks Daily Record*, a four-page illustrated daily paper of convention news.

Engineering Society Activities

The Philadelphia Association of Members of the American Society of Civil Engineers will hold its annual meeting Oct. 2 at the Philadelphia Engineers' Club. F. Herbert Snow, chief engineer of the Public Service Commission of Pennsylvania, will talk on the administration of the Pennsylvania Public Service Company law.

The Detroit Engineering Society, at its Oct. 6 meeting, will listen to an illustrated lecture by C. W. Hubbel, consulting engineer, on "Sewage Disposal and Contamination of the Detroit River."

The Albany Society of Civil Engineers will hold its first meeting Sept. 26 in Keeler's Maiden Lane Hotel. Henry G. Allen, city engineer of Syracuse and consulting engineer to the state engineer, will deliver an address on engineering and public works of the city of Syracuse.

The Municipal Engineers of the City of New York will hold their next meeting Sept. 27 in the Engineering Societies Building. Charles R. Ward, chief engineer of the topographical bureau of the Borough of Brooklyn, will present a paper entitled "Improvement and Protection of Coney Island Shore and Construction of a Proposed Boardwalk."

The League of Washington Municipalities will hold its annual convention in Everett Oct. 12, 13 and 14. The principal topic to be discussed is city planning. Among the speakers are A. H. Dimock, city engineer of Seattle; R. H. Thomson, former city engineer of Seattle, and now city councilman; Paul P. Whitham, former chief engineer of the Port of Seattle, and Dr. J. S. McBride, Seattle's health inspector.

The Illinois State Association of Highway Commissioners and Town Clerks met Sept. 15 and 16 at Peoria. Prof. F. H. Newell called attention to the facilities offered by the state university in original research in road materials and construction. A. H. Hunter, division engineer, State Highway Department, stated that 95 per cent of the 97,000 miles of highways were earth roads, for which only $40 to $50 per mile was spent. Prof. C. C. Wiley spoke on "Bridge Construction." Resolutions calling for more compensation for commissioners and town clerks, who are often paid less than day laborers, were adopted.

What Engineers and Contractors Are Doing

OLIVER W. CONNET, whose resignation from the Baltimore Sewerage Commission was noted in a recent issue, has been appointed valuation engineer for the Western Maryland Railway, with office in the Continental Building, Baltimore. Mr. Connet studied engineering at the University of Illinois from 1883 to 1886, following which he joined the engineering department of the Atchison, Topeka & Santa Fé Railway as instrumentman. He had attained the grade of resident engineer at the time of his resignation in 1888 to engage in making surveys on the Mississippi River. Two years later, after a brief experience with the Fort Worth & Rio Grande Railroad, Mr. Connet was made assistant engineer in the sewer department of the city of St. Louis. The following year found him once more on Mississippi River surveys and in 1892 he became assistant engineer on the U. S. Portage Lake and Lake Superior Canals in Michigan. He went to Baltimore the next year to take charge of a topographical survey of that city, which required more than two years for its completion. He took up private practice in 1895, but was made assistant city engineer the following year. During the next ten years he directed about $1,000,000 worth of paving and bridge work, and as division engineer for the Baltimore Sewerage Commission, to which position he was appointed in 1906, he had charge of contracts for the expenditure of nearly $6,000,000.

E. RICHARD, formerly with the Colorado Fuel & Iron Company, has joined the engineering department of the H. Koppers Company at Pueblo, Col. Mr. Richard was until recently employed on the Panama Canal on the construction of concrete blocks for the Atlantic breakwater.

EDWARD H. DEETS, who has recently been associated with C. J. Maddox in the preparation of a real estate atlas for a portion of Montgomery County, Maryland, is now in charge of some road construction for that county as superintendent and resident engineer.

W. F. B. RUBIDGE has resigned as resident engineer on the Rosedale section of the Bloor Street viaduct, Toronto, for the Dominion Bridge Company, Limited. He will now represent George F. Hardy, consulting engineer, of New York City, on the construction of the dam and power house for the Abitibi Power and Paper Company, Limited, at Twin Falls on the Abitibi River.

HAROLD E. KETCHUM, who was superintendent for the Hunkin-Conkey Construction Company on the Detroit-Superior bridge, Cleveland, has been made vice-president of the Graff Construction Company of Seattle.

W. V. BANISTER, superintendent of construction for the Stone & Webster Engineering Corporation, will have charge of erecting the new buildings for the B. F. Goodrich Company at Akron, Ohio.

W. MONTGOMERY MITCHELL, who for the past year has been employed by the engineering department of the Packard Motor Company, has joined the engineering department of the city of Flint, Mich., as assistant superintendent of waterworks. After graduation from the University of Michigan in 1911 Mr. Mitchell entered the employ of the engineering department of the Detroit Board of Water Commissioners. He resigned in 1915 to go to the Packard Motor Company.

C. R. CHEVALIER has resigned as division engineer for the Boston & Maine Railroad to become roadmaster of the Portland (Me.) Terminal Company.

JAMES W. BEARDSLEY, chief engineer of the Porto Rican Irrigation Service since 1910, has resigned. During the last six years he has had charge of building several earth and reinforced-concrete dams, canals, tunnels and other construction work for the irrigation service. He was formerly employed by the J. G. White Engineering Corporation on investigations of irrigation projects, previous to which he was for seven years engaged in engineering work in the Philippine Islands as chief of the bureau of engineering and later as director of public works.

JOHN ALBERT HOLMES has been made resident engineer for the J. G. White Engineering Corporation on the three earth dams to be built for the Southern Power Company near Bridgewater, N. C. Mr. Holmes' experience includes seven years as division engineer on the construction of the Charles River dam at Boston, and several years as resident engineer for the Power Construction Company on the large earth dam at Somerset, Vt. He has also had considerable experience on concrete-foundation work.

JOHN L. HALL, who has represented Purdy & Henderson, civil engineers of Seattle and New York City, during the last seven years as second vice-president in charge of the Pacific Coast territory, has acquired the company's interest in the Seattle branch. He will continue the practice in his own name at the present offices in the Henry Building. Mr. Hall will remain on the board of directors of the company with which he has been associated for the past 20 years.

CHARLES P. JAEGER has resigned as assistant water commissioner of the city of Cleveland. He has been acting commissioner since March 1.

GEORGE B. DUSINBERRE, of the consulting firm of R. S. Mueller & Company, Cleveland, will Oct. 1 become water commissioner of that city.

F. B. H. PAINE, WILLIAM MCCLELLAN and HORACE T. CAMPION have formed the engineering firm of Paine, McClellan & Campion, with offices in New York City and Philadelphia. Previous to opening consulting offices in New York City in 1911 Mr. Paine was general manager of construction for the Ontario Power Company for about six years. That was preceded by long service with the Westinghouse Company, whose laboratories he entered in 1886 as a student. From 1891 to 1893 he was with the Edison General Electric Company, returning to the Westinghouse organization and rising to the position of New England manager before his resignation to go to the Ontario Power Company. Mr. Campion's first four years of engineering work were spent in architectural and engineering offices. In 1893 he entered the electric railway field as draftsman for the People's Traction Company of Philadelphia. Two years later he went to the Union Traction Company of that city and in 1899 was made assistant engineer for the Philadelphia Rapid Transit Company. About four years later he was made assistant engineer for the Reinforced Concrete Construction Company of New York City, having charge of all work near Philadelphia. As a member of the John W. Allison Company from 1905 to 1907 he gained further experience in reinforced-concrete work. Since 1907 he has practised consulting engineering as a member of the Campion-McClellan Company. A biography of Mr. McClellan appeared in these pages of the Sept. 2 issue, at the time of his appointment as director of the Wharton School of Finance.

HENRY WELLES DURHAM, engineer of Bergen County, New Jersey, who has been home on a 60-day leave of absence, has returned to the border.

RAY L. JAEGER has resigned as inspector in the U. S. engineer's office at Grand Rapids, Mich., to join the Stone & Webster organization. He is at present employed as draftsman on work for the Mississippi River Power Company at Keokuk, Iowa. Mr. Jaeger was graduated from the University of Iowa in 1915, after which he entered the U. S. engineer's office at Grand Rapids.

R. L. TEMPLIN, who has for the last few months been in the bridge office of the Kansas City Terminal Railway, has returned to the University of Illinois to finish a research fellowship in theoretical and applied mechanics.

Y. D. VESELY, a recent graduate of the University of Iowa, is employed as transitman for the first and second districts of the Mississippi River Commission. His headquarters are in Memphis, Tenn.

B. V. SOMMERVILLE has been promoted from the position of principal assistant engineer to fill the recently-created position of resident engineer of the Pennsylvania Lines West of Pittsburgh, with office at Detroit. Mr. Sommerville entered the service of the Pennsylvania Railroad after graduation from Lafayette College in 1885. Since then he has risen from rodman to the position he now holds.

S. D. MOSES has been made resident engineer for the Southern Railway, with headquarters at Spartanburg, S. C. He succeeds W. G. Wallis, who resigned recently.

THE SUBSTRUCTURE COMPANY is the name of a new engineering and contracting firm organized by Charles Scott Landers, Reuben Davis and Alan M. Ferebee. The office is at 115 Broadway, New York City.

Obituary Notes

DR. ENRIQUE MUNEZ, secretary of sanitation for the Republic of Cuba, died Sept. 15 in New York City.

FRANK LEMUEL CLAPP, consulting engineer, of Boston, died recently at Dorchester, Mass. He was born in Boston and was graduated from the Massachusetts Agricultural College in 1896. For five years thereafter he was with the distribution department of the Metropolitan Water Board of Boston, resigning in 1901 to join the engineering department of Waterbury, Conn. After about five years in Waterbury Mr. Clapp went to New York City as assistant to the division engineer in the Board of Water Supply. He was later given charge of the Hudson River crossing of the Catskill aqueduct. He opened consulting offices in 1914 and since March, 1915, had been associated with Fay, Spofford & Thorndike, consulting engineers, of Boston.

PROF. F. D. SHERMAN, head of the department of graphics at Columbia University since 1904, died Sept. 19 in New York City at the age of 56. Professor Sherman was regarded as one of the leading mathematicians of the United States.

Civil Service Examinations

New York City—Applications for assistant electrical engineer will be received until Sept. 28 at room 1400 Municipal Building. Salary $2,280 to $3,180.

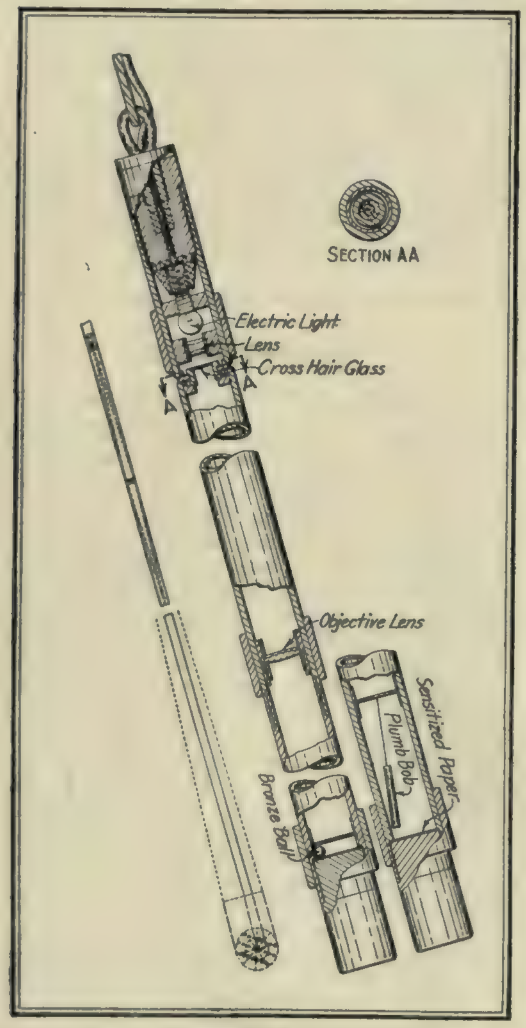
Illinois—Examinations will be held Oct. 7 for junior highway engineer; salary, $75 to $120 a month. Particulars may be obtained from the civil service commission at Springfield.

Examinations Previously Announced

Date		See Eng. Record
Sept. 30.	Assistant engineer and structural engineer, New York	Sept. 16
Oct. 3.	U. S. senior highway bridge engineer	Sept. 16
Oct. 4-5.	U. S. assistant engineer	Sept. 16
Oct. 4.	U. S. highway bridge engineer, civil engineer, and structural engineer	Sept. 16
Oct. 11.	U. S. junior civil engineer	Sept. 16

New Photographic Device Determines Paths of Deep Borings

In all deep diamond-drill borings the drill hole deviates considerably from its starting direction, and it is generally desirable to obtain a survey of the hole. The device here shown is the invention of Charles B. Galvin, of Cornwall-on-Hudson, N. Y., formerly assistant engineer on New York City's Catskill aqueduct. Its characteristic features are the formation and recording of an optical line of collimation, tangent to the curving axis of the hole, by the projection on to a disk of sensitized paper of the image of a cross-hair member. The vertical and horizontal directions are established on the photographic print by means of a gravity member—that is, a ball which is free to roll to the lowest point immediately in front of the sensitized paper, or a suspended bob. A diameter is drawn through the print of the center of ball or axis

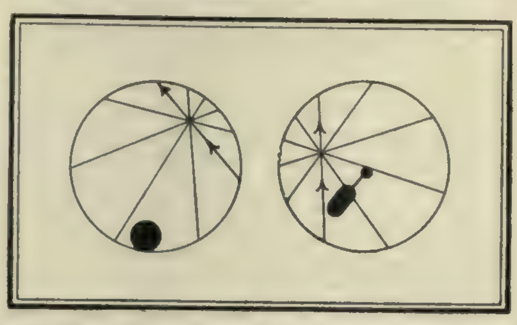


SURVEY OUTFIT FOR DRILL HOLES

of bob and another at right angles to this, to which the lateral and vertical deviations are referred. The amount and direction of deviation are thereby indicated graphically in the manner of co-ordinates.

The function of the instrument, therefore, may be said to be of the nature of a recording transit. A source of light, which may be a 1 or 2-candlepower battery lamp, current for which is supplied from the surface by a cable, is situated in the focus of the condenser in the manner shown. An efficient illumination of the cross-hair glass, which is placed immediately in front of the condenser, is thus obtained, and a well-defined image of the cross-hairs is projected on the disk of sensitized photographic paper at the other end of the tube by means of the objective lens, which is interposed at the proper focal distance between the cross-hairs and the paper. The distance from the cross-hairs to the objective would usually be from 2½ to 4 ft., and from objective to paper from 12 to 30 ft., according to the curvature of the hole.

The cross-hairs consist of lines etched on



PRINTS FROM DRILL-HOLE APPARATUS—BALL USED AT LEFT AND PLUMB BOB AT RIGHT

clear glass, and are so arranged geometrically that their center point can be plotted even though it be off the disk. The pointer, or parallel hairs, are used only to orient the instrument when taking the initial reading in holes that are begun vertically, as all other holes have a known initial azimuth.

A small quantity of flexible collodion applied to the joints when making them up is said to afford an excellent and convenient protection against leakage of water into the hole. Interchangeable collars are fitted over the outside of the tube to provide for holes of different diameters.

It is claimed that the instrument is adapted for use in inclined holes as well as vertical ones, and for holes of small diameter; that it is capable of accurate readings because the methods by which the plottings are derived provide good geometrical leverage; that it is independent of magnetic influences; that it holds its adjustment well and, as a whole, is decidedly rugged; that it is well adapted to being lowered into the hole on a cable, except when there is a great pressure of water in the hole, or in holes that are nearly horizontal, or pointing upward. For such cases the form is modified. The electric battery is then placed within the tube, together with an automatic circuit make-and-break device, which renders the instrument self-contained, and the instrument is then screwed to the drill rods.

Elevated Tank Shaped Like Flour Bag

A unique water tank symbolizing the business of the Campbell Flour Mills Company, Limited, was recently built at Toronto, Ont. The company's flour mills were recently equipped with an automatic sprinkler system to provide fire protection and reduce insurance rates. The tank is used for the storage of water necessary to operate the sprinkler equipment. The prominent position and great height of the structure render it peculiarly

UNIQUE TANK ADVERTISES COMPANY'S BUSINESS

effective for advertising purposes, and the company has taken advantage of this fact in having the tank built as a replica of a bag of flour. It is built entirely of steel, painted and lettered to represent exactly the sack in which the company's product is marketed.

The tank holds 40,000 gal. of water. Its total height is 152 ft. above foundations. The tank itself is 37 ft. deep and 18 ft. wide, being oval in the cross-section to correspond to the shape of a flour sack. The weight supported is more than 200 tons. The work was designed and executed by the Canadian Chicago Bridge & Iron Company, of Bridgeburg, Ont., which makes a specialty of this class of construction.

New Toggle Bolt's Holding Power Equal to Strength of Bolt

A toggle bolt entirely automatic in its operation and said to have a holding power equal to the strength of the bolt itself has been placed on the market by the U. S. Expansion Bolt Company, New York City. A spring inside the toggle head (see illustrations) automatically opens the wings as soon as they pass through the hole. The sharp arrow points

NEW TOGGLE WITH ROUND AND FLAT-HEAD BOLTS. WINGS SHOWN OPEN AND CLOSED

grip the inner wall surface, insure instant bearing and prevent turning.

When the bolt threads its way through the trunnion nut and the wings are opened and in place, the inner edges of the wings bear directly on threads of the bolt, providing a positive "lock-nut" effect, which prevents loosening under vibration. The arrow toggles are especially adapted for work in shallow holes, as the toggle wings are only 1 in. long. Arrow toggles, it is claimed, will hold in corners with but a single wing open. Each wing bears individually upon threads of the bolt, which automatically adjusts and equalizes any irregularities on the inner wall surface.

John V. Beekman Is Dead

John V. Beekman, for many years connected with the Lidgerwood Manufacturing Company, died Sept. 11 at his home in Plainfield, N. J. Mr. Beekman was born in 1842 at Somerville, N. J. He later engaged in the manufacture of rotary engines and pumps, following which he became a member of the firm of John A. Lighthall-Beekman & Company, New York City. The company was absorbed by the Lidgerwood Company in 1873, at which time Mr. Beekman took charge of the works. For the last ten years he had not taken an active part in business.

New York Lumber Office Has Good Facilities for Contractors

The Pearson & Ludascher Lumber Company, of Philadelphia, has opened a New York office at 30 Church Street in charge of S. C. Stailey, formerly manager of the Trexler Lumber Company. Mr. Stailey claims that he has exceptionally good facilities for handling contractors' business and points to his company's milling facilities as a good indication of quick service.

Engineering Record

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What Parts Wear Out First?

WE COMMEND to manufacturers of engineering and construction equipment the suggestion made by Major Fries in the letter on page 419 of this issue. Only he who has been far removed from a base of supplies can realize the feeling that comes over one when a part breaks that means a delay of anywhere from five to fifteen days in the construction of an important project. Moreover, Major Fries' case is not an isolated one. Construction engineers and contractors all over the far West and on the Coast are in a similar position. Even in the East breakage means several days' delay. "Service" is one of the slogans of all up-to-date manufacturers, and we therefore have no doubt that there will be ready response to Major Fries' suggestion.

Brick-Road Demonstration

NEXT WEEK the National Paving Brick Manufacturers' Association will meet in Terre Haute, Ind., and, after discussing various features of brick pavements, will go to Paris, Ill., to inspect the monolithic roads which have attracted so much attention. The description in this issue of the monolithic roads which are being built as part of the Vermilion County highway system is, therefore, opportune. The article goes into each detail of the work and gives information that will be welcomed by all engineers and contractors who are using or contemplate using this type of construction. The monolithic brick pavement has such intrinsic merits and has appealed so strongly to highway engineers that it is certain before long to become the exclusive method of brick-road building. For that reason the holding of a demonstration at Paris was a particularly happy thought. Much good should come of it.

Picking Water Supplies

ONCE MORE Sacramento, Cal., has been given a report on its water supply and told again that the best thing for it to do is to take the water which flows past its very doorstep. Filtered and disinfected it is the most acceptable water the consumers can get. The city is advised in a 660-page report not to flirt with alluring mountain supplies which will cost many times the more prosaic local supply. Years ago before filtration had reached anywhere near its present certainty of purifying a turbid stream, when the first New Orleans rapid-filter fiasco was still green in the mind of the sanitary engineer, Dr. Rudolph Hering recommended a ground-water supply for Sacramento. Ever since then the well-water enthusiasts in that town, forgetting that New Orleans has solved the problem of converting a turbid river water into a sparkling, bacteria-free supply, have felt positive there was an inexhaustible supply just below the surface. The scientific investigations outlined in the recent report certainly give the ground-water proposition all the credit it is entitled to, but even then the quantity available would only supply a population of 110,000. No enterprising California city of 67,000 people, as advantageously situated as Sacramento, in the heart of such an agricultural empire as the Sacramento and San Joaquin valleys, will admit that its future population will grow less rapidly than the average of the twenty-one other cities used by the engineers for comparison. By that comparison Sacramento would need the 30,000,000 gal. in 1928. The mountain supplies, the engineers found, were practically beyond the financial bonding ability of the city, and the possible incidental power development was of problematical value. The citizens of Sacramento will do well to look at the report carefully and not insist upon going far afield for a new and badly needed supply.

Inventorying Railroad Terminals

OF ALL PARTS of the physical plant of the railroad probably the terminals present the most difficult problems for the valuation engineer, and of all terminals probably the most complex are in Chicago, the world's greatest railroad center. Hence railroad valuation men should be interested in the account on page 410 of the valuation of the Rock Island terminal in that city. This is believed to be the first large terminal to be attacked in the federal valuation of the railroads, and it is interesting that the government has entrusted to the railroad the inventorying of the physical plant. And the move is believed by this journal to have been a very wise one on the part of the Division of Valuation. However competent and painstaking the government's staff might be, the railroad itself is bound to have a far better chance of getting a complete inventory by doing the work itself. The present visible plant tells only part of the story of reproduction cost, and less of original cost. If all of the hidden items are to be found at all, and all of the construction and reconstruction programs are to be traced through, it can be accomplished only by having all departments of the railroad on the alert to supply any kind of helpful information. Much of this is in the form of personal recollection. Smith, of the valuation department, who has been with the road twenty years, may not know how a certain piece of work was done twenty-five years ago, but he may remember that Burke, the supervisor, and Finnegan, the old yardmaster, were there, and by quizzing them he may be able to piece together the construction story. No outsider would know where to go for the data, and neither Burke nor Finnegan would be likely to realize that his knowledge was sought. With such complications as are found at the Forty-seventh street shops, at the Sixteenth Street crossing and in fact all over the terminal zone all of the conceivable sources of information are none too many. The Engineering Record is glad, therefore, that the Division of Valuation has seemingly appreciated the situation and has not attempted the near impossible.

A Federal Precedent

AS THESE LINES are being written New York City is facing the most sweeping strike threat ever made against a municipality in this country. In order to force the subway and elevated systems to cancel their agreements with their men and thus force the latter into the Amalgamated Association of Street and Electric Railway Employees, the Conference of Federated Unions has called upon all union labor in New York City to cease work. Should all obey, approximately three-quarters of a million workers would be affected. It is not necessary here to go into the details of the controversy. The men are clearly in the wrong. Public opinion is against them, and yet they attempt to bring the entire life of the city to a standstill. What, then, has led these men into such a false position? Undoubtedly their chiefs feel that the men will follow wherever they lead. Undoubtedly, too, the recent victory over Congress, abetted by the President, has encouraged them in their present stand. The degree of response to the call of the conference will be awaited with much interest. Four days ago the strike resolution was passed. Since then the individual unions have been debating it. It now seems that level heads are in the majority and that less than 200,000 will go out. If such be the case, it will indeed be gratifying. It will show that a majority place fair play above the dictates of misguided leaders. Nevertheless there will be inconvenience and probably some suffering. How much influence the recent federal precedent has had on the stand taken at New York it is impossible to say, but it is probable that it has not been inconsiderable.

First—A Good Engineer

A WELL-KNOWN COLLEGE PRESIDENT, commenting on the policy of this journal of urging engineers to participate more largely in civic affairs and to acquire a broad outlook on the country's economic problems, expressed the belief that there was danger of such a policy making a wrong impression on the young engineer. He might gather that outside activities were to be given attention even if his professional advancement were thereby to be made less rapid. "His first duty," the doctor

said significantly, "is to be a good engineer." Needless to say, we are in hearty agreement with the doctor. No man should devote time to outside activities until he has mastered his own job. Once he has his own work well in hand, however, participation in engineering-society or civic affairs will widen his horizon and help him in the mastery of the broader engineering problems. First, however, a good engineer.

Motor Trucks—for Every Service

THE AUTOMOBILE TRUCK is no longer an experiment on construction work. It is coming into deserved favor both with contractors and with material dealers. Its economical application to all sorts of construction problems is being worked out rapidly. Within a month's time the Engineering Record has described a job where the motor truck is used successfully for a haul so long that a railroad would ordinarily be built, and another where the hauls were so short that they seemed adapted for some sort of conveyor equipment.

In the case of the Ripogenus Dam construction (described Aug. 19, page 237, and Sept. 2, page 280) it paid to build a 30-mile macadam highway, which would require only light maintenance under the small traffic expected after the completion of the dam, and to spend a considerable sum per mile during the two-year construction period to keep this road in first-class condition for the use of nine 5-ton trucks operated at fairly high speeds. The preliminary investigation of this problem indicated that the use of motor trucks would be far cheaper than railroad or team haulage, all items of cost considered, and the actual performance checked the first estimates in a most satisfactory manner.

In the case of the Detroit-Superior Bridge in Cleveland, described on page 347 of the Sept. 16 issue, trucks were used on relatively short hauls with such successful results that engineers connected with the work have expressed the opinion that the actual rate of progress could not have been maintained with any other system of transportation. Of these hauls, that with wet concrete is so short that even recently it would have been considered foolhardy to think of using a motor vehicle. Steep grades and very indifferent pavements proved no obstacles to the truck.

As the development of construction methods is chronicled it is becoming more and more evident that the motor truck has found its place as a new and powerful tool in the hands of constructors. The shortcomings of the early models, which gave rise to the prediction that the motor truck would never be able to leave the first-class city pavements, have been largely overcome. Trucks are being taken even to the bottom of large excavations, to be loaded by steam shovels, as was done at the Pennsylvania Hotel in New York, described on page 267 of the Engineering Record for Aug. 26 last.

A construction tool which has proved its utility as well as the motor truck has done is not long in coming into general favor. It is safe to say that the next few years will witness an even greater rate of increase in both the number of trucks and diversity of uses than has made the truck in the last three years the most-talked-of item of the contractor's plant.

A Convention Program on the "American Plan"

DURING the presidential campaign preceding the election of William McKinley the Republican party adopted as its slogan "The Full Dinner Pail." A perusal of the program for the twenty-third annual convention of the American Society of Municipal Improvements, to be held in Newark, N. J., next month brings the phrase to mind. The committee on arrangements has crammed the pail of its convention program full of technical food—so full that an epidemic of indigestion may result.

Perhaps it is unfair to use the dinner pail as the measure of the convention's engineering provender. The program might better be likened to the bill of fare of the "American plan" hotel—everything from soup to nuts. A scanning of the menu shows that for the morning and afternoon sessions of a single day, Oct. 11, there are scheduled for presentation 24 technical papers, discussions and committee reports, in addition to the election of officers and the selection of the next place of meeting. Below the belt line of even the stoutest trencherman there develops a feeling of unrest at such an announcement. Nor is the anxiety allayed by the knowledge that the convention is to last five days.

How much of its very lengthy convention program the society will be able to follow is of course a matter of conjecture. Certain it is that many of the papers will have to be omitted. Nothing is gained by offering a program of this sort. This criticism, let it be clearly understood, is directed, not at the quality of the papers or the ability of the authors, but at the overwhelming volume of matter which it is expected to dispose of. The whole structure is top-heavy and sure to collapse. The schedule can, of course, be adhered to if a large number of the papers are read by title only, but if that were done, the author who has spent valuable time on the preparation of some contribution for the convention would have a just grievance. Many of the papers, fortunately, have been printed and issued in advance, and it is possible that the reading-by-title method will be the course adopted. Even then the discussion must be very limited.

The American Society of Municipal Improvements, since its amalgamation with the Society for Standardizing Paving Specifications, has made specification work one of its leading activities. It certainly should be taken as one of the most important things the society tries to do. Nevertheless, the program shows that the reports of committees on standard paving specifications are scheduled for the evening session of Oct. 12 *after* seven paving papers. Assuming that all seven of these papers are delivered and that the usual practice of discussing them is followed, it will be well past midnight before the members of the association will have an opportunity to consider the committee work, which has always been represented as of such signal value. If any vote on the adoption of standard specifications is to be taken, what representative opinion can be secured at an open meeting at midnight? Is the society preparing for a fiasco similar to last year's, when a patented paving was adopted as one of its standards?

If the committee in charge of the program had matched its initiative and energy in inducing men to write papers with a proper sense of proportion the result would have been better.

Navy Department Contract Documents an Important Step Forward

THE CONTRACTOR who knows his business and is efficient is enabled to secure contracts on terms under which he can be sure of doing good work and being fairly paid for it by the new form of contract documents adopted by the Bureau of Yards and Docks of the Navy Department and used in receiving bids on Sept. 2 last for the new structural shop at the Norfolk Navy Yard. Engineers and contractors who are interested in lowering the cost of contract work through the general recognition of standards covering the important business features of such documents—a thing which has been given deserved publicity in these columns of late—cannot do better than make a study of certain provisions of the new forms which are far ahead of the usual practice.

These provisions first permit the contractor to name his own time of completion. A stipulated sum per day, based usually on the rental value of the completed work, is announced as the value to the government of the time, after the contract is let and before it is completed, during which the structure is not in service. If one man bids on a basis of 800 days for completion and another on 700 days, this sum, times 100 days, is taken from the total of the second bid before comparing its relative value to the government with that of the first bid.

Next, unit prices are called for on quantities given in the proposal schedule and provision is made for changing these quantities at the order of the government. If they are increased, the contractor is guaranteed by the contract the actual cost of the increase plus 10 per cent. If they are decreased, a deduction of the actual cost or market price at the time the bid was made, plus 10 per cent, is required. If less than $500, such changes are valued by the officer in charge; if more, by a board of not less than three government representatives.

If the work calls for it, as in the case of the structural shop, the contractor may be required to furnish an exact progress schedule and report each month how closely he is living up to it, and, if the schedule is not working out, the reason for the variation.

The provisions named are evidently meant to determine the least cost of the work

under conditions most favorable to each bidder, and not the least cost under a set of conditions laid down in advance by the owner. If one contractor has a large amount of labor-saving equipment at hand, he may be able to do work much faster than firms whose plant is tied up on other jobs. He is given a legitimate means of taking full advantage of that fact in bidding. If another contractor has the brains to lay out the work so that it can be done faster than by old methods, his advantage is also assured by the method of bidding. If a third can arrange the job so that it will require more time, but can be done with far less equipment and lower overhead expense, he also is given the full benefit of his careful planning. This method of letting should also make it profitable to figure the exact cost of each part of the work, with its proper share of overhead expense, permitting an exact understanding by both parties of the financial conditions under which the construction will be carried on and making it easy to adjust the cost of changes.

The object of contract documents, as has been frequently stated, should be to eliminate guesswork and reduce the contract to a basis of exactly what result the owner wants and how the contractor can work with the owner's agents to produce it. Under such provisions as these, both parties know that the bids are submitted and the work begun on a definite plan of action, to accomplish a definite amount of work. If changes are necessary, the owner is assured, on the one hand, that the contractor will keep on with the work, and the contractor, on the other, that the owner will see that he does not lose by it.

While the questionable clause disclaiming responsibility for the plans and surveys remains, and while it is necessary in expending public money that the representatives of the government retain the right to decide all matters of payment, subject to revision only by the courts, these documents make evident in every paragraph an intention to be fair and reasonable. When statements are made in the contract documents such as, "It is mutually understood and agreed that the parties to the contract will . . . labor to mutual advantage"; that "delays caused by acts of the government will be regarded as unavoidable delays"; that, if it is necessary to tear out finished work to determine whether it meets the specifications, "the actual cost of the examination plus 10 per cent will be allowed the contractor" should the work be found to meet the requirements, the contractor will be safe in assuming that the engineers who made them will be honest in living up to them.

Rear Admiral Frederic R. Harris, the father of this change in policy, is to be congratulated for having taken a long step toward bringing into the work under his charge responsible and able contractors by offering them an honest chance to show the cash value of their superior ability. It is to be hoped that this demonstration of the practical advantage of this point of view in handling contracts will not be lost on those men who still insist that no methods but the old ones can be made to work.

Solution of the Labor Problem

LABOR, at the present minute, is a leading topic of discussion in both England and the United States. In both countries the war has brought the question to the front, though for different reasons. At the beginning of hostilities the "restriction of output" rules of the British labor unions caused a ghastly toll on the Flanders battle lines. When the facts were clearly before them the unions consented to the temporary abrogation of the restrictions. At the same time, Mr. Lloyd George organized the munitions manufacturing of the country and thousands of women were put at the lathe and the bench. To the astonishment of the English public—but not to those of its industrial leaders who knew factory conditions—these girls and women, after only a few weeks' training, showed a greater output than had their skilled-machinist predecessors. And their production has continued undiminished without any detrimental effect upon their health. What wonder, then, that England is concerning itself with the labor problem, debating as to what is to happen when the men come from the trenches to take their factory positions, and the women retire to their homes and their customary occupations!

In the United States our present labor discussions have been caused by the war, but only insofar as the latter is responsible for the munitions prosperity with which the country is afflicted. Labor knows that profits are high. It appreciates that plant owners can be forced to pay more, and it is using its organized force to secure concessions. So many are the demands for shorter hours or more pay that the country has been awakened as never before to a realization of the state in which our industries find themselves with reference to their labor problems.

In its issue of Sept. 9 the Engineering Record took occasion to point out the broader aspects of the railroad wage-increase controversy. It is interesting to note that simultaneously, in England, similar views were being placed before British labor and British industry by well-qualified authorities. Mr. Gerald Stoney, in his presidential address before the engineering section of the British Association for the Advancement of Science, and Mr. H. Gosling, president of the Trade Union Congress, and the Lord Mayor of Birmingham, Mr. Neville Chamberlain, all attacked the problem from angles proposed in this journal.

Mr. Stoney, who is well known in England as an officer of machinery-manufacturing companies, deplored the fact that British employers, as a rule, do not look after the welfare of their workmen. Proper lighting and ventilation of shops have been secured only through legislation, while conveniences, such as adequate clothes lockers, shower baths and lunching facilities, are not even now supplied, their installation not being made compulsory.

But he did not give labor a clean bill. He denounced most vehemently the agitating labor-union officials who feel that they are not adequately serving their members unless they are constantly trying to enforce new concessions, whether warranted or not.

Mr. Gosling suggested that workmen be allowed to take some part in the management of the plants in which they are engaged, while the Lord Mayor of Birmingham believed that much good would flow from admitting representatives of the workers to the counsels of the employers so that they "could see a little more of the game from the inside." In a word, Mr. Gosling and Mr. Chamberlain were desirous of developing plans that would engender that confidence which the Engineering Record said on Sept. 9 is absolutely essential if our labor problems are to be solved.

As has been heretofore stated in these columns, participation by workmen in the management of corporations is an accomplished fact in certain industries of this country. To our mind the plan should be more widely applied. In no other way will it be possible to impress upon the workman that his own prosperity depends upon that of the industry in which he is engaged. England has for years been worrying about its foreign trade. Germany has been making great inroads. Nevertheless, the British workman insisted upon the restriction of his output, not realizing that that restriction was raising the cost of production to a level seriously endangering his country's supremacy in the battle of commerce.

The present plan of procedure—of keeping the employees in ignorance of the detailed figures of the particular plant and of the economics of the whole industry—tends to excite in the employee's mind a suspicion that the owners are making tremendous profits. He sees them enjoying more of the world's goods than he has, and no one has given him an opportunity to learn whether the return is reasonable in view of the capital and ability invested.

It is but natural that employers should not, when it is first suggested, take kindly to such a plan. Everyone prefers to conduct his business as he sees fit. It is one way, however, to attack a very serious problem, and a way that offers much promise. Whether through this course, or some other, the essential is to gain the confidence and loyalty of the men, meanwhile increasing the all-around efficiency of the establishment.

The strength of labor is rapidly increasing. Its present disposition—except in some of the older and more conservative unions—is to get whatever it wants by force. If what it considers its rightful share in the earnings of industry is not granted willingly by the employer, that share will be forced from him by legislation. We are not in as bad a state to-day as England is, but unless we act quickly and effectively the intolerable conditions which have been settled on British industry by its unions will likewise obtain here.

Fortunately, the problem is possible of solution without a conflict—aye, even with increased profits to the employer. The wise man will work to that solution of the problem and not stubbornly await the conflict which otherwise is inevitable.

BRICK ARE GROUTED IMMEDIATELY AFTER ROLLING IS COMPLETED—FINISHING GROUT WHEELED FROM MIXER

In Monolithic Pavements in Vermilion County, Illinois, Brick Are Laid Directly on Concrete Base

Thin Layer of Dry Sand and Cement, Used at Paris, Illinois, Is Discarded—Construction Procedure, Modified by Experience, Permitted Good Progress to Be Made

By HARLAN H. EDWARDS

Urbana, Ill.; Former Inspector, Vermilion County Bond Issue Roads

IN but a little more than a year a revolution has been worked in the construction of brick highways. The sand cushion is doomed to pass into highway history. Paris, Ill., became a Mecca for road engineers when it began building monolithic brick pavements. Thus a thin dry mix of cement and sand was spread on the green concrete and the bricks immediately placed. Vermilion County, Illinois, on those of its bond-issue roads being built with brick, has gone a step farther. The bricks are being laid directly on the concrete base. Twenty-five miles of this type is being laid. The construction methods now in use are, as a result of study and development, well worth the attention of highway engineers and contractors.

In order to bring the whole subject clearly before the reader a brief summary of the development of the monolithic type will be given before proceeding to a description of the design and construction of the Vermilion County roads.

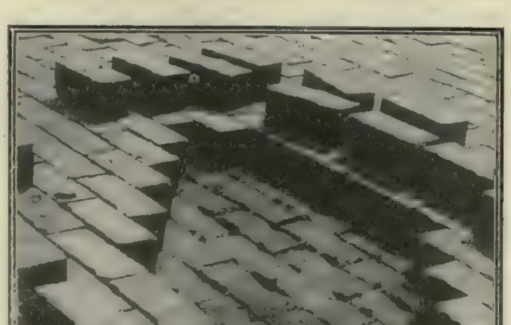
THREE STEPS IN DEVELOPMENT

There were three steps in the evolution of the true monolithic brick pavement from the old sand-cushion type. First came the substitution of the 1½-in. cement-sand bed for the old sand cushion, using just enough cement to prevent any movement of the sand under traffic. This proved unsatisfactory, for the only function of the sand was to provide a smooth surface upon which to lay the brick, and the use of such a thickness of the cement-sand mixture was too expensive.

The next step therefore came in the reduction of the thickness of the cement-sand bed. A 3/16-in. layer of a dry mix of cement and sand was laid upon the fresh concrete and the brick immediately laid and rolled. This, the first that really could be called monolithic, was the type laid at Paris, Ill., and described in detail in the Engineering Record (July 10, 1915, page 54) by W. T. Blackburn, and adopted this year as the standard brick pavement by the Illinois State Highway Department.

With this type of construction, however, it has often been the practice not to grout the brick for several days after laying. As a result, the layer of dry mix has constituted a weak plane, with consequent danger of separation along this plane, thus greatly reducing the strength of the pavement.

Finally therefore, as developed on the Vermilion County bond-issue roads, under the direction of P. C. McArdle, superintending engineer, this intermediate layer has been entirely abandoned and the brick are laid, rolled, and grouted upon the fresh concrete base after it has been struck off to the proper crown and tamped to an even, smooth and compact surface by means of templates. This makes a true monolithic pavement, with no plane at which separation may take place.



BRICK ARE BEDDED IN THE CONCRETE BY AN 800-POUND HAND ROLLER

EXPERIMENTAL SECTIONS

The first monolithic brick pavement of this type was laid near Danville, Ill., as an experiment, upon the suggestion of W. W. Marr, state highway engineer, on a road receiving heavy traffic from coal mines. It was laid in four sections, as follows: (1) A length of 36 ft., using 3-in. brick laid upon a 3-in. base, with 1:3½:6 concrete; (2) a length of 64 ft., using 4-in. brick laid longitudinally on a 2-in. base; (3) a length of 50 ft., using a 4-in. brick laid transversely on the same thickness of base, and (4) a length of 48 ft., using a 4-in. brick laid transversely on a 1-in. base, the concrete being a 1:3½ cement-sand mixture. The pavement was crowned 1½ in. in a width of 15 ft. The concrete was placed just as wet as possible, without running at the edges, struck off with a template but not tamped, and the brick laid and grouted immediately. The fourth section was placed where it received the most severe test—at the edge of a soft gravel road. In the spring when the frost is going out of the ground this gravel road is little better than a series of mudholes, from which the traffic bumps up on the pavement, while in the summer the surface of the gravel road is high above the brick and the traffic drops down upon the edge of the pavement. However, none of the work has shown the slightest sign of failure.

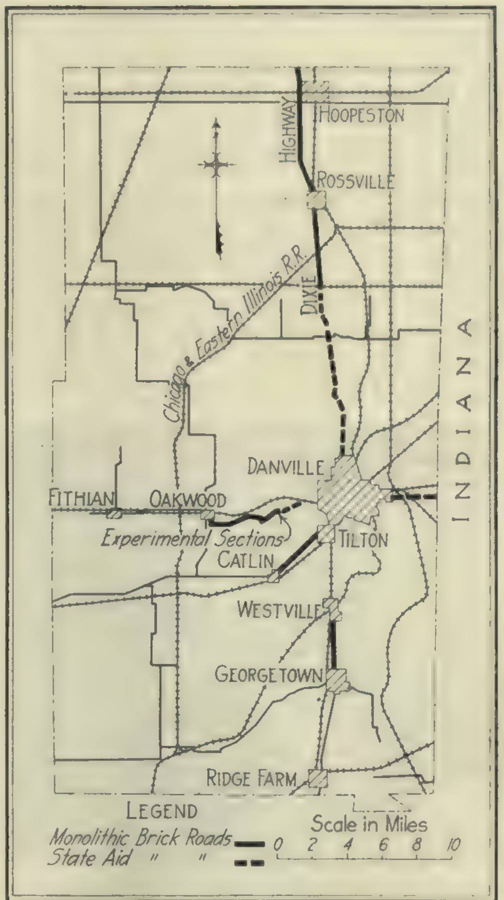
As a result, Stockland Township, Iroquois County, Ill., has this year voted $50,000 for the construction of 9-ft. mono-

lithic brick roads of this type, using a 4-in. wire-cut-lug brick laid upon 1 in. of concrete on a crowned subgrade. This type was approved by the state highway engineer, Mr. Marr, and the work was let for less than $9,000 per mile, including two graded earth roads on the side. This work is now in progress.

Design of Road

Of the system of 166 miles of hard roads being constructed by bond issue in Vermilion County, for which contracts were let last spring, about 25 miles are of monolithic brick construction. The pavement, 10 ft. wide, is constructed of 4-in. wire-cut-lug paving brick laid directly upon a fresh concrete base 4 in. thick at the sides and crowned 1 in. On each side of the pavement a strip of macadam 3 ft. wide is to be laid, and beyond this an earth shoulder 7 ft. in width, making the total width of roadway 30 ft.

Approximately $11\frac{1}{2}$ miles of this type of construction are along the Dixie Highway, running from the northern boundary of the county southward, meeting a 15-mile stretch of state-aid brick road, so that the entire length of the Dixie Highway through the county will be paved with brick. The other sections of monolithic brick road are located as shown on the map. The $3\frac{1}{4}$ miles between Tilton and Catlin are completed, 3 miles between Georgetown and Westville are under construction at the present time, while 2 miles of the work near Hoopeston are nearly finished.



HEAVY LINES SHOW BRICK ROADS

Handling Materials

In the construction of the Tilton-Catlin road the pioneer work was done. All objections to this method of construction were met and overcome, and it was established as a practical, economical, and altogether successful pavement. As is often the case with new work, inefficient methods were at first employed, but soon discarded for better and cheaper ones. The same contractor, the Granite City Lime & Cement Company, also obtained the contract for the work near Hoopeston, and the construction there consequently received the benefits of the experience gained on the previous work at Catlin.

In the work near Hoopeston, the sand and stone are unloaded from cars at the construction camp by clamshell bucket and crane, and dumped into elevated bins, whence they are loaded into $1\frac{1}{2}$-yd. side-dump cars for hauling to the road. The brick are unloaded with tongs and placed directly into small cars, operated on a 2-ft. gage industrial track laid along the side of the subgrade.

Over this track the concrete materials are hauled to the road by dinkey engine and dumped upon the center of the subgrade, as shown in one of the pictures. The sand and stone are placed in alternate piles in this order: 2 cars stone, 2 cars sand, 2 cars stone, and 1 car sand. There are thus approximately 7.5 yd. of sand and 13 yd. of stone in every 100 lin. ft. In this way the materials are quickly placed so that the wheelers may operate from either side of the piles.

The steel forms are set 1000 ft. or more in advance of the mixer. Thus a very good line can be maintained with little difficulty. Six-inch steel forms are used. They have a 2-in. strip of wood bolted to the bottom, enabling them to be utilized on other types of hard roads of less thickness. Before the concrete base is placed, the faces of the forms are greased with a low-grade oil to insure a smooth surface toward the pavement and prevent the grout from sticking to and roughening the forms.

Brick and Cement

The brick are stacked 14 in each course along the side of the road, being placed there with tongs from the small cars, in such order that they may be laid in the pavement with minimum confusion.

Whenever possible the cement is handled directly from the cars to the mixer, moving the cars ahead when necessary. When, however, a clear track is needed for hauling shoulder stone and other material past the mixer to the completed pavement, the cement is unloaded on racks, as described on page 421.

The cement is furnished by the county, and in the work a 2 per cent variation from a standard calculated amount is allowed, all in excess of that amount being paid for by the contractor. In actual work the cement consumption usually runs within these limits.

Concrete

A $\frac{1}{2}$-yd. Cube mixer is used. It is not run directly upon the subgrade but on 3-in. oak planks, having $\frac{3}{8}$-in. bolts running horizontally through them to prevent their splitting and breaking away under the heavy load.

The concrete used in the base is of a $1:3\frac{1}{2}:6$ mix, using $1\frac{1}{2}$ to $\frac{1}{2}$-in. crushed stone and sand graded from $\frac{1}{4}$ in. down. It is of a slightly quaky consistency, is dumped directly from the mixer to the dampened subgrade, spread out between the side forms and struck off to the proper thickness and crown by two templates weighted down with sandbags and drawn forward by the mixer as it moves ahead.

At first only one template was used. This was made of two 2 x 10-in. oak planks placed vertically 10 in. apart, with suitable bracing between. The lower edge of these planks was cut to a 1-in. crown and faced with a strip of iron. Rollers were fastened to each of these planks for movement along the form. This template was not satisfactory, however, for although well weighted down the concrete often became piled up in front of it as it was being pulled ahead, causing the rear face to rise and leave a high place in the concrete. This, if not removed by a second dragging of the template, would have caused a wave in the pavement.

Therefore a second template, having the crowned faces 2 ft. apart, was devised.

GOOD CONCRETE SURFACE SECURED BY SLIDING AND TAMPING TEMPLATES

MATERIALS ARE NEATLY PLACED WITH THE CEMENT ON RACKS

This was supported on the forms by runners 3 ft. long, faced with iron and curved upward at the front end. This template acts as a check on the first one, taking off any high places and filling in the low ones, if any. A new steel template is now in course of preparation which will have three faces placed about 1½ ft. apart, the rear two being tilted slightly so as to smooth down and compact the concrete. This template will be pulled along the form on 7-ft. runners, projecting a foot or more in front of the front face.

Runners are used on the templates instead of rollers in order to eliminate any irregularities in the surface or at the joints of the forms. Rollers drop into any depressions, leaving the concrete with the same contour as the surface of the form. They also concentrate the weight of the template, tending to make irregularities in the forms, especially at the joints, while the runner distributes this weight over a large area. Instead of having the same crown as the finished pavement, the faces of this new template will be crowned 1½ in. to allow for more compacting of the concrete and for a greater depth of embedment of the brick, while still maintaining a final crown of 1 in.

After the template cuts off the concrete to the desired crown the concrete is tamped with a crowned tamping template. This template is made of two 2 x 10-in. planks placed vertically, between which is placed a 1 x 6-in. strip extending diagonally upward and outward from each end, and containing at the upper end a handle for moving the template up and down. The bottom edges of these planks are crowned 1¼ in., similar to the dragging template, and have a 1 x 10-in. strip nailed to them as a tamping face. The upper part of the planks extends out over the edge of the form, while the lower part is cut in to the width between the forms, the depth of cut being the distance desired between the concrete and the top of the form.

The template is operated with a vertical tamping motion by two men. A thin coat of mortar is thus flushed to the surface, and upon it the brick are laid, and rolled to a smooth, even surface with an 800-lb. water-ballast hand roller. The brick are carried in tongs from the piles to the pavement, and stacked in regular order for laying so that the lugs will all be in one direction and the best face up. Inspection is made at this time, and all rough, broken or cracked brick are either turned over or put out of the pavement.

ALL OPERATIONS ARE CARRIED ON WITHIN 10 FEET OF THE MIXER

GROUTING

The brick are grouted immediately after the rolling is completed. The grout is made of equal parts of cement and sand, mixed to a uniform consistency in a small Marsh-Capron grout mixer. The sand is of such size that it all will pass a No. 12 screen, and if necessary is screened in the yard. It is sacked and placed along the roadway with an equal amount of cement, so that no time is lost in measuring. This also maintains a uniform mix, so that with a constant amount of water, grout of the same consistency is obtained.

The first coat, of the consistency of thin cream, is run on from the mixer through a spout having a grating on the lower end to catch any lumps that may have escaped the operator's attention. It is broomed into the joints and allowed to set. The second coat is put on within an hour, but is carried back in wheelbarrows instead of running the mixer back over the pavement already grouted. The second coat is also of the consistency of thin cream, and is worked thoroughly into the joints with a squeegee. The material along the edges is made somewhat thinner by sprinkling the sides slightly before applying the second coat. This insures a thorough filling along the edges of the pavement. A small amount of grout is left on the pavement at this time to provide for settlement. When it has partially stiffened, the pavement is gone over a second time with the squeegee, filling all joints and cleaning the grout off flush with the surface of the brick. All operations are carried on within 100 ft. of the mixer.

When the grout has hardened sufficiently, the pavement is covered with 2 in. of earth and kept wet for ten days. Traffic is kept off for at least three weeks. The pavement is then cleaned off, the shoulders shaped up and the 3-ft. macadam or gravel shoulders placed and compacted by rolling along the side of the pavement.

ORGANIZATION OF GANG

In the usual organization for the carrying on of this work 32 men are required. They are distributed as follows:

Ahead of the mixer are 1 form setter, 5 wheelers, 3 shovelers, and 1 cement man. At the mixer are the operator and the fireman. Behind the mixer there are two men spreading concrete and one for carrying forward the boards upon which the mixer is run, and for tamping the concrete. In the paving gang there are 1 brick setter, 3 stackers, 1 starter (who helps with the tamping), 1 batter, 5 carriers, 1 culler, and 1 roller. Three men usually suffice to grout the pavement. Finally, one man is needed to keep the pavement wet down and to pull the forms. With this organization and a good mixer 700 or 800 ft. of pavement is a good day's work.

There are no expansion joints in the pavement, care being taken to bond each day's work to that previously laid. In the work so far completed contraction cracks have occurred straight across the pavement at intervals of from 60 to 125 ft., depending on the temperature at which the pavement was laid.

With this type of construction the most important part of the work, so far as obtaining a smooth surface is concerned, is at the mixer and the templates. Intelligent rolling of the brick is a necessity, but if the concrete is not of uniform consistency almost no amount of work short of taking up the brick and reshaping the concrete will make the pavement smooth. Too great emphasis cannot be placed upon this detail of the work. The proper operation of the mixer to insure a uniform consistency of concrete is imperative.

Auto in Boston Water Department Averages 700 Miles a Month

Two hundred trips a month, each averaging 3½ miles, is the record of the emergency repair car used by the Boston water department. The car, which can carry fourteen men and a large supply of equipment, has traveled about 37,000 miles since it was built, in 1911. Twice in five years it has been overhauled, and it is said that during the first 17,000 miles of service its only expense was for fuel, oil and tires. No choice of routes is made in answering calls, despite which the car's maintenance cost is comparatively low. The chassis is a White, with a 40-hp. motor.

Filtered-Water Supply for Sacramento Recommended in 660-Page Report

River Water Considered Most Satisfactory and Economical of Many Sources Investigated—Novel Head-House Design Described

FILTERED Sacramento River water is the best and most economical supply for the city of Sacramento. That is the finding of Charles Gilman Hyde and George H. Wilhelm, consulting engineers, and Frank C. Miller, city engineer—the three engineers who have made a 660-page report on every feasible supply. In addition to the filtered supply, pumped from the river, ground water and gravity supplies from the distant mountains were studied in minute detail. The comparisons were made on the basis of quality, available yield, dependability, cost of construction, annual cost and total cost.

River Water Best

All of the sources and projects are deemed of equal merit with respect to bacteria content, for costs to free them from disease-producing bacteria were included. Turbidity would be something in the unfiltered mountain water and micro-organisms must be cared for in the storage basins. Tastes and odors may also be developed. The river water filtered is considered the most attractive. Color troubles do not enter into the problem. Hardness of the mountain streams and rivers is nearly the same—40 and 50 parts per million—but the ground water has a hardness of 85. As to quantity, the ground-water supply is limited to a precarious supply of 30,000,000 gal. daily. The two mountain sources in the Sierra Nevada Mountains each can be developed to 100,000,000 gal. daily, but the river supply for all practical purposes is unlimited.

Costs per 1,000,000 gal. daily to develop the various supplies are as follows: $18,300 for the river, $43,800 for the ground water, $139,200 for the mountain supply from American River and $153,100 for the other proposed mountain supply from the Mokelumne River below Electra. These figures are based on a development of about 70,000,000 gal. daily for all but the ground water, which is limited, as noted above, to 30,000,000 gal. No extraordinary profits, the engineers found, may be anticipated by investing in power-plant equipment to utilize the head in the mountain projects. Annual costs also favor the river supply. In initial stages of the development for 20,000,000 gal. the relative annual costs are $25.40, $25.64, $88.40 and $91.90 for the river, ground water and two mountain supplies. For 30,000,000 gal. the relative costs are $19.40, $18.55, $53.70 and $55.90 respectively.

Rapid Filters Chosen

Although a number of combinations of processes were studied, the most economical and the one recommended is as follows:

Preliminary subsidence in a grit basin to remove the coarsest sediment which would settle rapidly and freely, due to its own weight and character, is to be followed by a longer period of subsidence (employing a coagulant when necessary) to remove the great bulk of the finer suspended matter and some of the bacteria. Final purification is to be effected by rapid sand filters of the usual type, employing a secondary dose of coagulant applied in special basins containing a sufficient storage merely to permit the chemical reaction to take place, and thus insure a well-defined flocculation of the water. These filters should be designed for an average rate of operation not greater than 125,000,000 gal. per acre per day. Considerable latitude in actual rates of operation in practice will be permitted by this type of filter. Disinfection of the effluent is provided for by a suitable chemical, probably liquid chlorine or chlorine gas generated electrolytically.

Upward-Pressure Difficulties

The material in which the excavation for the proposed basins is to be made is a fairly sandy clay and sand in which the ground-water level probably fluctuates with changes in elevation of the water in the river. The bottoms of the basins, as proposed, will probably rest in a thick stratum of fairly clean sand. If any basin should be emptied when the ground-water elevation in the surrounding material is relatively high, the upward thrust against the floor lining might be sufficient, unless corrective measures were taken, to cause this to be upheaved and destroyed. To meet this condition it is proposed to cover the entire bottom of the excavation for the basins with a layer of gravel averaging at least 6 in. in thickness. Beneath this layer cross-trenches in both directions, and from 25 to 30 ft. apart, would be excavated. These trenches, perhaps 1 ft. deep and 2 ft. wide, would also be filled with gravel and would serve as collectors from which the ground water would be delivered into any basin, while emptying and empty, through numerous relief valves placed in the bottom. It has been assumed that as many as 160 of these valves might be necessary in the system of basins. By such means the water level should be lowered as rapidly and completely as necessary and thus obviate any dangerous upward thrust.

Waterproof Lining of Floors

Above the gravel layer it is suggested that a layer of oil-clay, gravel, and fine broken stone puddle, 6 in. in thickness, be placed. This puddle, if properly proportioned, mixed and laid, should constitute a thoroughly waterproof lining for the basin floors. It is believed that the asphaltic oil-mixed puddle will be greatly superior to the ordinary water-mixed puddle because it will neither crack in the cold nor dry out and crack under the action of the sunlight and hot, dry atmosphere before the protecting floor of concrete is placed. Moreover, so far as the available evidence goes, it appears that it would be durable and would not disintegrate under the action of water. If, however, the asphaltic oil should disintegrate with the passage of time, it seems certain that the clay, broken stone and sand would constitute a suitable waterproofing. Test borings indicate that suitable clay and sand will be obtained from the various excavations for the plant. Tentatively a floor of concrete laid in squares with suitable waterproof joints has been assumed. Further studies may show that it will be better to provide a reinforced-concrete floor tied into the side walls and laid continuously without joints. Such a floor might make it unnecessary to provide a puddle lining.

Head-House Novel

The head-house will serve a fourfold purpose in connection with the proposed works, as follows: (1) Beneath the ground it will contain a large drainage sump having an effective capacity of perhaps 290,000 gal. and serving as a receiver of washwater from the filters, of subsoil drainage waters from the ground about the works and, when necessary, of the deposits washed from the coagulating and sedimentation basins in the process of cleaning; (2) the ground floor, at the same elevation as the operating floor of the filters, will contain a main corridor leading to the filter operating floor and a coagulant receiving and hoisting room, together with rooms for the superintendent of filtration, the filter attendants, etc.; (3) a second floor will be devoted to the necessary apparatus for the mixing, measurement and application of all coagulant and disinfectant or sterilizing solutions; (4) the uppermost portion will contain a great steel storage tank containing fully 200,000 gal. of water for use in washing the filters.

The washwater tank, as proposed, will contain a sufficient volume of water to wash effectively two and perhaps three filters. The tank will be supplied from the force main leading from the high-lift, high-duty pumping engines to the city distribution system through a pipe so arranged that the rate of delivery and the volume discharged into the tank may be very effectively controlled. With proper regulation the load on the main pumping engines will not be caused to fluctuate violently on account of rapid changes in elevation of water in the tank. It may readily be demonstrated that it is very much cheaper and better to supply this elevated tank with filtered and sterilized water by means of the main high-duty pumping equipment than through any auxiliary equipment which would ordinarily be provided for such a purpose. The washwater tank proposed is elevated considerably higher above the filters than those which have usually been constructed in connection with filtration works built elsewhere.

Rate Washwater Will Be Used

With the single-wash process of cleaning filters the rate at which the washwater will be used will be fully 7.5 times the rate of yield from the filters represented by their nominal capacity and nearly 5.5 times the rate of yield represented by their ordinary maximum capacity. The rate of use of water in washing one filter in a ten-unit plant would therefore be about 75 per cent of the rate of yield from the entire plant when operating at its nominal capacity of 125,000,000 gal. per acre per day, and 55 per cent of the rate of yield at what may be assumed to be an ordinary maximum capacity of 175,000,000 gal. per acre per day. It is therefore obvious that a generous storage of washwater is necessary if this is to be supplied through the main pumping engines and if the rate of draft upon these engines is to be kept relatively low and maintained as uniform as possible.

In connection with this project, it is proposed to construct immediately ten filter units having a nominal daily capacity of 30,000,000 gal., representing a rate of

125,000,000 gal. per acre per day, and a maximum capacity of perhaps 40,000,000 to 45,000,000 gal. per day. Each unit would have an effective filtering or sand surface area of about 1050 sq. ft., or 0.024 acre. The filters would be built in two batteries of five units each, separated by a pipe gallery 20 ft. in width. They will rest upon and be supported by portions of the roofs of the filtered-water basins. Each unit will be built of reinforced concrete as a monolith, complete with sides, bottom and roof.

PERFORATED PIPE UNDERDRAIN

It is proposed to equip the filters with a special type of underdrainage system which, in the experience of one of the engineers, has been demonstrated to be cheaper and more efficient than almost any other. The underdrainage system must be designed to collect the filtered water in the ordinary operation of the plant and to distribute and diffuse the filtered washwater —and air, if used—in the process of cleaning the filtering media. This underdrainage system must therefore connect both with the filter effluent piping, regulating and controlling equipment and with the air-wash and water-wash system.

Air washing is not proposed in connection with the Sacramento filtration works, but it is suggested that the design be such that it may be installed at any future time if its use should appear necessary or desirable. The underdrainage system within each filter unit would be divided into four equal parts, each of which would be provided with a special cast-iron manifold and a system of properly and uniformly spaced pipes with uniformly spaced perforations or orifices of proper size in the under side along the axes thereof. Such a manifold and piping system, if properly designed and installed, would be equally serviceable in filtered-water collection as in washwater and air distribution and diffusion. Each quarter of the filter would be so connected with the main effluent and washwater-supply piping that it will yield its proportional part of the filtered-water supply from the entire unit, or receive its proper proportion of the supply of air and water in washing. The filters will be designed to respond automatically to the requirements of the city and thus maintain the filtered-water basins continuously nearly full so that a supply of water in storage sufficient for all ordinary emergencies will be always available.

GRAVEL AROUND UNDERDRAINAGE SYSTEM

The underdrainage piping system would be surrounded and entirely covered by a layer about 6 in. in depth of coarse gravel whose particles will possibly vary from 1.5 to 2.5 in. in size. Above these, three other layers of successively finer material, making a total underdrainage depth of 15 in., might be employed. A sand bed 30 in. deep, having an effective size of about 0.35 mm. and a uniformity coefficient between 1.3 and 1.5, would probably represent a satisfactory and very efficient filtering medium. Above the sand surface a maximum water depth of 6 ft. is tentatively proposed. This depth is fully 2 ft. greater than that ordinarily employed with this type of filter, but there are very good reasons, states the report, for believing that difficulty with patent claims may be completely avoided by such design, and that from other standpoints, such as freedom from air entrainment, unusually satisfactory results in operation will thereby be insured.

Illinois Central Presents Terminal Plans

New Station in Chicago Would Cost $30,000,000, and Electrification As Much More—Other Roads Would Have to Come In

WHAT the Illinois Central Railroad would like to build at Twelfth Street, Chicago, was shown Sept. 20 to the Chicago City Railway Terminal Commission in eleven plans. A. S. Baldwin, chief engineer, spokesman for the company, frankly stated that the enormous development, which John F. Wallace of the commission roughly estimated would cost $30,000,000, and as much more for complete electrification, could not be justified unless other roads not now using the Union and North Western stations came into the terminal. No such agreements have been made.

The scheme involves a head-house 250 ft. deep and 700 ft. wide fronting on Twelfth Street. The monumental Ionic style conforms to that of the Field Museum being erected to the east at a cost of $8,000,000. The first floor of the station, subsurface, will be for suburban traffic; the next higher for mail, baggage, express and the like, and the third for a general waiting room. Still higher will be three floors for offices. In the waiting room will be a mezzanine floor overlooking the lake and the Field Museum. To the west of the station a large hotel of twelve or more stories was presented on the plans. This is at the corner of Michigan Boulevard and Twelfth Street east, on property now owned by the Illinois Central. A bridge across Indiana Avenue, which would be extended north to Grant Park, connects the station with the hotel. The property north of Twelfth Street extended east is to be added to Grant Park.

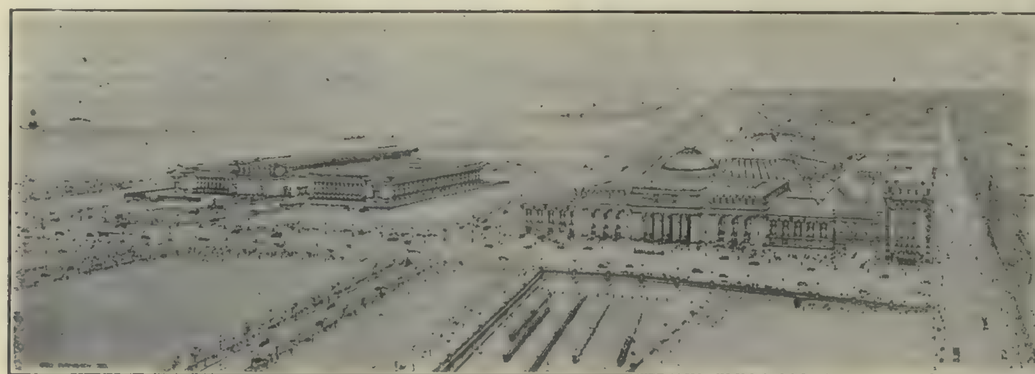
To increase the facilities of access to the entrance of this proposed station the plans show that the Twelfth Street car line shall be extended to the east boundary of the Illinois Central property. The tracks of the line are to be depressed below the surface, starting about Wabash Avenue and going under Michigan Avenue. At the same time the plans show that Twelfth Street Boulevard is to be extended east from its present terminus at about the viaduct level now maintained west of State Street, across the various railroad tracks of the Chicago & Western Indiana and Rock Island groups of roads.

With the property fully developed there will be twenty-four stub-end tracks leading into the station at the level of the general waiting room. Perhaps as many more will be provided on the subsurface level for suburban traffic.

According to the track layout and building sites indicated, the freight facilities will be on the ground level to the south of the station, and nearest the lake and the promised recreation development of the South Park Commission. The separation of grades will start about Twenty-fourth Street, the long-distance trains ascending and the suburban trains descending.

To get other roads into the station it is proposed to have an entrance to the track yards at Eighteenth Street. The Illinois Central proposes to buy a strip 200 ft. wide, immediately north of Eighteenth Street, and extend it west to the south branch of the river that it may intercept all lines that now lead into other railway stations east of the river.

"A complete development of the property," said Mr. Baldwin, "practically necessitates the electrification of the suburban service. Electrification of it will not be necessary with a partial development, because the suburban trains can be brought in on the present level."



PROPOSED STATION FACES A WIDENED TWELFTH STREET—MICHIGAN AVENUE ON THE RIGHT, THE NEW FIELD MUSEUM ON THE LEFT

Location of Water Gates Made Easy by Tying to Permanent Structures

How the location of water gates in Boston is made easy was told by George H. Finneran, general foreman of water service of that city, in his paper on the emergency repair gang presented at the recent convention of the New England Waterworks Association. A distance mark is stenciled on a fence, pole, or building directly opposite the gate, if possible, telling the number of feet from the mark out to the gate. If the mark cannot be placed opposite the gate it gives the distance between the mark and a point opposite the gate. A stenciled arrow shows the direction, right or left of the mark, that one must measure to get the opposite point. In other words, the mark gives the base and perpendicular of a right-angle triangle, the apex of which is the gate. These marks are black on white ground, or the reverse, depending on the color of the background. The object is to make them as conspicuous as possible, especially at night. When the ground is covered with snow these marks are invaluable. In squares and intersections where there are many gates a sign is erected on a post with the distances for all the gates tied from the one point—the post. This makes unnecessary a number of marks on the corners and sides of the squares or intersections, and concentrates the information at one point. The sign is not unsightly. It has gold letters on a dark-blue ground, and is similar in outline and general appearance to the street-name signs.

Adopt Rules of Procedure for New York Board

Building Regulations to Be Controlled by Resolutions of Board of Standards and Appeals —Meetings Open to the Public

UNUSUALLY complete rules of procedure have been adopted by the New York City Board of Standards and Appeals, which has final control over all orders and requirements relating to building construction in this city and the interpretation of the code and the new zoning restrictions passed on July 25. Meetings are held weekly in the Municipal Building on Thursday afternoons, which are open to the public, and any person can be heard on a matter before the board at a given meeting by handing his name beforehand to the secretary. Those in opposition to any proposed action are to be heard first, to insure orderly procedure. The work is reported weekly in a bulletin, in which all announcements are made. The rules regarding resolutions give evidence of such careful consideration that they are reprinted here in full.

The board of appeals after Oct. 1 will consist of Rudolph P. Miller, chairman; H. C. Baird, William Crawford, A. R. Kirkus, A. J. Boulton, L. C. Holden and Fire Chief John Kenlon. The board of standards and appeals consists of the foregoing, together with the fire commissioner and the superintendents of buildings of each of the five boroughs. Daniel Sullivan is secretary.

RULES GOVERNING RESOLUTIONS

The following are the rules governing resolutions:

"Every act of the board or the board of appeals shall be by resolution.

"Every member or his authorized representative present at a meeting shall vote on all resolutions unless excused from voting by the chairman, but such excuse shall only be made on the ground of personal interest. The vote of each member or his authorized representative upon every resolution shall be recorded unless absent or excused from voting, in which case such fact shall be noted.

"No resolution of the board of appeals granting an appeal from any order, requirement, decision or determination of a superintendent of buildings or the fire commissioner under Section 719 of the charter shall be passed, unless the appeal has been taken within twenty days of the date of the issuance of such order, requirement, decision or determination, and the officer from whom the appeal is taken has been notified as prescribed. Five affirmative votes of the board of appeals shall be necessary for the adoption of such a resolution.

"No resolution of the board adopting a rule or regulation under subdivisions 2 or 3 of Section 718a of the charter shall be passed until a hearing, after at least ten days' notice by publication in the bulletin of the board, has been held on such proposed rule or regulation. Eight affirmative votes of the board shall be necessary for the adoption of such a resolution.

"No resolution of the board granting a petition for a variation of the labor law or of any rule adopted thereunder, affecting the construction or alteration of buildings, exits therefrom, the installation of fixtures and apparatus as authorized by Section 718a, subdivision 4 of the charter, shall be passed, until a hearing, after at least ten days' notice, has been held on such petition. Eight affirmative votes of the board shall be necessary for the adoption of such a resolution.

"Every resolution of the board suggesting changes or amendments to the law under subdivision 5, Section 718a of the charter, shall require at least eight affirmative votes for its adoption.

"Every resolution not otherwise provided for, ordinary motions, or decisions on rules of order shall require in the case of the board of standards and appeals seven affirmative votes, and in the case of the board of appeals four affirmative votes.

"No amendment of any resolution shall be passed on the same date that it is offered, except that verbal changes, which do not alter the substance of the resolution, may be passed by unanimous consent of the members present.

"No resolution amending or repealing a rule or approval, previously adopted or existing, shall be passed until notice of such an amendment or repeal has been given and a hearing on the same has been held as required for the adoption of such a rule or approval. The same number of affirmative votes shall be necessary for the adoption of a resolution amending or repealing any rule or approval previously adopted or existing as is required for the adoption of a new rule or approval.

"Matters not on the calendar and not requiring notice may be considered at any meeting by unanimous consent of those present entitled to vote."

Office of Public Roads Prescribes Rules for Federal-Aid Appropriations

Will Control Disbursement of $75,000,000—Close Government Supervision Insured at Every Step—Rules Now in Force

THE DISBURSEMENT of the federal-aid road funds, aggregating in five years $75,000,000, was entrusted by Congress to the Secretary of Agriculture. He, in turn, has turned over the administration of the law to the Office of Public Roads and Rural Engineering. In order to draw up rules for the handling of details a meeting was held in Washington some time ago at which the various features of the procedure were discussed with state highway officials. As a result there has been formulated a set of rules which has been approved by the Secretary and is now in force.

The rules set forth the government's contact with each step of the procedure. Close supervision is provided from the first proposal of a project until its completion. The government will know at all times just how and for what its money is being spent.

The following paragraphs give the main features of the rules. The legal phraseology has been modified and minor steps omitted:

INFORMATION FOR THE SECRETARY

Before an agreement is made upon any road or roads to be constructed in a state, or the character and method of construction, upon request of the Secretary there shall be furnished to him, by or on behalf of the state, general information as to its laws affecting roads and the authority of the state and local officials in reference to the construction and maintenance of roads; as to schemes for future construction; and as to provisions made, or to be made, for constructing and maintaining roads upon which it is contemplated that the expenditure of money appropriated by or under the Act will be proposed.

The information furnished shall be sufficient to enable the Secretary to determine whether it is likely that the money apportioned to the state will be expended, and the roads constructed will be properly maintained, in accordance with the terms of the Act.

PROJECT STATEMENTS

A project statement shall contain all information necessary to enable the Secretary to ascertain (*a*) whether the project conforms to the requirements of the Act; (*b*) whether adequate funds, or their equivalent, are or will be available by or on behalf of the state for construction; (*c*) what purpose the project will serve and how it correlates with the other highway work of the state; (*d*) the administrative control of, and responsibility for, the project; (*e*) the practicability and economy of the project from an engineering and construction standpoint; (*f*) the adequacy of the plans and provisions for proper maintenance of roads; and (*g*) the approximate amount of federal aid desired. With each statement there shall be submitted for the approval of the Secretary copies of the form of contract, together with all documents referred to therein or made part thereof, and of the contractor's bond which it is proposed to use on the project.

Projects will be deemed preferred, and recommended for approval, by the state highway department in the order in which the project statements are submitted, unless it be otherwise specified in writing; but the Secretary may, in his discretion, consider the projects in a different order.

Each project statement shall be accompanied by a sketch map, showing the location of the proposed project and all main contiguous transportation features.

Suitable samples of materials suggested for use in the construction shall be submitted to the Office of Public Roads, whenever requested by it.

Where any part of the cost of a project is to be furnished by a county or other local subdivision or subdivisions of a state, the project statement shall be accompanied by certified copy of each resolution or order, if any, of the appropriate local officials respecting the funds which are or will be made available, or respecting the supervision of the construction of the road and of the expenditure of the money provided or to be provided for paying such cost.

SURVEYS, PLANS, SPECIFICATIONS, AND ESTIMATES

Surveys and plans shall show necessary data, in connection with the specifications and estimates, to enable the Secretary to ascertain and pass upon location, grades, drainage, bridges, other structures, special and unusual features, the work to be performed, and the probable cost thereof.

Specifications shall set forth the proposed method of construction, type of construction,

materials to be used, and other essentials, in such detail as to afford complete knowledge of all steps to be taken in the construction of the project.

The estimate for each project shall show the estimated quantity and cost of each item of construction in detail and, separately, the 10 per cent fund, and shall not include any expense of advertising.

RIGHTS-OF-WAY AND GRADE CROSSINGS

Rights of way necessary for any project shall be provided, and any incidental damages to adjoining property due to construction work paid, by or on behalf of the state, and the expense thereof shall not be included in the estimate or paid in any part by the federal government.

Grade crossings shall be avoided where practicable. The estimated cost of eliminating a grade crossing shall not include any amount the state, county or other civil subdivision is entitled to receive, as reimbursement or payment from the owner of a public utility, on account of such elimination.

No part of the expense of making surveys, plans, specifications or estimates, by the state prior to the beginning of construction, shall be included in the estimate or paid by the federal government.

CONTRACTS

No part of the federal money set aside on account of any project shall be paid until it has been shown to the satisfaction of the Secretary that adequate means, either by advertising or otherwise, were employed, prior to the beginning of construction, to insure the economical and practical expenditure of such money.

Bids shall be in such form that the unit prices will be clearly shown.

Copy of the tabulated bid prices, showing the unit prices and the totals of each bid for every project, shall be furnished promptly to the Office of Public Roads.

In advance of the acceptance of any bid, sufficient notice of the time and place the contract is to be awarded shall be given to the Office of Public Roads to enable it, if it so desires, to have a representative present. When a bid has been accepted prompt notice thereof shall be given to the Office of Public Roads.

If the contract be awarded to any other than the lowest responsible bidder, the federal government shall not pay more than its pro rata share of the lowest responsible bid, unless it be satisfactorily shown that it was advantageous to the work to accept the higher bid.

CONSTRUCTION WORK AND LABOR

Unless otherwise stipulated in writing, materials for the construction of any project shall, prior to use, be tested for conformity with specifications, according to methods approved by the Office of Public Roads.

Unless otherwise specifically stipulated in the project agreement, bridges, viaducts and under-passes shall have clear width of roadway of not less than 16 ft., and clear head room of not less than 14 ft. for a width of 8 ft. at the center.

No part of the money apportioned under the Act shall be used, directly or indirectly, to pay, or to reimburse a state, county or local subdivision for the payment of any premium or royalty on any patented or proprietary material, specification, process, or type of construction, unless purchased or obtained on open actual competitive bidding at the same or a less cost than unpatented articles or methods equally suitable for the same purpose.

Written notice of commencement and completion of construction work on any project shall be given promptly by the state highway department to the Office of Public Roads.

Reports of progress, showing force employed and work done, shall be furnished whenever requested by the Secretary or his authorized representative.

RECORDS AND COST KEEPING

A separate account for each project shall be so kept by the state highway department as to enable the Secretary to ascertain at any time the expenditures on and the liabilities against the project and, separately, the condition of the 10 per cent fund.

Such other records of contract and force account work, and of inspections and tests by the state, shall be kept by the state highway department as will enable the Secretary at any time to determine the condition of the construction and maintenance of, and the cost to the state and the federal government of, the construction work and labor done on any project.

The accounts and records, together with all supporting documents, shall be open, at all times, to the inspection of the Secretary, or his authorized representative, and copies thereof shall be furnished when requested.

Certified copies of payrolls on force account work and of all vouchers for other expenditures shall be furnished, whenever requested by the Secretary or his authorized representative.

Whenever requested by the Secretary or his authorized representative, unit costs on any project shall be kept, on forms furnished by the Office of Public Roads.

PAYMENTS

Vouchers, in the form provided by the Secretary and certified as therein prescribed, showing amounts expended on any project and amount claimed to be due from the federal government on account thereof, shall be submitted by the state highway department to the Office of Public Roads, either after completion of construction of the project or, if the Secretary has determined to make payments as the construction progresses, at intervals of not less than one month.

Solve Silt Problem on Yuma Irrigation Project

Reclamation Engineer Tells of Troubles at Laguna Dam and Describes Methods of Silt Removal from Ditches

SINCE the siphon under the Colorado River at Yuma was completed to furnish water to the Gila River and the Indian Reservation the 65,000,000 acre-feet of water discharged has contained enough silt to cover 1,000,000 acres 1 ft. deep. Approximately one-one-hundredth part of this water was diverted into the canal system of the Yuma project. L. M. Lawson, project manager, in a recent issue of the *Reclamation Record*, states that the sluicing operations at the Laguna dam are so successful that the heavy sand, which represents 25 per cent of the sediment, is all removed and does not find its way into the canal system. Sand has no fertilizing qualities, so the sluicing operations in this respect are considered wholly satisfactory.

In addition to the removal of the sand, a certain varying quantity of the silt in suspension is also removed. With increased wasteway facilities and with the increase in acreage under cultivation, which in the past four years has averaged 5000 acres a year, the difficulty of handling the problem of silt will be greatly diminished. The plan of removing the accumulations of silt, which in the past has consisted in the use of teams and has involved a shutdown of from forty to sixty days in the winter months, is giving way to a program of machine cleaning, using dragline excavators, which will be in operation throughout the entire year, will not interfere with water deliveries, and which will remove the silt at one-third the cost of team excavation.

Had the same amount of silt and sand as the river water contained gone into the canals and onto the land, it would have amounted to 12,000 acre-feet of submerged mud, but an estimate based on the cross-section of the canals and their carrying capacity indicates only 600 acre-feet. It is not deemed necessary to remove this entirely because only one-fourth of the area of the project land is in cultivation. To this limited area using water can be attributed the cause of the quantity of silt now present. As the canals are constructed for the entire area, their cross-section has decreased materially by the discharge of the small amount of water possible because of the limited area being served. In the larger canals, where greater quantities of water can be discharged than were actually required for irrigation, the decrease in area has not taken place to such a large extent, but in the laterals of the project, where only a small percentage of the acreage that they were designed to serve was in cultivation, and where the full capacity of the canal could not be discharged, considerable silting has occurred.

Water Company Asks Advance Payment for Metered Water

As an opening wedge to the disagreeable task of sending notices of reminder that water bills must be paid when due, the Terre Haute Water Company puts into the first paragraph of a letter sent to all consumers the suggestion that many customers dislike to be bothered with bills every month and have therefore asked if advance payments cannot be made. The letter goes on to suggest a system whereby this may be done and receipted bills sent each month, thus saving the time necessary to make out checks. Not until the last part of the fifth paragraph is the "sting" reached in the words, "In the future, where bills are delinquent, the supply will not be continued. Where water is shut off on account of bills not being paid, there is an additional charge of $1." The last paragraph reverts to the prepayment plan again thus: "We have failed to find any other adequate way of enforcing payment from the very small percentage of our customers, who apparently want special favors. We dislike to use this method—it is not pleasant for us, nor for the women folks, who are the ones most inconvenienced. Possibly the new plan of advanced payments may solve the problem—we sincerely trust it will."

CUTOFF-WALL CONSTRUCTION HANDLED BY CRANE AND MIXER MOUNTED ON TOWER

Careful Construction to Make Large Dam for Youngstown, Ohio, Watertight

Well-Rolled Fill, Cutoff Walls to Rock, Riprap Grouted by Pouring and Use of Local Concrete Materials Mark Construction of Large Storage Basin

THE DAM now being completed in Milton township to form a 12,000,000,000-gal. storage basin for the water supply of Youngstown, Ohio, is being built with special attention to securing a permanent, watertight structure of the earthfill-concrete-spillway type. The 200,000-yd. clay-and-gravel fill for the earth portion of the dam was rolled in 6-in. layers, the surface being wet down in advance of each layer. Rock fissures beneath the cutoff wall which protects this fill were drilled into and grouted through 3-in. pipes embedded in the concrete, after the wall was finished, thus saving several months' delay in completing the earthfill. A satisfactory method of securing a riprap slope paving laid up in cement mortar by grouting the riprap, which is first laid dry, saving much time over laying the riprap in mortar by hand, has been developed. An unusual plant, including five towers and two mixers, which made large use of sand, gravel, crushed rock and plum stone obtained on the site, has been used to advantage in constructing the 50,000-yd. concrete spillway section.

FEATURES OF DEVELOPMENT

The dam, which will flood 1700 acres, forming a reservoir 6½ miles long and 1½ miles wide at its widest point, will conserve the flow of the Mahoning River. This stream, which is joined below the reservoir by two others of about the same size, is relied on for at least one-third of the water supply of Youngstown, Ohio, which is expected eventually to reach a consumption of 100,000,000 gal. daily. The present total consumption is about 15,000,000 gal. daily. It is expected that the normal annual discharge of the Mahoning River will be sufficient to keep the reservoir approximately full under the heaviest daily draft that will be made for some time to come. Youngstown takes its water from the river at a pumping station just above the city, at its filtration plant, and the construction of an aqueduct from the new reservoir is not contemplated at present. It acts, therefore, merely as a storage basin.

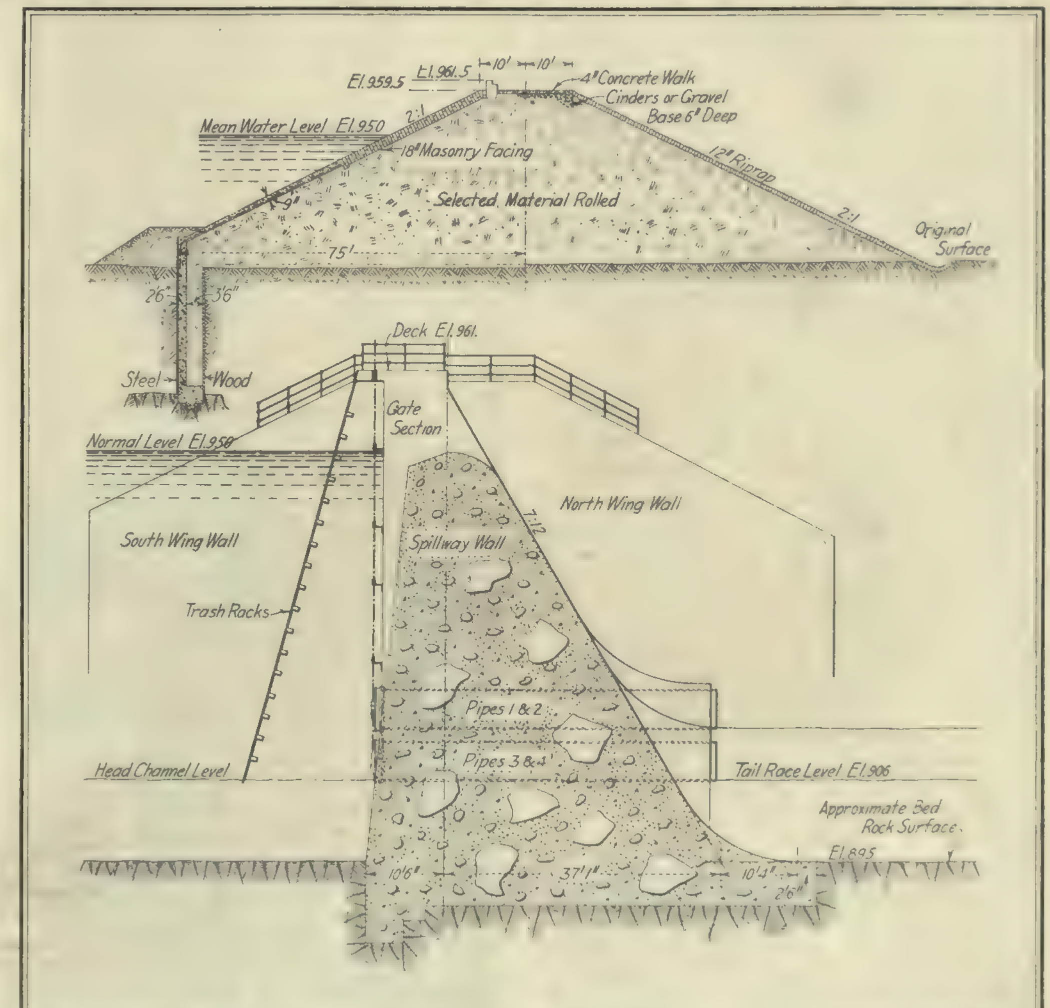
The spillway section of the dam is 638 ft. long, with four sluiceway openings of 20 sq. ft. each located at its west end. The overall length of the dam is 2840 ft., the parapet along the earth section being at El. 961.5, the spillway at El. 9500 and the present river level at about El. 905. The sandstone which underlies the dam site outcrops at the west end and dips to a depth of about 25 ft. below the river level at the east end of the spillway. The project has required the relocation of about 8 miles of road, the clearing of about 500 acres of land and the construction of four concrete and steel bridges. One of these bridges, 1436 ft. long, contains 1274 ft. of concrete viaduct, with a 19-ft. clear roadway, the remaining length consisting of a 160-ft. steel span on concrete piers. Another is of similar construction with a steel structure 800 ft. long and a total length of 1280 ft., with a 23-ft. clear roadway.

EARTH DAM BUILT WITH TEAMS AND DUMP CARS

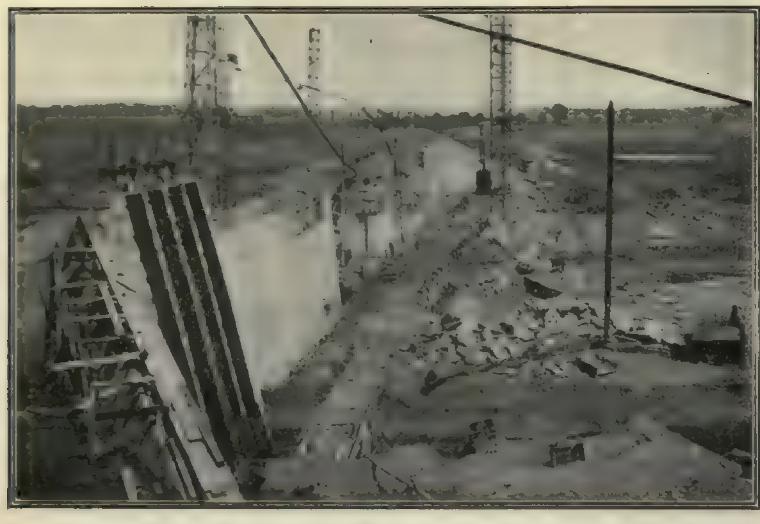
The earthfill section of the dam consists largely of clay, with some gravel. Most of the material was excavated adjacent to the fill inside the reservoir basin by two small steam shovels. At first, only teams and wagons were used in placing it, the greater part of the embankment being placed in this way. Heavy rains during the second construction season, however, made this method difficult and small dump cars on narrow-gage track, which was shifted from side to side as filling progressed, were substituted. The cars were hauled by teams, a snatch team being used to pull six-car trains up from the pit. It was not difficult to keep the thickness of the layers down to 6 in. with this method, and as a 10-ton road roller was used to compact the fill, the method is said to have proved very satisfactory.

CUTOFF WALL BUILT IN NARROW TRENCH

Early in the work a 6-ft. wide trench, sheeted on the upstream side with steel and on the downstream side with wood, was started in which to build the cutoff wall at the upstream toe of the earthfill. The steel sheeting was driven by an ordinary pile-driver, and the wood sheeting was placed as the excavation progressed. This work was taken care of by hand digging and a locomotive crane on a track parallel to the up-



EARTH DAM AND SPILLWAY MADE TIGHT WITH KEYWAYS, CUTOFF WALLS AND GROUTING



CRANES ABOVE AND BELOW DAM AND EXTENSIVE SPOUTING PLANT BUILT SPILLWAY MASONRY WITH MATERIALS BORROWED AT SITE

stream side of the trench. The material was dumped upstream from this track and used for the toe of the extra bank fill upstream from the cutoff. As soon as rock was reached, it was found that grouting underneath the wall to close occasional vertical seams and the horizontal seams between layers of the sandstone would be necessary. To avoid delaying the construction of the wall, which would have held up the placing of the fill, 3-in. pipe was embedded in the concrete at 5-ft. intervals, through which grout holes were drilled at leisure by a single Calyx shot drill. Alternate holes were drilled and grouted, and afterward intermediate holes were drilled as test holes. Very little grout was taken by the secondary holes, and it is believed that all of the seams were successfully closed by grouting in this way.

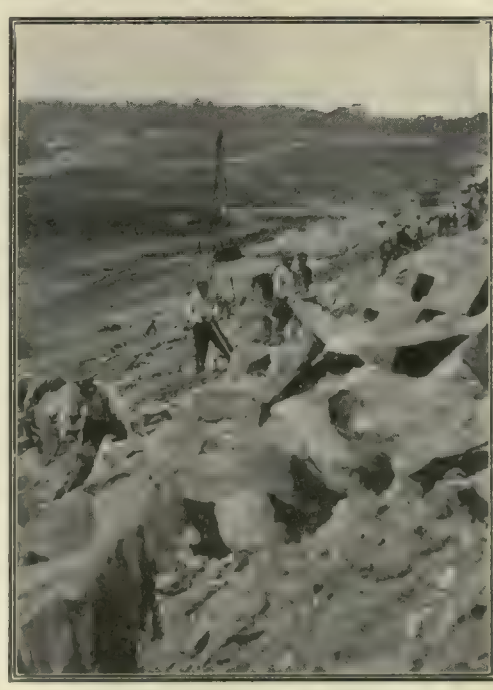
The wall itself, 2½ ft. thick, was poured against the steel sheeting in the upstream side of the 6-ft. trench, and the remainder was puddled. The rock lay from 30 to 36 ft. below the surface of the ground, and the trench was carried down as far as it was practicable to excavate the work by hand with hammer and bars. A key was then cut into the solid rock, the bottom of the trench completely filled with concrete to a point about 3 ft. above bottom of steel sheeting and the wall carried up with a thickness of 2½ ft. from this point. A mixer set in a traveling tower downstream from the trench concreted this wall. Materials were delivered to it by team from the sand and gravel pits. The way in which sand and gravel were wheeled from the earthfill out to the tower over a timber bridge is shown in one of the photographs. This plant was, of course, able to spout concrete directly to place in the wall. On the completion of a section of concrete, the forms, bracing and wood sheeting were taken out and the trench was backfilled with puddled clay and gravel.

Concrete and Riprap Slope Paving

In the top of the cutoff wall was embedded the lower edge of the first sheets of expanded-metal reinforcing for the 9-in. concrete paving which covers the lower half of the upstream face of the earth dam. This paving was not started until the fill was practically complete. It was spouted from a small mixer carried along the top of the fill. A fairly wet concrete, it was found, would stand, if properly manipulated, on the 2:1 slope. The slabs were built in three layers; concrete was first spread over the bank, then expanded metal was placed, then a fairly wet layer, and last a drier mix. The slabs were cast 21 ft. wide, and expansion joints at the sides and bottom were painted with Barrett's paving pitch. Where this paving joined the abutments of the spillway section, a 12 x 18-in. shelf was made in the top of the abutment wing wall, and also a keyway by nailing a 2 x 4-in. strip inside the form, this shelf and keyway being filled by the concrete of the slab when the latter was poured. This precaution and that of extending the slab reinforcing into the cutoff wall are expected to prevent any leakage at these joints, and also to provide against settlement.

Stone Laid Up Dry Before Grouting

As soon as enough of the concrete paving was placed, the earth slope above it was leveled off to a depth of 18 in. below the finished slope surface and work started on laying the rubble masonry extending from the paving to the concrete coping at the top of the fill. The stone for this purpose was brought from a quarry 2 miles east of the dam on long platform cars, in two-car trains hauled by a single team. At first the usual method of laying the stone up in cement mortar by hand was tried. It was thought, however, that considerable time could be saved by laying the stone up dry in advance and then grouting it. This method produces equal, if not superior, results to the old way.



STONE PAVING LAID DRY AND GROUTED

In advance of laying up the dry riprap, the 18-in. face at right angles to the slope above the concrete paving was cut under about 6 in. and plastered with cement mortar. The riprap was laid dry clear to the top of the slope, this work being carried considerably in advance of the grouting. For the latter, a small mortar mixer, gasoline driven, was carried along the top of the fill, being supplied with materials by team. A sectional wood chute from this mixer was laid on the slope to within a few feet of the bottom of the riprap. Mortar was poured down this chute, deflected with a shovel, prevented from piling up at one point by spreading it with wire brooms, and allowed to fill all the joints for a distance of 4 or 5 ft. above the concrete slab. This work was carried 20 or 30 ft. in advance before the upper part of the slope was grouted. A section would then be taken off the bottom of the chute and several feet above the first grouted strip filled. In the next operation another section of chute was taken out and the grouting carried to the top of the bank. The chute was moved by hand over the slope in circles, and the mixer was moved about 30 ft. at a time. A grout of one part cement to three of sand, mixed to flow readily, was used. This grout would disappear from the surface and travel through the joints along the clay slope to a distance of from 6 to 10 ft. from the point where it was first discharged. The work was closely inspected to make sure that the grout was of a consistency to flow properly and that all the joints were filled. It was found that with this method small voids caused by shrinkage occurred about 2 in. below the surface, but that the lower 15 or 16 in. of the stone was thoroughly filled with the gravel.

The top of the earthfill will be paved with a concrete walk having a parapet on the upstream side. The downstream slope will be covered with a compact pavement of 12-in. riprap. It is thought that in this way the dam will be protected against damage from burrowing animals and that provision will be made against the cost of maintaining the 2 to 1 earth slope.

Cranes Excavate Spillway Foundation

Two locomotive cranes, one above and one below the spillway section, on trestles parallel to it, handled the excavation for the foundation and placed the plum stone in the masonry. The earth excavated was piled above and below the dam, but most of it was carried away by one or two floods

which occurred during construction. The stone excavated was largely saved, and used, together with stone from a quarry opened for obtaining crushed rock at a point above the dam, for plum stone.

The crane on the up-stream side was also used to construct the cutoff wall, which was carried well into the hill facing the east end of the dam.

One concrete plant was located near the middle of the spillway section on the downstream side. The aggregate used was half crushed rock and half gravel with sandstone boulders. The plant was supplied from the quarry mentioned, from a large pit stripped below the dam and from a small one above it. Over the ¾-yd. mixer were erected bins filled by a clamshell derrick. This derrick took washed sand and gravel and crushed stone from storage piles, to which material was carried by cars from the quarry, and by gravity from the washing and screening plant and from the crusher plant. The screening plant was supplied by a bucket elevator drawing materials from a small pit into which cars from the gravel pit were dumped.

A second mixer, used for the west end of the spillway section and the short cutoff wall back of the west abutment, was set on top of the hill at the west end of the dam a short distance from the county road. This mixer was supplied with materials brought in by rail to Pritchard, a mile and a half west of the site. A narrow-gage track was laid at the side of the highway from this station, and material was hauled in trains of dump cars by team.

CONCRETE SPOUTED 450 FEET

An extensive Lakewood spouting system, consisting of two steel towers, one at each mixer, and three wooden tail towers, was used. All five towers were about 150 ft. high, and the chutes were suspended from cables strung between these towers and other cables clamped to the first set and extending along the crest of the dam. Concrete was spouted a maximum distance of 450 ft.

The concrete was carried up in sections small enough to allow a depth of several feet to be poured before the cement began to set. The plum stones, weighing from a few hundred pounds to a ton, were washed off with a hose and when necessary cleaned with steel brush brooms, after which they were dropped into the fluid concrete. Smaller stones were embedded by hand in the top of each lift to form a bond with the next section. The sandstone boulders, or plum stones, formed about one-third of the spillway concrete. All vertical sections were keyed to each other in the usual manner. Expansion joints were spaced from 40 to 60 ft. apart. No cracks have developed in any of the sections.

PROJECT NEARING COMPLETION

The earth dam and spillway were started at approximately the same time in the fall of 1913. The latter is now complete except for the upper part of the central concrete section, which has been left open temporarily to take care of flood waters. The earth-fill is finished, as is the paving on its upstream slope. The road reconstruction necessary has been completed, including the four bridges mentioned, so that it will be possible to fill the reservoir this fall. The reservoir will be cleared and burned over, but no earth stripping will be done.

The project has been designed by F. M. Lillie, city engineer, and has been carried on under his general direction. William M. McCartney, supervising engineer for the city, has been in charge of the construction of the reservoir. The contractors for the dam, which will cost about $575,000, are Adovasio & Company of Youngstown. The entire project is estimated to cost about $1,250,000.

FILL, CHIEFLY CLAY, PLACED IN 6-INCH LAYERS AND COMPACTED WITH 10-TON ROLLER

San Francisco-Oakland Bridge Plans

An error was made in the description of the cantilever type of design for the proposed San Francisco-Oakland bridge, submitted by Charles Evan Fowler of Seattle in the news note on page 275 of the issue of Aug. 26. The three 2000-ft. cantilever spans in this design are between Telegraph Hill and Goat Island, and the 2950-ft. approach would connect Goat Island with Oakland. A more complete description of this design will be found in the issue of Oct. 10, 1914, page 398, with editorial comment, or in J. A. L. Waddell's new book, "Bridge Engineering." Associated with Mr. Fowler in developing this design were Gustav Lindenthal, Frank C. Osborn, Edwin Duryea, Jr., and Prof. Charles B. Wing. A typographical error in the note made the estimated cost of the Wilbur J. Watson design $23,000,900; the correct figure is $23,900,000.

How Horsepower Is Burned Up at Arrowrock Dam

Batteries of Gates Are Placed at Different Levels—Smooth Passages Under High "Spouting Velocities" Wear Well

AT THE HEIGHT of the irrigation season enough energy in the discharge of the Arrowrock dam must be destroyed every second to lift a 250-ton locomotive 100 ft. in the air. The tale of how the water is regulated and foot-pounds are smashed up into British thermal units at this high dam is one of many sleepless nights and days of hard work in the design, construction and installation of the various valves and devices now in operation. J. M. Gaylord, in the August *Reclamation Record*, tells the story of how it has been done at Arrowrock.

FIVE PASSAGES THROUGH DAM

At the level of the river bed five passages lead straight through the solid concrete of the dam. These passages are for draining the reservoir, should this become necessary, and were also used to carry the flow of the river when the diversion tunnel was closed upon completion of the dam. In each passage is a massive sliding gate of steel and cast iron, operated by a powerful oil cylinder. An operating gallery just above these outlet passages runs parallel with the face of the dam and contains the operating mechanism for the sluice gates. These gates are intended for operation only when the water is less than 60 ft. deep over the outlet, but the oil cylinders are sufficiently powerful to operate them under 100-ft. head should emergency require. It is not desirable to operate these gates partly open except under very low head, as this kind of service subjects the mechanism to much greater stresses than wide-open discharge when the leaf is completely withdrawn from the flowing stream. Neither is this type of gate adapted to use under high heads even when wide open. When the water reaches a depth of 100 ft. it has a very high "spouting velocity" and when released will attain a speed of nearly 60 miles per hour. These terrific velocities must be handled with due respect, and an entirely different type of valve has been developed for this service.

TEN OUTLETS REGULATE FLOW

Five feet above the river bed a battery of ten outlets is placed, this time circular in form and controlled by Ensign balanced valves, described in the Engineering Record of July 11, 1914, page 53. These are the lower main outlets for the discharge of irrigation water and are designed for continuous regulating duty under high heads up to 150 ft. if necessary. These are, by courtesy, called needle valves, although the analogy is rather remote, the so-called "needle" being a small trinket of cast iron and bronze 6 ft. in diameter and weighing in the neighborhood of 10 tons. The valves themselves are placed on the upstream face of the dam and are entirely submerged. By an ingenious yet very simple arrangement of the needle and cylinder in which it moves each valve is made to constitute its own power plant, and the operation which in the case of the sluicing gates requires an oil-pump motor and piping is performed by simply opening or closing a small control valve in the second operating gallery. The water surrounding the valves is the operating force and the balanced valves follow the operation of the control valve, opening

when it opens and closing when the control valve closes.

Smooth Passages Do Not Wear

The water enters the valve radially and is discharged as a smooth circular jet in the center of the outlet passage. Every precaution has been taken to make the water passage below the valves perfectly smooth and straight so as to offer the least possible resistance to the stream. To these straight smooth passages and the correct shape of the needles is largely due the success of these outlets, which have operated throughout two seasons and are still in perfect condition. The tar is not even worn off the castings of the valves.

At this level there are, in addition to the irrigation outlets, three openings designed to deliver water to a power plant should one be constructed at a later date.

At an elevation 150 ft. above the lowest outlets is located the upper battery of ten balanced valves for the regulation of the irrigation flow and to assist in the control of floods. Each of these twenty valves will discharge up to 800 cu. ft. of water per second, and when these jets, each 5 ft. in diameter, are in operation, the results are indeed spectacular. The water falls clear of the dam and its energy is absorbed harmlessly in the pool below.

Rolling-Dam Spillways Work

Last, though not least in importance of the control devices, is the regulating spillway crest, which is said to be actually endowed with almost human intelligence. It consists of six closed steel tanks, 62 ft. long, with a cross-section like a sector of a circle being hinged along the narrow side just below the concrete crest of the spillway (see Engineering Record of Aug. 2, 1913, page 125). They can be depressed into chambers in the spillway to allow a flood to pass or raised to any desired height to maintain the desired water level. When set for automatic operation, the moving crests will, without attention, fall step by step to allow a flood to pass and gradually rise again to the desired elevation as the flood subsides, thus allowing the flood to pass as quickly as is safe, yet storing the desired amount of water as soon as the flow falls to a safe valve. These crests are the watchdogs of the reservoir and protect the dam and river below against sudden floods. They have been tested out experimentally and their operation demonstrated to be remarkably satisfactory.

The various devices for the control of water at Arrowrock are operating with perfect satisfaction. The flow can be regulated from 1 sec.-ft. to 10,000 sec.-ft. with ease and safety, and floods of 40,000 sec.-ft. can be handled by the spillways, although no such flood has yet passed the dam. The success of these devices is no doubt due in large measure to their efficiency and simplicity, which are the true criteria of engineering excellence of design.

Road Engineers Needed

Inquiries made by the National Automobile Chamber of Commerce to highway commissions show that there is a lack of well-trained highway engineers. Steps have been taken in a movement to encourage the universities and colleges to provide special courses in highway engineering to meet the rapidly growing demand for engineers in this field.

Valuation of Rock Island Terminal Zone in Chicago Presents Many Special Problems

What Is Believed to Be First Inventory of Large Terminal in Connection with Federal Valuation Is Being Made by the Railroad

By C. W. STARK
Associate Editor, Engineering Record

When one thinks of the tremendous task imposed upon the Interstate Commerce Commission by the federal Valuation Act, one is likely to have in mind the 250,000 miles of railroads stretching over the entire country, and to overlook the complicated conditions at the large railroad centers. The Division of Valuation, beginning with some of the smaller roads, away from the great centers, has not yet got deeply into the terminal tangles, even though a large part of the mileage of some of the leading railroad systems has now been covered by the field parties. An inkling of the special problems to be encountered in terminal zones is found in the inventorying of the Rock Island terminal district at Chicago, now nearly completed. In the editorial pages will be found comment on the decision of the Division of Valuation, believed by the writer to be a wise one, to let the railroad make the inventory. Suffice it to say here that the usual procedure has been reversed, so that the railroad company is doing the work and the government is merely providing the pilot or inspector.

What the Terminal Zone Comprises

The part of the Rock Island system designated as the Chicago terminal comprises everything owned or used by the company between the La Salle Street Station and Joliet, 43 miles west on the main line. In addition to the 43 miles of main line, there is a suburban line 7 miles long, known as the Dummy Line, leaving the main line at Gresham and coming back at Blue Island, and a line known as the South Chicago Branch, which is used by the Baltimore & Ohio and the Pere Marquette as an entrance to Chicago, and by the Rock Island for interchange freight business. This branch is also 7 miles long, and extends from Gresham east to South Chicago. In addition to this are the great industrial centers throughout the South Chicago manufacturing district, which are tapped by this line.

The La Salle Street terminal station, one of the six principal passenger terminals of Chicago, is owned jointly by the Rock Island and the New York Central. The two roads own and operate jointly the main tracks from the terminal to Englewood, 6.7 miles, the New York, Chicago & St. Louis being a tenant of the New York Central. In this stretch there is also a profusion of side tracks, freight yards and houses, shops and bridges, some under the sole ownership of one or the other of the two companies, others under various divisions of ownership in no way discernible on the ground.

Parts of the South Chicago line are owned and operated jointly with the Chicago & Western Indiana. In addition, as previously stated, the Baltimore & Ohio and the Pere Marquette are tenants of this line and about a mile of the Dummy Line. At Joliet, too, there are joint facilities with other roads.

In the last twenty years or so the La Salle Street terminal has been built, the joint line to Englewood has been elevated in nine successive programs, more track elevation has been and is being done on the main line beyond Englewood, track elevation has been done at South Chicago and Joliet and a new joint station for five roads has been built at Joliet.

Special Problems Every Mile

Practically every mile of the line, at least within the corporate limits of Chicago, involves special difficulties. At Van Buren Street is the terminal station itself, which has undergone various minor alterations, covered fairly well, however, by the records. At Twelfth Street is the long viaduct crossing over not only the Rock Island-New York Central facilities, but also over the Chicago & Western Indiana group of roads, and the Chicago River. The Rock Island owns several spans of the viaduct and paid in a large part for two north-and-south approaches.

At Sixteenth Street and at South Chicago there have been grade separations—the one some fifteen years ago, the other recently—of two of the most complex railroad grade crossings in the United States. At each point tracks pass in every direction, some straight, some curved, some intersecting at grade, some passing under or over. Ten railroads participated in the work at Sixteenth Street, while five were involved at South Chicago. At each, streets are involved, and with the numerous interchange tracks and connections there is a profusion of bridges, walls and approaches, the division of ownership of which can become known to the outsider only by an exhaustive study of the records and the local topographical conditions.

Then at Forty-seventh Street are the locomotive shops, engine house, testing room, etc., of the Rock Island, where with the expansion of the road and the efforts to utilize to the best advantage the limited area available facility has crowded out facility. Here are buildings for which no plans have been found, and masses of buried pipe lines discovered by accident. Probably no inventory could possibly cover all of the physical plant between Forty-seventh and Fifty-first streets.

And at Seventy-ninth Street is a complex piece of recent construction, where the Rock Island passes over the Chicago & West Indiana at an angle of 16 deg. and the Western Indiana in turn passes over Seventy-ninth Street.

Track Elevation in Sections

Throughout the terminal zone, as Chicago rapidly grew, the railroad has also grown, in tracks, freight houses and signal plants. And at the same time expediency or ordinances have forced the elevation of the tracks, one section after another. Each successive section has required semi-permanent transitions and adjustments between the old level and the new at the ends of the sections. At one point there have been three distinct lifts years apart, the first entailing the raising of a grade crossing 5 ft., the second, which was nearly fifty years ago, consisting of a grade raise at the

time the entire city was raised off the prairie level so as to provide drainage, and the third to separate the street and railroad grades.

All this has a direct bearing on the original cost, because market and labor conditions and the consequent unit prices may have differed greatly with each construction program. The railroad company can also reasonably contend that it has almost as much bearing on the reproduction cost. In most instances any other method of construction than the piecemeal one employed of first building the railroad on the ground and afterward elevating it would probably have been out of the question, involving a prohibitive amount of hauling of bridge and other heavy material through streets. Consequently the inventory aims to record not only what has been built, but when and how each item was built, so that the original construction conditions may be known preparatory to outlining a reasonable and economical method of reproduction. The prices can then be fixed accordingly.

CHICAGO ROCK ISLAND AND PACIFIC RAILWAY

RECORD OF TIE CLASSIFICATION AS OF______________1915.

VALUATION SECTION_____, CHICAGO TERMINALS.

Between____

GROUP 1

YEAR				1895	1896	1897	1898	1899	1900	1901	1902	1903
Creo.												
Zinc												
W Oak												
Cedar												

YEAR	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	Total	%
Creo.														
Zinc														
W Oak														
Cedar														

	GROUP 2	GROUP 3	GROUP 4	GROUP 5	Total	%
TREATED						
Creosote						
Zinc						
UNTREATED						
White Oak						
Cedar						
All Other						
TOTAL						

GRAND TOTAL--------------

Grouping of Tracks in this Section.

Group 1

Group 2

Group 3

Group 4

Group 5

REMARKS:

THIS FORM ACCOUNTS FOR EVERY TIE—SIMILAR FORMS USED FOR RAIL AND OTHER TRACK PARTS

Organization of Valuation Work

The organization of the valuation work is very similar to that used by the government. The whole terminal zone has been divided into two divisions, each in charge of an assistant engineer. The divisions have been subdivided into convenient valuation sections and subsections, those within the track-elevation zone conforming as closely as practicable to the limits of the various elevation programs. The 6.7 miles from the La Salle Terminal to Englewood, for example, are divided into nine subsections.

The inventory of each of the two divisions has been handled by one main roadway party assisted by specialists in various lines—bridges, buildings, signals, machinery and the like. Each party was accompanied by a government representative. Just as where the work is done by government forces, the notes were kept in duplicate on government note forms, with blanks for the signatures of both the carrier's and the railroad's representatives. In cases when other carriers are interested their representatives joined the field party, which for the time being became a joint party with the other carrier or carriers, and copies of all records, notes and the like on the joint utility were supplied to each carrier intended.

The notes are now being worked up and summarized by the railroad's men in office cars maintained by the company, and as sections are completed the originals of the notes and computations are transmitted to the government, the railroad keeping the carbons—or in case of several carriers, blueprint copies.

High Standard of Accuracy

Because of the larger values involved a much higher standard of accuracy has been maintained than in ordinary country districts. The cross-sections were taken with a wye level and referred to city datum, and all the data and quantities carefully checked and compared. In this way accurate cross-sections of present embankments were possible, but it was still necessary to resort to old profiles and cross-sections to separate the whole grading at various points into that of two or more improvements made at different times.

All available plans of bridges and buildings were compared in the field with the structures they represented. If a few check measurements showed that the structure had been built according to the drawings, no detail survey was made. If there were deviations from the plans, these were carefully measured and if possible indicated on the drawings, otherwise on separate sketches.

The La Salle Street Station is covered by 160 plans. Although in the main the construction agrees with the plans, there have been many minor deviations, particularly in the matter of new partitions and various building changes, and it was no small task to locate these, measure them and correct the drawings. Even this only showed the structure as it is now. As is well known, in a large building of this sort interior changes to meet new requirements are frequent. Careful examination of all available records has been necessary to run these down, and it is probable that no inventory will ever list them all.

More field work has been required for some of the smaller buildings, for which there are no plans, than for larger structures well covered by drawings. Much time has also been spent on interior fixtures. In the present state of the valuation art, with the likelihood that there will be disagreements between railroad and government over features of the final valuations, and that the railroad may be called upon to prove any contentions it may make, the company has deemed it safest to go into minute detail in the construction of buildings and their fittings. Thus for the Forty-seventh Street shops there are 143 pages of building notes. For the racks and other fittings of a two-story storehouse 257 x 60 ft. there are twelve pages of notes, the building itself being covered by ten plans.

Forty-seventh Street Shops

These Forty-seventh Street shops have been one of the most troublesome parts of the terminal to inventory. Built in the period from 1869 to 1873, when the main tracks were at the low level, they have undergone numerous changes in the effort to keep them adequate for the needs of the rapidly growing traffic. There are two roundhouses, one occupying practically the whole circle. Part of the other was torn down recently. The other facilities include locomotive shops, paint shops, storehouses and a laboratory. Aside from the dismantled locomotives in various stages of repair and reconstruction, suggesting interesting problems for the equipment appraisers, there are machinery of many sorts

undergoing changes and replacements even during the period of the inventory; pipe lines and conduits overhead and underground, in use and of known location; walls, tunnels, sewers and the like once useful and so elements of original cost, but discoverable only by study of old plans, or by sheer accident, and undoubtedly similar items not discovered at all.

The field men were not able to apply any formula to the inventorying of this plant. They could only push through by main strength, going over the ground repeatedly, to see that they had not skipped anything, and studying old records and querying old employees for hidden quantities. At best the valuation department believes that a percentage should be allowed for contingencies of inventory, but is not prepared to name the figure.

Photographs are an important part of the notes. Pictures were taken freely of small buildings, signal bridges and other structures; also of types of signs, switchstands and the like, and classifications of masonry—in short, wherever it was thought they would visualize and supplement the field notes or take the place of sketches.

EVERY TIE AND RAIL ACCOUNTED FOR

In common with the other railroads, the Rock Island disagrees entirely with the government's interpretation of depreciation (see the Engineering Record of June 17, page 794), and the notes do not include findings of condition per cent. Nevertheless it is the aim in the valuation of the Rock Island Terminal to present the best information for whatever interpretation is accepted. In the matter of buildings the railroad can do little but present records to show when they and their various additions were built. What is held to be a more precise method than the Division of Valuation is using elsewhere, however, is being applied to the elements of track. Each tie and rail is, in fact, accounted for.

The tie-classification form used is here reproduced. The tracks are first grouped according to speed and usage, the grouping being indicated in the blank space below the center of the page. Group 1 covers the main tracks. Group 2 covers switching leads, ladders in yards and other tracks carrying heavy but not high-speed traffic. Passing sidings and the body tracks in yards make up group 3, freighthouse, team and important industry tracks form group 4, while group 5 is confined to the tracks least used. The railroad proposes to file with the Division of Valuation plans showing the grouping. The company is fortunate in that the ties bear dating nails showing when each was laid. In group 1 the ties are classified both as to kind and as to age. In the remaining groups the ages are ignored but the kinds are treated. With this form filled out the company believes that the government can do much better than make a blanket estimate of the condition per cent of all the ties.

A form of the same general type is used for rail, the tracks being grouped in the same way. Under group 1 age, weight, kind and linear feet are given; under the others only weight, kind and linear feet. A third form accounts for tieplates, and also has spaces for short summaries of the ballast and the drainage.

The arrangement between government and railroad covers only the inventory of the physical property of the railroad. As the railroad is taking no part in any findings as to condition per cent except to present the facts of age and kind as aforementioned, so it is not proposing unit prices nor offering data bearing upon intangibles or "other elements of value." The company's valuation department is, however, working along both of these lines, with a view to getting its evidence ready for use at the proper time. Working in conjunction with a committee of all the railroads entering Chicago, all the cost data available on all of these roads in what they designate the Chicago terminal district are being assembled, analyzed and tabulated.

Studies are also being made of the traffic on the various lines, and traffic charts will be filed with the government. These are intended both to give a better understanding of the standards of construction and maintenance required and to aid in determining what values attach to the various lines from the service standpoint, apart from the original and reproduction costs of the "bare bones." Thus far it has been necessary to subordinate these investigations to the demands of the inventory, but with the field work disposed of it is hoped that more attention can be given to them.

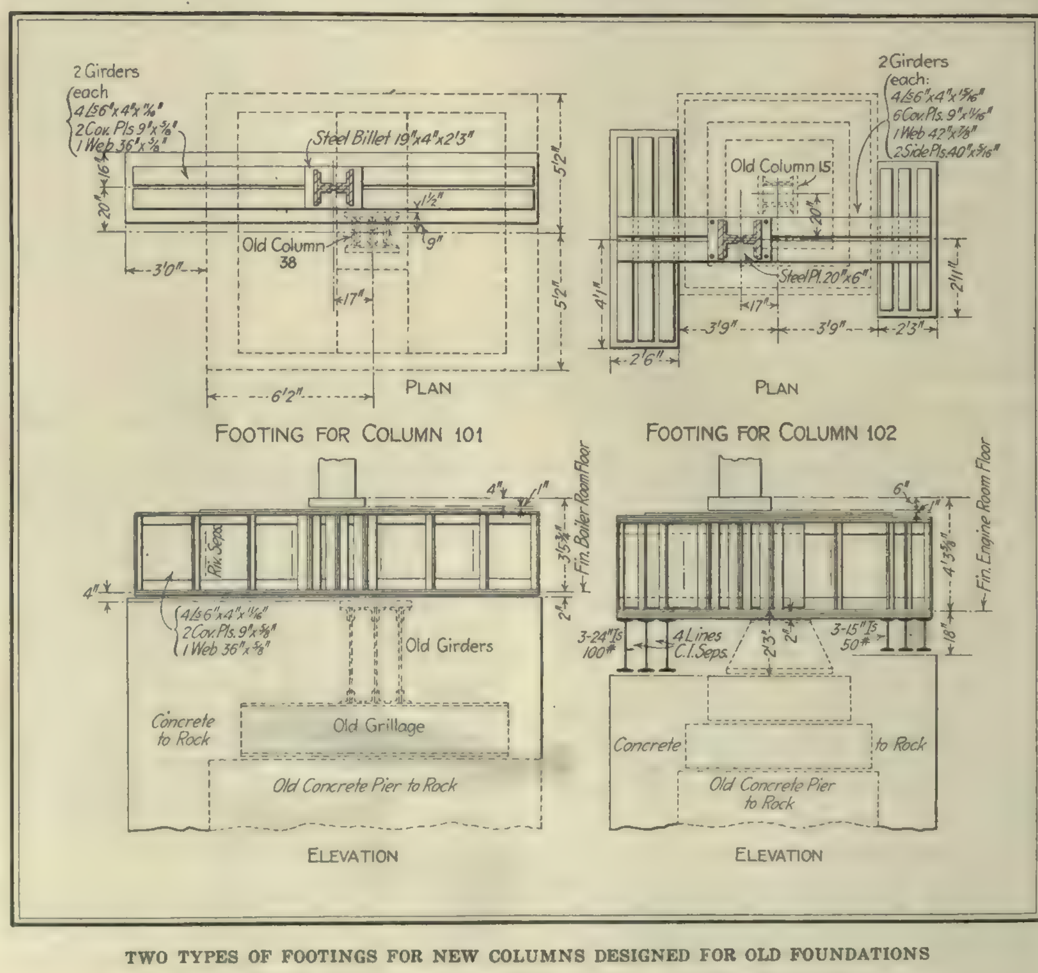
The valuation of the Rock Island terminal zone is being carried out under the general direction of C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Railway, and chairman of the company's valuation committee, and under the immedate direction of R. H. Ford, engineer of track elevation—R. C. Sattley, valuation engineer, confining his attention to the remainder of the Rock Island system, the inventory of which is nearing completion by the government forces. F. F. Tate is in charge of one of the two main subdivisions of the terminal zone—the work of the other having been finished and the force disbanded—and William Sharpe, cost accountant, with a force of accountants, is working on the records. The field work was started July 18, 1915. A year later it was practically completed, but considerable work still remains in the way of computations and the assembling of the data.

New Columns and Trusses to Support Added Stories in Engineering Societies Building

Special Foundations Adjacent to Old Columns Are Carried Down to Solid Rock—Cantilever and Connecting Trusses with Hangers to Be Used

WHEN the American Society of Civil Engineers voted to join with the United Engineering Societies last June, and the board of direction decided to accept the plan providing for an addition of three stories to the present building on Thirty-ninth Street, in New York City, plans for the structural framework were approved by the city building department before the new height-restriction law was passed on July 25, limiting the height in this district to twice the width of the street. Fortunately, the building code passed since the original design of the existing structure built in 1907 (see the Engineering Record of Feb. 5, page 170) allows higher unit stresses in the present columns in the exterior walls on the west and rear, so that they can carry the added loading without reinforcement.

Four new interior columns have been designed to pass through the building from



TWO TYPES OF FOOTINGS FOR NEW COLUMNS DESIGNED FOR OLD FOUNDATIONS

Columns 101 and 104 and columns 102 and 103 have similar foundations.

new foundations in the basement to the roof, to support long-span trusses just below the present roof. Above these trusses, two of which cantilever over the new columns, will rise the required additional columns, and below them, supported by angle hangers, will be a new stack-room floor, above the present library. The four long new columns are located at the corners of the main auditorium just outside of existing columns, this location being practically fixed by the presence of open-duct or freight-elevator spaces. Furthermore, only slight interference with interior partitions here results, pilasters being used in some floors. The new foundations, adjacent to existing concrete piers and steel grillages, had to be carried to sound rock and required a special design, illustrated herewith.

New Foundation Details

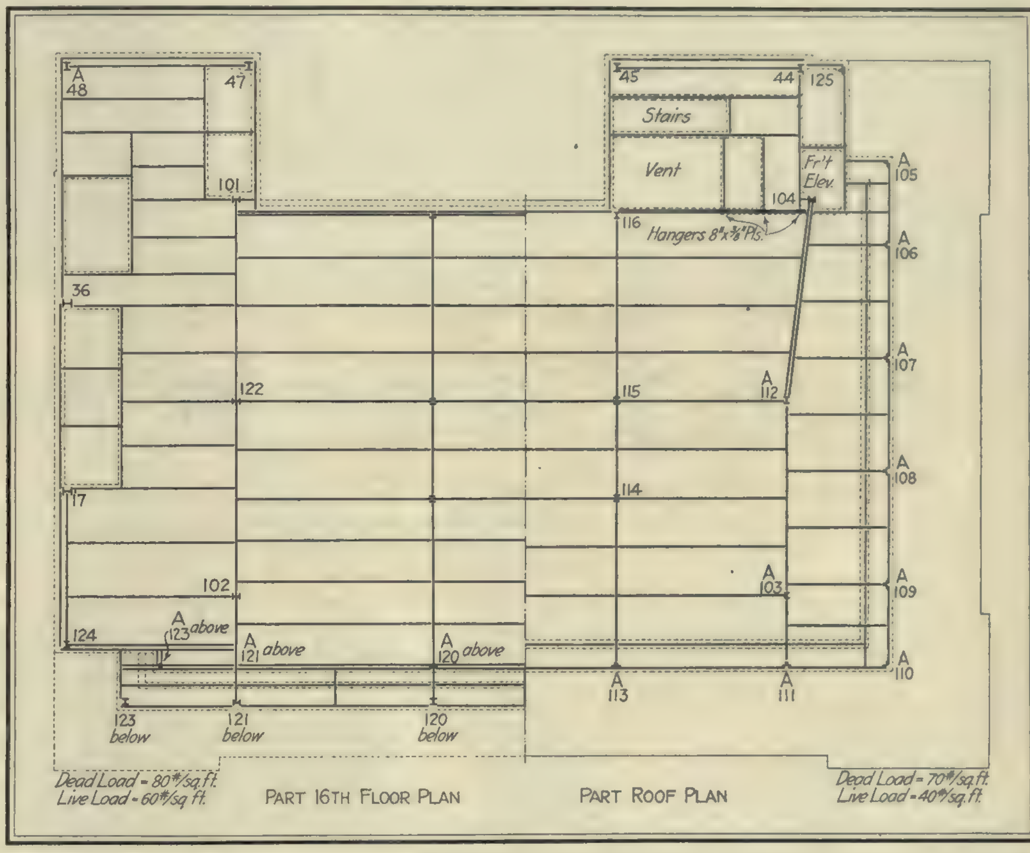
The foundations for the four new columns, carried down about 50 ft. below sidewalk level to sound rock in each case, are of two different types. Columns 101 and 104 will be supported by foundations of the same type, as shown, in which two steel-plate girders above the old steel grillage girders are carried by new concrete placed on one side of the existing concrete pier. Columns 102 and 103 will be supported by a type in which the two plate girders are carried on steel grillages at each end, placed on new concrete next to the old pier on each side.

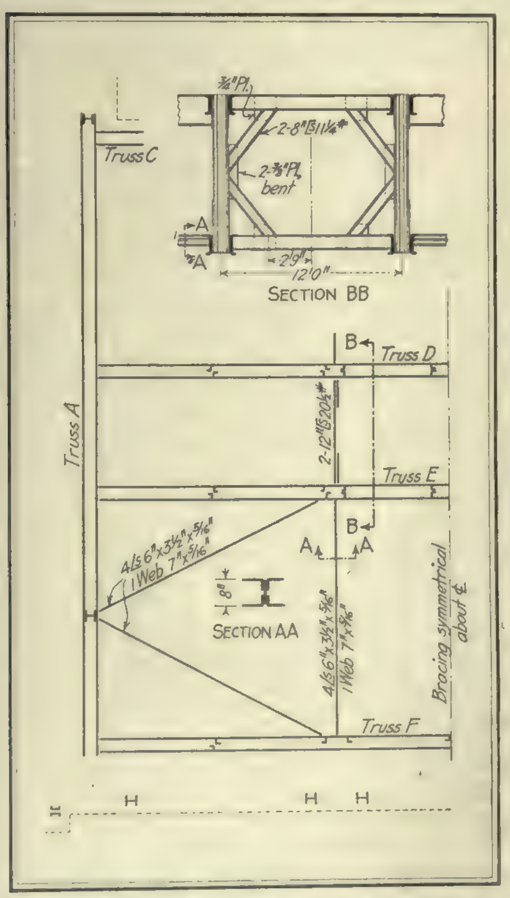
The foundation work has been carried out with some difficulty because of the restricted working spaces in the basement of the building and interferences with existing columns and walls. Timber sheeting was used for the excavation and the concrete poured against this sheeting as an exterior form. The concrete was mixed by hand on the floor of the boiler room.

The problem of furnishing support for the additional loading of the new floors quickly reduced itself to a single practicable solution. Owing to the impossibility of gaining access to the present front columns, and the fact that many interior columns do not run straight through the building but are offset at trusses or beam framing which could not be reinforced, the addition of reinforcing metal to existing columns was impracticable. The presence of ventilating ducts and elevator spaces near four interior columns suggested the satisfactory plan of using this waste space for new columns which would support trusses carrying practically all of the increased load by cantilevering over to the front of the building.

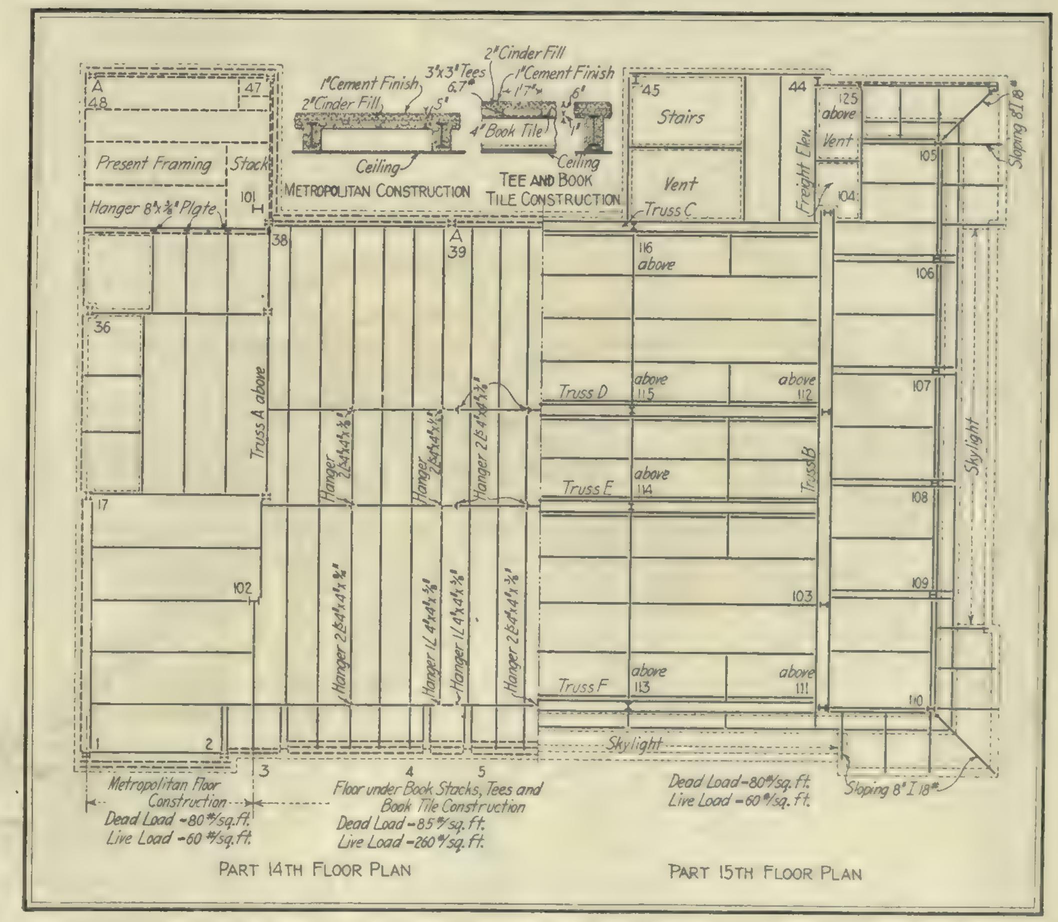
The new columns are of the usual built-up I-section, and carry varying loads, with a maximum of 1,537,000 lb. on column 103. They are about 240 ft. long from foundation to top of trusses near the present roof line and are connected to the existing columns or to floor framing at the various floors by angles or diaphragm connections, as illustrated in typical details in the drawing herewith. The old columns in the rear and west-side outer walls will be spliced to new columns carried to the height of the new roof.

The other columns, as illustrated in the framing plans shown, are located above the





HALF PLAN OF BRACING IN PLANE OF LOWER CHORDS OF TRUSSES



LOCATION OF COLUMNS AND TRUSSES FOR ADDITION TO THE ENGINEERING SOCIETIES BUILDING

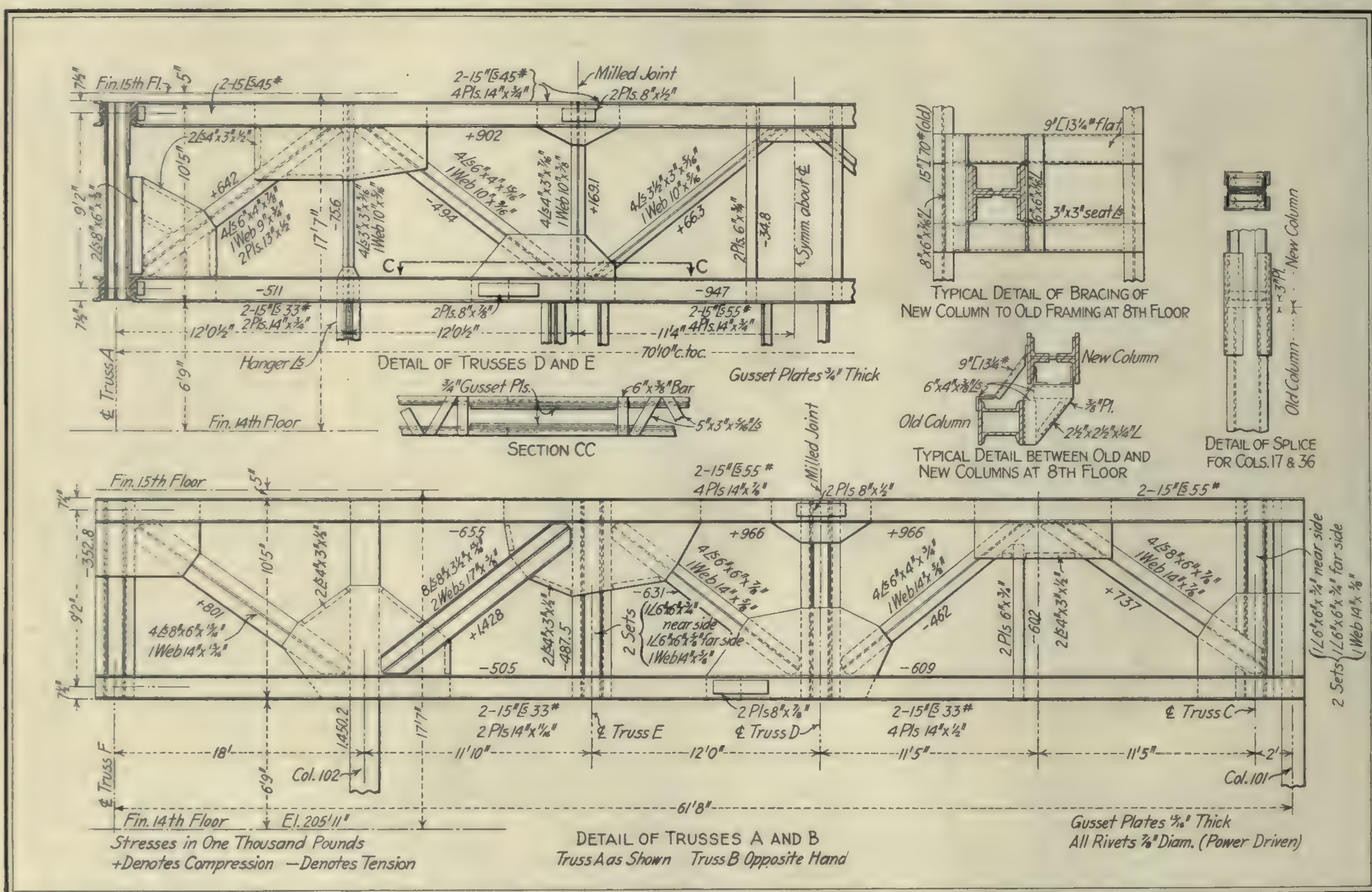
new trusses, with exterior offsets on the front and east side to produce a pleasing dome-like outline to the added portion of the building. The appearance of the building from Thirty-ninth Street and Fifth Avenue is, by means of a model, being given particularly careful study to avoid the destruction of the architectural harmony of the present structure.

TRUSSES AND DETAILS

The greater part of the added loading is carried by the cantilever trusses *A* and *B*, perpendicular to Thirty-ninth Street, framing directly into the new columns as shown on the detail drawing. Four trusses frame into these end trusses, as indicated by the floor plans, and support the fourteenth or stack-room floor by hangers as noted and the upper floors and roof by columns located as shown on the plan views. This layout was fixed by the location of the supporting columns and the relative position required for the new columns above the present roof line, as well as by the advantageous position of new stack space required to house the Civil Engineers' library.

The live loads, specified on the drawings, were fixed by the building code, except that for the stack-room floor. This value of 260 lb. per square foot was found by assuming books and stacks to weigh 45 lb. per cubic foot, less about 20 per cent for empty space, and including live load on the floor area between stacks at 60 lb. per square foot, then averaging the total. Wind pressure and lateral forces are transferred to the columns by horizontal struts and diagonals in the plane of the lower chords of the trusses, as illustrated.

The original design and layout of the Engineering Societies Building was described in articles in the Engineering Record of Dec. 16, 1905, page 686; Feb. 16, 1907, page 186; April 6, 1907, page 449, and April 20, 1907, page 480. The addition is being designed by Henry G. Morse, architect, who was associate architect for the original building, and Purdy & Henderson, of New York, consulting engineers. The total cost up to $250,000 will be borne by the American Society of Civil Engineers, and any excess over this amount will be paid by the United Engineering Societies. The work is divided into two contracts. The first, for the four new columns and foundations, has been let to the Wells Construction Company, and the work is being pushed with the idea of completing this part of the construction, which interferes with the occupancy of the building, before the middle of October. The steel columns are designed of stock material and fabricated by the Bethlehem Steel Company. The second contract, for the remainder of the work, has not been advertised, and will await the final decisions as to floor plans and exterior finish, which are not yet settled. The building committee in charge consists of one member from each of the constituent societies—H. H. Barnes, Jr., H. G. Stott, Charles Warren Hunt and Charles F. Rand.



DETAILS OF CANTILEVER AND CONNECTING TRUSSES SUPPORTING NEW FLOORS BY HANGERS AND COLUMNS

New List of Geographic Points in Michigan and Indiana

Descriptions, latitudes and longitudes of 865 points in Indiana and Michigan, constituting the horizontal control upon which the topographic maps of the U. S. Geological Survey are built, are given in the recently issued Bulletin 644. Engineers having use for this information may secure a copy by applying to the Department of the Interior.

Creosoting Effective for Fence Posts

Government Tests Indicate That Good Open-Tank Treatment Will Produce Satisfactory Results

GOVERNMENT experiments indicate that creosoting is effective in protecting fence posts against decay, and that an open-tank method of treatment is the most satisfactory. The service tests have been conducted by the U. S. Forest Service in co-operation with various state agricultural experiment stations on posts installed between 1906 and 1909, and are discussed by Harlow Bradley, assistant engineer in forest products, U. S. Forest Products Laboratory, in Bulletin 187 of the American Railway Engineering Associaton. These notes are taken from his paper.

The posts were given a variety of treatments in an effort to develop the most satisfactory apparatus and method for use on the farm, this being the primary object of the experiment. The open-tank method of treatment, which has proved to be the most practical for this purpose, is carried on about as follows:

The butt of the post is soaked for a time in the hot preservative (200 to 220 deg. Fahr.). In this way the air and moisture in the wood are expanded and partly forced out, very little oil being absorbed during this operation. The post is then allowed to cool in the same oil for several hours. As the interior of the wood cools, the air contracts and the preservative is drawn in. This is known as a single-tank treatment. The top of the post remains untreated. At the end of the hot bath the post may be removed and either the butt or the entire

post submerged in a second tank containing cold or cooling oil. This is the double-tank treatment, and where the post is totally submerged, the top receives a like treatment owing to the soaking action of the wood.

Either the single or the double-tank method of treatment was applied to most of the posts, although the brush treatment, soaking treatment (in cold oil) and charring were also tried. The brush treatment consists in painting the posts with two or three coats of hot creosote, generally using a wide brush for the purpose. In the soaking or dipping treatment the posts were merely submerged in cold or warm oil for a few minutes. The soaking treatment should not be confused with the open-tank treatment, which depends on the partial vacuum created within the wood by the contraction of the air.

The experiment was carried out in co-operation with the following agricultural experiment stations: South Carolina Agricultural Experiment Station, Clemson College; Alabama Polytechnic Institute, Auburn; North Louisiana Agricultural Experiment Station, Calhoun; University of Minnesota, Zumbra Heights; Iowa State College, Ames; Maryland Agricultural College, College Park.

CONCLUSIONS

The data show that nondurable species, especially in the South, should have at least a light top treatment in addition to the heavier butt treatment. Brush treatments, soaking in cold oil, and double-tank treatments where asphaltum was used as the heating medium in the hot bath were not very effective in preventing decay in nondurable species. Charring was apparently of no value. Care must be taken to have the butt treatment extend well above the ground line to allow for possible changes that may occur in the ground level, and for possible carelessness in setting.

Butternut and willow decayed so readily in the tops that a heavy treatment of the entire post seems advisable. An especially good treatment appears necessary in basswood if satisfactory service is to be obtained.

Conditions seem to be more favorable for decay when posts are set around barnyards than when set in fields or woodlots.

The results clearly indicate that a good open-tank treatment of fence posts with creosote will give satisfactory results in preventing decay in most of the nondurable species.

Posts treated with water-gas-tar creosote and water-gas tar have stood up very well thus far. Those treated with the creosote are in somewhat better condition than those treated with the tar.

MIXER LAYOUT AND CONSTRUCTION TRESTLE—NORTH END OF BRIDGE

Central Bridge at Lawrence Is Built from Four Separate Mixing Plants

Construction Trestle Used Over Shallow Merrimac River—Three Caissons for One Bascule Pier Sunk Under Compressed Air

By E. K. CORTRIGHT
Resident Engineer at Lawrence for B. H. Davis, Consulting Engineer, New York City

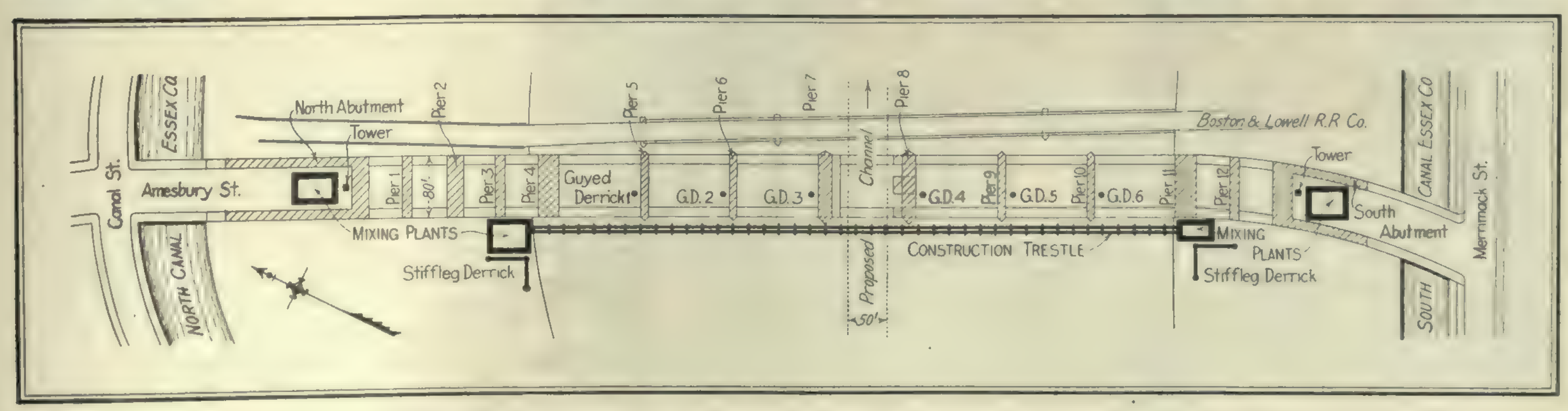
IN MAKING the plant layout for the construction of the Central Bridge at Lawrence, Mass., only a small amount of floating equipment could be used because there is normally only 3 ft. of stream flow in the Merrimac River at this point. This condition, together with the very limited space available at either end of the structure, resulted in an unusual concrete plant layout with four separate 1-yd. mixers used in combination with a construction trestle.

Two heavy bascule piers, one of which rests as a spread foundation upon compact gravel, the other on three separate caissons carried to bedrock by compressed air, provide for the possibility of future navigation. In concreting the river piers above the top of the foundations no horizontal joints were permitted, the only joints being in vertical planes parallel to the center line of the bridge.

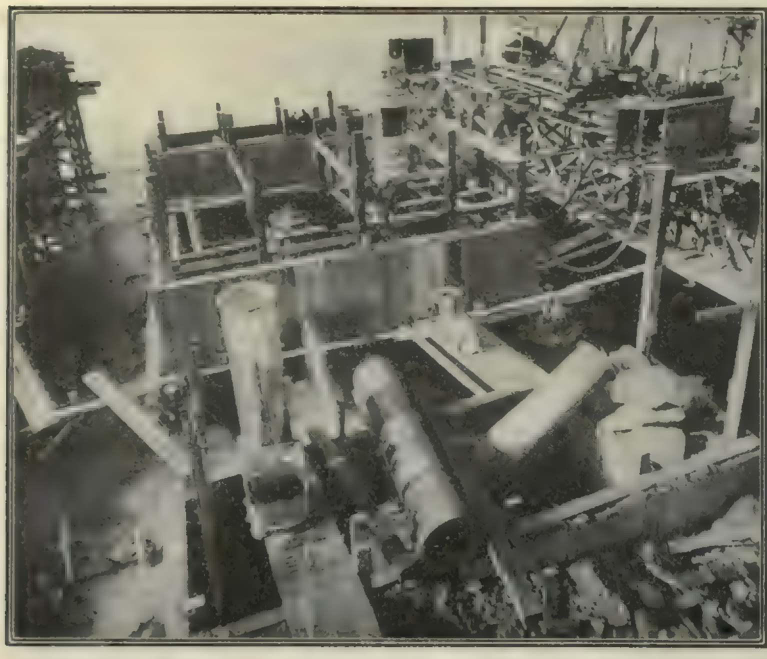
PLANT LAYOUT

The Lawrence Central Bridge is a reinforced concrete structure, 1750 ft. long by 80 ft. in width, spanning the Merrimac River at the foot of Amesbury Street, Lawrence. The design involves 200 ft. of retaining wall of the counterfort type, with earth-fills at either end of the bridge. There are six 107-ft. three-centered reinforced-concrete arch spans of the open-spandrel type, one temporary 90-ft. concrete arch span and six 44-ft. segmental arch rib spans. After investigation the contractors decided not to use a cableway for the following reasons: The limited space available for towers, anchorages, etc.; the width and length of the structure, the necessity of moving heavy steel centers, and finally the difficulties of attempting to place concrete, erect forms, and distribute materials of construction simultaneously.

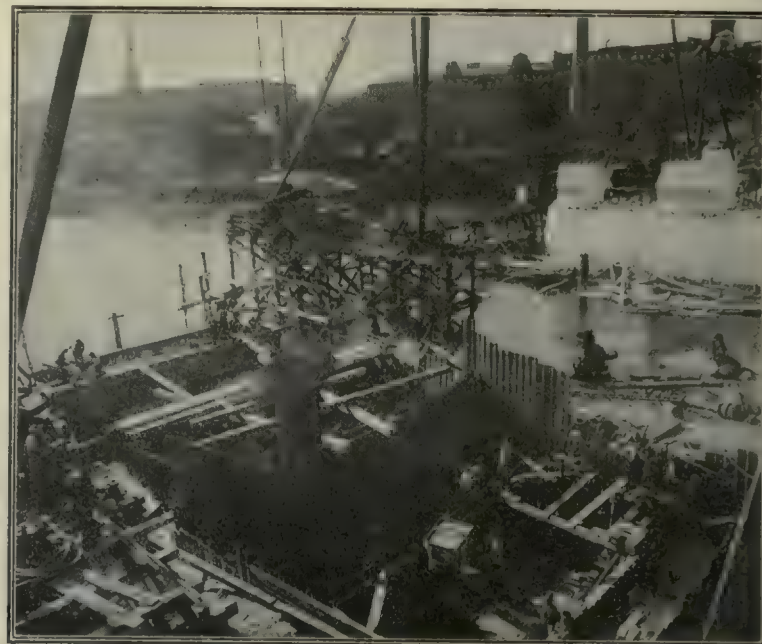
The method adopted was to erect a derrick on pile bents adjacent to each pier at the elevation of the springing line. At the bascule piers an additional car derrick was placed in order to be able to drive sheeting and carry on excavation at the same time. Along the up-stream side of the work a temporary trestle was constructed which served as a supply line for



FOUR MIXING PLANTS SERVED THE FULL 1750-FOOT LENGTH OF CENTRAL BRIDGE AT LAWRENCE, MASS.



COMPRESSED AIR CAISSON FOR SOUTH BASCULE PIER



CONCRETING THE FOUNDATION OF THE NORTH BASCULE PIER

all the river work. For concreting, the work was divided into four sections, as follows: Retaining walls and arch ribs of the north approach, river work north of the temporary span, river work south of temporary span, and south approach retaining walls and arch ribs. Each section was supplied with a 1-yd. Smith mixer. For the approach work two Insley towers, approximately 100 ft. in height, were used to chute all concrete within a 1:3 pitch from the tower, while for the river work the mixers discharged directly into buckets mounted upon cars on the temporary trestle.

Downstream Half Built First

The piers to the springing-line elevation were completed for the full width of the bridge. In building the superstructure the down-stream half of the work was first finished; upon its completion all derricks at the river piers were taken down and the up-stream or remaining half of the work built with traveling stiff-leg car derricks erected at either end upon the completed roadway.

A double row of test borings of the site showed the rock surface to lie at least 35 ft. below normal water. This condition, together with the hard and compact nature of the river bed, justified the design of a spread foundation at elevation —7.0 for the river piers, a depth of about 14 ft. below normal water. In the construction of these piers 4-in. hard-pine sheet piling, 24 ft. long, grooved and splined, was set up in two sets of 6 x 8 in. walings, which in turn were bolted to guide piles on the outside of the cofferdam.

Each cofferdam, 22 x 95 ft. in plan, was sheeted, driven, unwatered, excavated and concreted as a unit. A 1500-lb. drop hammer swung in leads from the derrick booms did all the driving through about 12 ft. of gravel, and no difficulty was experienced later in pulling this sheeting. In most cases there was but little trouble encountered from leakage due to the care taken in setting, driving and bracing the wood sheeting. All of the excavation in these piers was done with an orange-peel bucket. Upon reaching the required depth a 2-ft. layer of concrete was deposited to seal the bottom, after which forms were built and the concrete brought to the top of foundation, any leakage of water being drained along the sides of the cofferdam. Above the top of the foundation these piers are monolithic, having no horizontal joints and only two vertical joints parallel to the axis of the bridge, spaced so as to divide the entire pier into three equal parts, each section holding about 300 cu. yd. of concrete, which was placed in a continuous run of sixteen hours.

Bascule Piers

In the original design no provision was made for navigation, but legislation subsequent to the signing of the contract necessitated the erection of two large abutment piers to provide for the future installation of a bascule span in the middle of the channel when the Merrimac River is made navigable. A recent act of legislation has permitted the erection of a 90-ft. temporary unreinforced-concrete span, to be replaced with a double-leaf bascule drawspan upon the demand of the federal authorities when the river is opened for navigation.

Below the springing line these piers are designed to act as abutments for the adjacent 107-ft. spans, while above the springing line there are provided a series of dry joints which will permit the building of either a steel bascule span or a temporary concrete arch span to be removed at such a time as the river may be made navigable.

Spread Foundation for North Pier

In laying out the north bascule pier, it was the intention to use three separate caissons, 15 x 38 ft. in plan, of steel sheet piling driven to rock. On account of an irregularity of the rock profile not disclosed by the borings, it became necessary to alter the original design and build this pier upon a spread foundation for its full length, on compact gravel about 36 ft. below normal water. The material encountered about 18 ft. below the river bed proved to be a gumbo clay of such extreme tenacity that an orange-peel bucket would make little or no impression upon it,

STEEL ARCH CENTERS ON TIMBER BLOCKING SUPPORT THE ARCH RING FORMS

and which could be removed by hand only with great difficulty.

The great depth of the underlying rock and this peculiar clay formation made open-caisson work very slow and expensive, and caused the introduction of compressed-air work in the south bascule pier. Three caissons, 15 x 38 ft. in plan, were sunk to bedrock 40 to 60 ft. below normal water. This air work was done as a subcontract in 83 days and involved 3000 cu. yd. of excavation and 2300 cu. yd. of concrete. Much of the troublesome clay formation was jetted and blowpiped from the caissons.

ARCH SPANS

The 44-ft. segmental approach arches consist of seven ribs 30 and 36 in. wide, about 12 ft. on centers, and provide a direct bearing for the floor slab. These spans occur in pairs and are reinforced for continuity over the intermediate piers, although in the design no allowance was made for possible balanced cantilever action. Investigation proved the economy of wood centering over steel for these small spans. All framing for the sides and floor was made in panels and used six times.

For building the main 107-ft. spans three-hinged steel arch centers were used for the two outside ribs, 9 ft. in width, and one middle rib 16 ft. wide. Pile bents with a permissible load of 10 tons per pile were driven about 10 ft. into the river bottom to support the centers. As only the abutment piers were capable of sustaining the unbalanced thrust of the dead load, centers for one-half of the transverse width of the bridge for three spans were provided. All centering was kept in place for twenty-eight days after the final keys were poured, and was then lowered by means of hydraulic jacks and moved transversely on rollers to complete the remaining half. The steel centers were given a camber of 3 in., which in most cases proved sufficient, although not excessive, there being about 1-in. settlement in the piles and blocking, about 1-in. deflection of the steel work and 1-in. deflection of the concrete arch ring under its full load.

These arch rings were poured as a series of alternate blocks and keys in order to facilitate the work and to prevent the occurrence of cracks due to settlement of centering and shrinkage of concrete. Each ring was divided into five large blocks separated by small key blocks, which were poured after the main blocks had been allowed to set and shrink for one week. The outside faces of the outer arch ribs were divided by scorings into voussoir blocks and have a water-dike molding along the extrados projecting above and 3 in. beyond the face of the arch.

FLOOR SYSTEM

The roadway is 56 ft. wide between curbs, with provision for two electric-railway tracks, and the sidewalks are each 11 ft. wide exclusive of concrete balustrades and the lamp-posts, which were also constructed of reinforced concrete and made high enough to support the cross-wires for the electric railway. In order to provide for ballast under the electric railway tracks without unnecessary dead load, the floor slab was lowered 9 in. for a width of 23 ft. throughout the length of the bridge.

The clear span of 20 ft. between arch rings and the fact that no steel centers were provided for the floor system raised a question as to the best method for framing the floorbeams. Investigation showed that to carry the total weight of 25 tons of wet concrete in the beam and adjacent slab, the side forms of the floorbeams would have to be 4 in. thick and trussed with two ¾-in. round rods with a 1¾-in. pin connection at either end. This method was followed and eliminated the necessity of shoring and proved ample to carry the weight without appreciable deflection.

The approximate quantities of the more important items involved in the work are: 36,000 cu. yd. of concrete, 625 tons of steel reinforcing, 10,000 cu. yd. of river excavation and 5000 cu. yd. of dry excavation.

The Central Bridge now nearing completion is being built for the city of Lawrence under the direction of the Lawrence Bridge Commission, of which John J. Donovan of Lawrence is chairman. B. H. Davis, consulting engineer, New York City, is the engineer, and the contractors are Ryan & Keon of Boston. The Merrill-Ruckgaber Company of New York was the subcontractor for the pneumatic work and the Boston Bridge Company supplied the steel centers. Fred L. Mulcahy is the inspector.

Literature

For the Civil Engineer and Contractor

New Publications

THE HEAT TREATMENT OF TOOL STEEL. By Harry Brearley. Second edition. Cloth, 6 x 9 in.; 222 pages; illustrated. New York and London, Longmans, Green & Company. $3.50 net.

An illustrated description of the physical changes and properties induced in tool steel by heating and cooling operations.

PROCEEDINGS OF THE TWENTY-EIGHTH ANNUAL MEETING OF THE IOWA ENGINEERING SOCIETY. Paper, 6 x 9 in.; 164 pages; illustrated. Iowa City, Iowa, published by the Society. 50 cents.

REPORT ON PIPE-LINE TRANSPORTATION OF PETROLEUM BY U. S. FEDERAL TRADE COMMISSION. Paper, 6 x 9 in.; 467 pages; illustrated. Washington, Government Printing Office.

THE STABILITY OF ARCHES. By Ernest H. Sprague, assistant at University College, London; lecturer at the Westminster Technical Institute. Cloth, 5 x 7 in.; 138 pages; illustrated. London, Scott, Greenwood & Son; New York, D. Van Nostrand Company. $1.25 net.

INDUSTRIAL CONDITIONS IN SPRINGFIELD, ILL. By Louise C. Odencrantz and Zenas L. Potter. Paper, 6 x 9 in.; 173 pages; illustrated. New York, Russell Sage Foundation, Department of Surveys and Exhibits. 25 cents.

STRESSES IN STRUCTURES. By A. H. Heller, late professor of structural engineering, Ohio State University. Revised by Clyde T. Morris, professor of structural engineering, Ohio State University. Third edition. Cloth, 6 x 9 in.; 374 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $2.75 net.

CONCRETE LININGS FOR IRRIGATION CANALS. Paper, 6 x 9 in.; 15 pages; illustrated. Chicago, Portland Cement Association.

Booklet for free distribution, illustrates several examples of the application of concrete to prevent losses from seepage in canals.

THE LAND-TITLE REGISTRATION ACT OF THE STATE OF NEW YORK. Indexed, with introduction by Dorr Viele and Joseph C. Baecher of the New York Bar, official examiners of title. Second edition. Paper, 6 x 9 in.; 87 pages. Albany, Matthew Bender & Company, Inc. 50 cents.

BRICK ROADS. By V. M. Pierce, chief of construction, and Charles H. Moorefield, senior highway engineer, U. S. Office of Public Roads. Bulletin 373. Paper, 6 x 9 in.; 40 pages; illustrated. Washington, Government Printing Office.

A revision of Bulletin 246, entitled "Vitrified Brick Pavements for Country Roads."

ELEMENTS OF CHART MAKING. By E. Lester Jones, superintendent, U. S. Coast and Geodetic Survey. Special Bulletin 38. Stiff paper; 6 x 9 in.; 15 pages; illustrated. Washington, Government Printing Office.

Technical and practical details involved in the preparation of a chart for the use of navigators are outlined in a nontechnical manner. Includes field work and office details.

PRACTICAL SAFETY METHODS AND DEVICES—MANUFACTURING AND ENGINEERING. By George Alvin Cowee, E.M., S.B., manager, Bureau of Safety, Utica Mutual Compensation Insurance Corporation. Cloth, 6 x 9 in.; 434 pages; illustrated. New York, D. Van Nostrand Company. $3 net.

CONCRETE SWIMMING AND WADING POOLS AND HOW TO BUILD THEM. Paper, 6 x 9 in.; 18 pages; illustrated. Chicago, Portland Cement Association.

Booklet for free distribution; gives many examples and typical plans of reinforced-concrete swimming and wading pools.

CALCULO DE ESTRUCTUROS. By Juan Manuel de Zafra, professor in Las Escuela Especial del Cuerpo. Two volumes. Cloth, 7 x 9½ in.; 608 and 786 pages; illustrated. Madrid, Tejada y Martin. 50 pesetas ($9.65) per volume.

Among the original features of this complete work on the analysis of structures may be mentioned the solution of the problems of multiple arcades, triangular reticulated structures and trapezoidal structures. Many of the problems require the solution of simultaneous equations, and the appendix of the second volume describes a mechanical equation solver which is actually under construction.

Books Reviewed

Bridge Engineering

Author, J. A. L. Waddell, C.E., B.A.Sc., Ma.E., D.Sc., D.E., LL.D., consulting engineer. Two volumes. Cloth, 6 x 9 in.; illustrated; Vol. 1, 1064 pages; Vol. 2, 2177 pages. New York, John Wiley & Sons, Inc. $10 per set.

REVIEWED BY F. H. CONSTANT

Professor of Civil Engineering, Princeton University, Princeton

The mere announcement that a treatise on bridge engineering of nearly 2200 pages has appeared from the hand of Dr. Waddell is sufficient introduction. Manifestly an extended review is impossible, for the work includes some eighty chapters, many of which are themselves in the nature of individual professional papers upon which the reviewer could linger at length. Nor can he take refuge in its sheer size, giving merely a list of chapter headings. Those familiar with the author's little work, "De Pontibus," which first appeared some eighteen years ago, will recognize the same interesting, piquant, almost conversational style.

Engineering books are, as a rule, singularly devoid of any charm of style, being either devoted to the mathematical development of theory for text-book use or dryly descriptive. The present work is neither. It is the interesting, personal, almost autobiographical, narrative of a notable professional career. It holds the reader, not solely because of the value of the subject matter, but because it is a very readable book, full of personal, often humorous, incidents and touches. Like his notable paper, "Some Disputed Points in Railway Bridge Designing," which was published in 1892 in the *Transactions* of the American Society of Civil Engineers, and which awakened widespread discussion at that time, it contains many a challenge or conclusion which the reader would like to discuss at length.

The aim of the book is stated in the preface as follows: "In writing this book it has been the author's aim to give to his readers, concerning every branch of bridge work, all the information he has been able to accumulate during a practice of forty years. Nothing of any value has been omitted, except such matter as can readily be obtained from other books, because he has never been a believer in the pseudo-economic idea that what has cost much

labor and money to discover and record should be utilized only for one's personal gain. On that account there appear for the first time in print all the diagrams of weights of metal, quantities of masonry, costs of constructions, economic functions, etc., that this book contains."

These records, diagrams, digests, systematic analyses, etc., are presented in the form of several hundred tables and cross-section diagrams of curves. In giving this information to the public Dr. Waddell certainly merits the thanks of all engineers.

Contents of Volumes

In spite of their number no adequate idea of the scope of the work can be formed without a list of the chapter headings; space will not permit of any review of the chapter contents.

Volume 1—Evolution of bridge engineering; the bridge specialist; ordinary materials of bridge construction; alloy steels in bridge work; dead loads; live loads; impact loads; centrifugal force and other effects of track curvature; wind, vibration and traction loads; methods of stress computation; secondary, temperature and indeterminate stresses; deflections; combination of stresses; working stresses; first principles of designing; detailing; shop work; classes of traffic; floor system; laterals and swaybracing; plate-girder and I-beam bridges; simple truss bridges; trestles; viaducts and bridge approaches; elevated railroads; cantilever bridges; arch bridges; suspension bridges; movable bridges; swingbridges; bascule bridges; vertical-lift bridges; riveted versus pin-connected trusses; dimensioning for camber; protection of metal work, wooden bridges and trestles; drawbridge protection; reinforced-concrete bridges; foundations; cofferdams; open-dredging process; pneumatic-caisson process; piles and pile-driving; piers; pedestals; abutments; retaining walls and culverts, and shore protection.

Volume 2—Expedients in design and construction; data required for designing; location and surveys; borings; waterways; governmental requirements; hydrographic surveys; esthetics in design; true economy in design; determination of layouts; weights of steel superstructures; quantities for piers, pedestals, etc.; estimates; office practice; inspection; triangulation; engineering of construction; erection and falsework; maintenance of traffic; bridge examination; reconstruction; maintenance and repair of existing bridges; status of highway-bridge building; bridge failures and their lessons; specifications in general, contracts; reports; administration; arbitration; promotion of projects; fees; business features; responsibility of the bridge engineer; ethics; general specifications for superstructure; glossary of terms and index.

Glossary of Terms

The glossary of terms covers 223 pages, the index 60 pages. It will be noted that the first volume is the more technical; the second, the more general of the two. While the work is not primarily concerned with the development of formulas, it contains many such, especially for use in the design of reinforced-concrete bridges. The reader is constantly referred, by name and often by page, to other books for the development of such formulas or for a more theoretical treatment of the subject. References to technical papers are interspersed freely throughout the text. Cross-referencing to other books or papers and the discussion of text illustrations not reproduced in this book are likely to be inconvenient for the reader who may not have these other works at hand.

In relation to its field of usefulness the author states: "Primarily the book should prove useful to all engineers who are engaged either directly or indirectly in the designing and building of bridges, and especially to the younger ones, for not only are the principles of design explained and exemplified, but also many practical hints are given, which otherwise would come to them only through wide experience. With the various tables and diagrams it is feasible to make quickly a close estimate of cost for nearly every kind of bridge and for structures of any length or size yet attained, no matter what may be the complication of traffic that they have to carry. Again, in respect to spans of unprecedented weight and length, data are given for determining, at least approximately, the weights of metal required by the use of alloy steels of various elastic limits."

In regard to its use in engineering schools he says: "While the work was not prepared as a text book for engineering students, it is well adapted to supplement the standard treatises used in the classroom."

In the conclusion of the preface the author states "that he considers this book to be the greatest and most important work of his entire professional career, which has been an unusually busy one; and most certainly he would be bitterly disappointed if, for many years to come, it should fail to prove of great value to the engineering profession."

Dr. Waddell will not be disappointed. His readers will not fail to appreciate the sacrifice of time and money involved in the making of this great book and its real value to them in their work.

The Construction of Roads and Pavements

Author, T. R. Agg, civil engineer and professor of highway engineering, Iowa State College. Cloth, 6½ x 9½ in.; 432 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company, Ltd. $3 net.

Reviewed by Henry G. Shirley
Chief Engineer, State Roads Commission, Baltimore

In this volume of twenty chapters dealing with the construction of roads and pavements the first gives a brief description of the development of highway systems and discusses the progress and growth of this branch of engineering. Chapter 2 covers in a concise and complete form the general rules for making plans and surveys. Chapter 3, on "The Design of Rural Highways," gives many cross-sections of the different roads throughout the country, and is of great value. Chapters 4 to 13 inclusive treat the construction of all types of roads, from the sand-clay road to the stone-block pavement, and give the latest methods used in construction and many examples of pavements, as well as many helpful views. These chapters are well handled, and contain many tables that will be of great value not only to the student but to the engineer in practice as well.

Chapters 14, 15 and 16 consider the treatment of roads with bituminous materials, dust layers and asphaltic surfacings, including the penetration methods, sheet asphalt and asphaltic concrete, as well as bituminous carpets for the maintenance and preservation of macadam and other types of road surface.

Chapter 17, entitled "Selection of Type of Surface for Rural Highways," and Chapter 18, on "Selection of Type of Pavement Surface," are well written and will be of much value to the young engineer in selecting the proper type of road under the many varying conditions. Chapter 19, "The Design of Pavements," is presented in a clear fashion, accompanied by well-selected illustrations. The tests for bituminous road and paving materials are set forth in Chapter 20, which gives the latest and most improved methods of testing such materials.

As a whole, the book is concise and well arranged. It gives data that will be of great assistance to the student, and will make an exceedingly valuable book of reference for the engineer who has the actual charge of designing and constructing roads and pavements. It is a desirable addition to existing highway literature, and no highway engineer's library will be complete without it.

Photographs as Specifications

All Data the Contractor Needs in Bidding on Work Proposed by Portland, Ore., Contained on Prints from Camera Negative

PORTLAND, ORE., has prepared and issues in printed loose-leaf form standard specifications for all material and methods to be used in all structures and work carried on under the city's supervision. These specifications do not, of course, refer to any particular work, but are strictly general in character and are issued unbound to any contractor on application. This plan simplifies the preparation of specifications on new work to such a degree that but little more than detailed drawings is necessary.

The labor of getting out specifications is still further simplified by photographing both the text and the drawings, so that the space covered and the cost of producing one or two dozen copies are a minimum. This is made feasible by typing the specifications, single space, on a sheet about twice letter-head size, and then making an 8 x 10-in. negative of the large sheet. The drawings are likewise photographed on 8 x 10-in. plates; and even though certain minor details and figures are lost in process of reduction, it is believed that for estimating all the data really needed will be legible. For construction purposes, of course, blueprints of the original drawings are used.

Under this system the amount of text accompanying the drawings, even on extensive work, is notably slight, and this is because wherever materials or methods are involved which are covered in the list of standard specifications already referred to, the page and paragraph of the references are all that need be given to make the standard list a part of the contract covering the particular work in hand.

Photographs of specifications for small jobs are printed on heavy velox paper, and where more extended reference is anticipated a special cloth paper is used. In either case the collection of photographs of drawings and text is fastened together inside a cloth blueprint cover, on the outside of which the title and general information are printed.

The plan has been used for some time by Philip H. Dater, city engineer of Portland.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Cobble Gutters

SIR: In reviewing the standards of cobble gutters on state improved highways, one will find them not different from any other kind of standards in spirit and effect. Besides being too general and carrying with them the tendency of creating an indifferent mind and stale initiative, they are incomplete. There is no discrimination shown between the various kinds of soils encountered, or the presence of grades, tangents or curves, as to the width of the cobble gutter.

I have observed many a washout of cobble gutters due to lack of proper width of cobble pavement on shoulders, especially on sharp curves and steep grades, of big watersheds. The inertia of the water leading from a gutter on a tangent down a steep grade to a gutter on a sharp curve will invariably cause erosion into the bank on the outside and into the shoulder on the inside of the curve. This process will continue until the cobble gutter is undermined and washed out. On narrow shoulders this erosion may undermine the pavement of the traveled roadway and cause considerable damage.

Evidently the subject of cobble gutters is being looked upon as unimportant, and is generally neglected. M. P.

Eccentric Loading on Columns

SIR: The writer has read with much interest Mr. Fleming's discussion of the stresses arising in columns due to eccentric loads, in the issue of Sept. 2, page 296. He has verified the values of the bending moments and horizontal reactions there given. Our formulas for the strength of columns have been derived from both theory and experiments, but it has been assumed that the loading was concentric; yet it will be found by inspecting Mr. Fleming's article and sketches that the stresses due to eccentric loads are not only large, but vary in intensity from top to bottom of column.

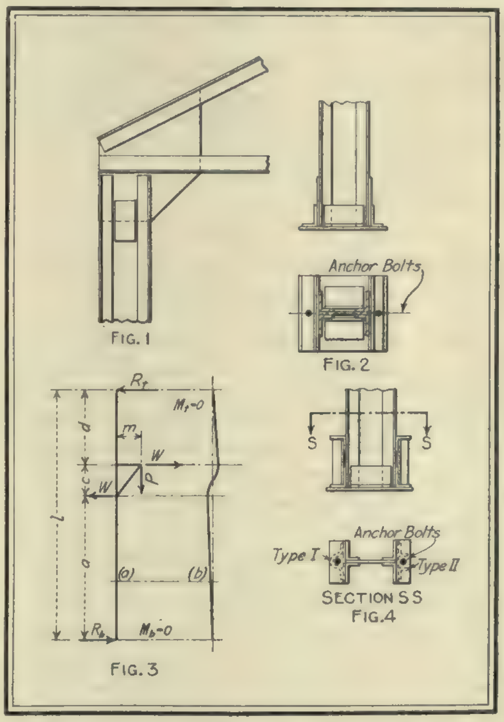
The writer believes that it is possible to make a slender mill-building column continuous at top by using the detail shown in Fig. 1, which also stiffens the building generally. But in an ordinary mill-building column with a base of plate and angles, Fig. 2, it is impossible to get a fixed end, as seems demonstrated by the following:

Fig. 3 shows a column with bracket, similar to Mr. Fleming's Fig. 1, with both ends assumed to be hinged. An investigation has been made to determine the position of the axis, assuming the column to have a constant cross-section. It has also been assumed that the column axes at top and bottom are in the same vertical plane when exposed to the pair of forces supplied by the girder bracket, Fig. 3 (a and b). If the column be considered as a beam supported, not restrained, at the two ends, and subject to a couple acting somewhere between the ends, the equations for the deflection in sections d, c and a can be written, and finally the tangent of the elastic line at the base of the column found to be:

$$\frac{dv}{dx} = \frac{Wc}{2EI}\left[\frac{l}{3} - \frac{c^2}{3l} - \frac{cd}{l} - \frac{d^2}{l}\right]$$

Taking as a practical example a column of four angles 6 x 4 x ½ and one plate 18 x ½, the moment of inertia I about an axis perpendicular to the web plates is 1525. Assume the length of column, as in Mr. Fleming's example, to be 24 ft., and also assume a as 14 ft. and W as 10,000 lb. Then c is 2 ft. and d is 8 ft. Solving for dv/dx there is found 0.0001089 for the tangent of the angle of the elastic line of the base of column. Hence the angle is about one-half of one minute. If the base plate is 27 in. wide we shall have a deflection of its extreme edge below the center of 0.0015 in., a very small amount.

It is not likely that any other condition can prevail than the hinged or slightly held



FIGS. 1 TO 4—DETAILS OF COLUMNS

condition, as a concrete pier will compress such a slight amount very readily, the ratio of good concrete and steel moduli being about 1 to 15. In addition to the compressibility of the concrete pier there is the condition of the usual steel-base attachment, Fig. 2, for which it is reasonable to assume that the base plate and side angle will bend somewhat. It seems, therefore, that to assume the lower end fixed is erroneous.

Somewhat better is a column as indicated in Fig. 4, which is more expensive and not used very often. Here the objection of the yielding base is overcome by a strong side attachment with rivets in shear, and lugs for anchor bolts deep enough not to yield under the pull of the anchor bolt. This does not overcome the effect of yielding of the concrete pier, which renders the base probably somewhere between fixed and hinged, as mentioned by Mr. Fleming.

In an office building column, spliced with side plates parallel to one axis, and two small clip angles parallel to the other axis, it is likely that the column is continuous all the way down if the eccentric load is applied in a plane normal to the splice plates. If applied in a plane parallel to the splice plates, there seems likely to be some motion, enough to destroy the continuity.

This subject is interesting not only as a theoretical problem but for practical reasons. As the exact determinations of the stresses would be somewhat expensive in an office, it is a good plan on each separate piece of work to make one general investigation, which does not take long, and then use approximate values close enough for all practical work. J. S. BRANNE,
Consulting Engineer.
New York City.

SIR: The recent article by Mr. Fleming on eccentric loading should have the effect on its readers of clearing up some popular misconceptions on this subject. On page 287 of the 1916 Carnegie Steel Handbook, as well as in various other steel handbooks, is found an analysis of this problem which gives results that are incorrect, although on the safe side.

There seems to be no logical excuse for any formula which makes the factor of safety a factor of ignorance. In extreme cases which seldom occur in practice these formulas in the "Carnegie" give results only a little on the safe side. The large majority of columns eccentrically loaded in this fashion have a factor of ignorance of almost twice the assumed factor of safety.

The formulas given in Mr. Fleming's article are easy to follow and well deserving attention from the designer. Should not such formulas be stated in any handbook upon which many designers lean for the moral support of their calculations? Should not every designer know that the eccentric bending moment developed in the sketch on page 287 of "Carnegie" is carried by sections both above and below the point of application of eccentric load, instead of being carried entirely by one section, as is there stated?

It seems to the writer that two advantages would result from a correct statement of this matter in handbooks. First, the designer would have a clearer idea of the manner in which any column acts to resist bending due to eccentric loading. Second, the responsibility for the safety of a structure would rest a little more with the designer and a little less with the much-abused factor of safety. G. A. MANEY,
University of Minnesota.
Minneapolis.

Manufacturers Should Tell What Parts Wear Out First

SIR: Yellowstone Park is in the midst of the Rocky Mountains and just about 1000 miles from any considerable center of trade, manufacture or labor. Hence we probably feel more the necessity of keeping on hand parts of machinery that are likely to break or wear out than most users of machinery. As in all modern road construction, we are fast acquiring quite a varied and extensive line of machinery, and it is only by a lavish use of the telegraph, express and parcel post that we are enabled to keep going.

It has often occurred to me that it would be an enormous help if every manufacturer of machinery would publish for each machine a list of the parts that wear out quickest and break oftenest, so that the user could carry those parts in stock in the necessary quantities to insure him of reasonably continuous operation; it ought also

to increase the sales of such machines. For instance, we have been operating for two seasons a 5-ton White truck, and the nearest point from which supplies can be obtained is Cleveland, some 1500 or 1600 miles distant. The truck is a remarkably good one, but we have had occasion several times to order small parts that were absolutely essential; and as they have to come from such a distance, it takes nearly a week to get them even when using the telegraph and express.

In fact, had we not been able to borrow a couple of times from other owners of the same truck, we would have had several days' delay, and each day's delay costs us about $50. In a number of cases we have asked the manufacturers when purchasing machinery what parts were most likely to break or wear out and should be carried in stock, and never, except in one instance, did we get any information on the subject. Certainly, where a hundred or more machines have been in use over a period of two years it ought to be easy to develop a list of parts that wear out or break, so as to show the probabilities of such breakage, and thus enable the owner to keep on hand a reasonable stock of spare parts.

I believe this subject worth the attention of your paper, for the loss of time and efficiency resulting from even a day's or half day's delay will amount to far more in one season that the cost of extra supplies, even to the man who has only a few miles to go to get spare parts. AMOS A. FRIES,
Major, Corps of Engineers, U. S. A.
Yellowstone Park, Wyo.

Is State Insurance Accident Prevention?

SIR: In your issue of Aug. 26, page 248, appears an editorial entitled "Is State Insurance Accident Prevention?" In it you make quotations which indicate that state insurance tends toward carelessness on the part of employers and that private insurance tends toward making the employer more careful. You also draw the conclusion at the end that private insurance seems to form the method for obtaining less accidents and lower rates of insurance.

As a member of the State Insurance Fund of Pennsylvania I cannot agree with either the quotations or your conclusion. Last fall the stock companies, when in conference making up their proposed rates for the year, added to the net cost of insurance losses about 42 per cent for expenses, leaving 58 per cent to be paid for the losses. The state fund has not had such a percentage of expenses. The state fund of this state, and I believe of other states, is just as active in following up and insisting upon the adoption of safe and careful methods in industries insuring with it as are private companies.

The state fund has its corps of inspectors exactly as have private companies, and in addition it has the advantage of very close relations with the state inspectors of the labor department. The state fund is not, in Pennsylvania, or in most states, intended to be a monopoly, nor should it become so. The theory of its creation is based upon the need on the part of the authorities to have accurate information as to what the cost of losses and expenses should be, in order that the state authorities may insist that private companies charge reasonable rates. The result in this state has been that our authorities have had valuable information as to the costs of operation and as to loss costs always available from the state fund. On the other hand, although the authorities have the power under the law to gather such information from the private companies, by some means or other such information has not been obtainable either promptly or in satisfactory form. Without such information the authorities cannot determine reasonable rates. The state fund furnishes such information both promptly and accurately. The state fund, further, shows the possibilities as to what can be required with regard to promptness of loss payments, and concerning various other items of administration which are essential to effective compensation systems.

I am personally a very warm advocate of having our business carried on by private industry and initiative, and for that reason I should deeply regret any move in our state, or any other state, which was in the line of making a monopoly of the accident-insurance business. On the other hand, I am equally convinced, by reason of the facts and experiences which have been forced upon me in the last year, that a state insurance fund, properly handled and carried on in such a way as not to become a monopoly, is a most essential element in the efficient development of the compensation system. JOHN PRICE JACKSON,
Commissioner, Pennsylvania Department of Labor and Industry.
Harrisburg, Pa.

Inconsistencies Shown in Water and Sewer Laws

SIR: In an article in your issue of Sept. 2, page 284, by W. L. Butcher, entitled "Inconsistencies Shown in Water and Sewer Laws," I notice a statement to the effect that in Pennsylvania communities are expressly prohibited from charging annual rentals or maintenance cost for the use of the sewers.

I am inclosing herewith a copy of an act of the General Assembly, approved May 11, 1915, authorizing boroughs to collect an annual rental or assessment from property abutting on sewers constructed at public expense and providing for the collection thereof. Please notice that Section 4 specifically states that the rental may include the cost of maintenance, repair, alteration, inspection, and the interest charges on money expended in the construction of the sewer or sewer system. C. A. EMERSON, JR.,
Acting Chief Engineer, Engineering Division, Pennsylvania Department of Health.
Harrisburg, Pa.

AN ACT authorizing boroughs to collect an annual rental or assessment from property abutting on sewers constructed at public expense, and providing for the collection thereof.

Section 1. Be it enacted, etc., That whenever any borough of the Commonwealth of Pennsylvania has heretofore constructed, or shall hereafter construct, any sewer or sewer system, at public expense, the council of the said borough may provide by ordinance for the collection of an annual rental or charge, for the use of such sewer or sewer system, from the owners of property served by it. Such annual rental or charge shall be authorized and collected as provided by general ordinances, and when so levied and charged shall be a lien on the properties charged, and the collection thereof shall be made and enforced in the manner borough taxes are now collected.

Section 2. The councils of said boroughs shall execute a warrant, or warrants, authorizing the collection of the said annual sewer rentals or charges, to the officer employed by council to collect the same, and the officer collecting the said rentals shall have the authority now vested by law in collection of borough taxes.

Section 3. The said annual sewer rentals or charges shall be lien on the properties charged with the payment thereof, from the date set in the said ordinance, and if not paid after thirty days' notice may be collected by an action in assumpsit, in the name of the borough, against the owner of the property charged, or by distress of personal property on the premises, or by a lien filed in the nature of a tax lien.

Section 4. The said annual rental, so to be levied and charged as herein provided, shall not exceed the amount expended annually by the said boroughs in the maintenance, repair, alteration, inspection, or other expense in relation thereto, and may include any interest on money expended by the said borough in the construction of the said sewer or sewer system. The said annual sum shall be apportioned equitably among the several properties served by the said sewers.

Hydraulic Flow Reviewed—A Correction

SIR: My attention has been called to a misstatement in my review of "Hydraulic Flow Reviewed," by Alfred A. Barnes, which appeared in the issue of Aug. 26, 1916, page 269. The statement reads as follows: ". . . not less than 3162 separate experiments being quoted." In making this statement, I was misled by the author's use of serial numbers. The number of experiments quoted and classified are as follows:

New asphalted cast-iron pipes	79
New uncoated cast-iron pipes	37
New asphalted screw-jointed riveted wrought-iron pipes	14
New asphalted single-riveted wrought-iron and steel pipes	16
New asphalted double-riveted wrought-iron and steel pipes	65
Clean lead pipes	24
Clean glass pipes	8
Clean planed wood troughs and new smooth wood-stave pipes	57
Clean unplaned wood troughs and new unplaned wood-stave pipes	123
Clean neat cement channels or pipes	33
Clean hard-brick well-pointed conduits	81
Clean smooth-faced concrete conduits	52
Dressed masonry channels in cement with no projecting surfaces	12
Rock-faced masonry channels in cement	17
Hammer-dressed dry masonry watercourses	27
Earth canals in average working condition and rivers free from vegetation	162

Summing up these experiments, it will be found that the number is 807 instead of 3162. A. G. HILLBERG,
New York City. Hydraulic Engineer.

Bronze-on-Bronze Friction in Sluice Gates Tested

SIR: Since writing the article, "Bronze-on-Bronze Friction in Sluice Gates Tested," which was published in your issue of Sept. 9, page 330, I have ascertained the composition of the bronze used in the gates, a statement of which may add to the value of the article. The percentages were as follows:

	Gate Leaves	Frames
Copper	82.8	82.7
Lead	8.0	4.9
Zinc	4.4	5.3
Tin	4.8	7.1

D. C. HENNY,
Consulting Hydraulic Engineer.
Portland, Ore.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Handle Cement Safely and Cheaply on Plank Racks in Road Work

By HARLAN H. EDWARDS
Urbana, Illinois

THE RACKS plainly shown in the accompanying illustration have been found very convenient for handling cement sacks on the highway construction described elsewhere in this issue. These racks are made

PLANK RACKS KEEP CEMENT DRY

from seven 2 x 4-in. pieces, having the second and sixth sticks projecting about 2 ft. on each end to furnish handles for carrying the rack forward with the remaining cement sacks, if any are left over when the mixer is moved. The racks are kept raised from the ground by three 4 x 4s nailed across the bottom. In wet weather and at night the cement piled on these racks is covered with tarpaulin, which affords complete protection from moisture.

Mixer Train Handles Gravel from Hopper Cars on Belt Conveyors

By W. A. KELLNER
Office Engineer, Chicago, Milwaukee & St. Paul Railway Company

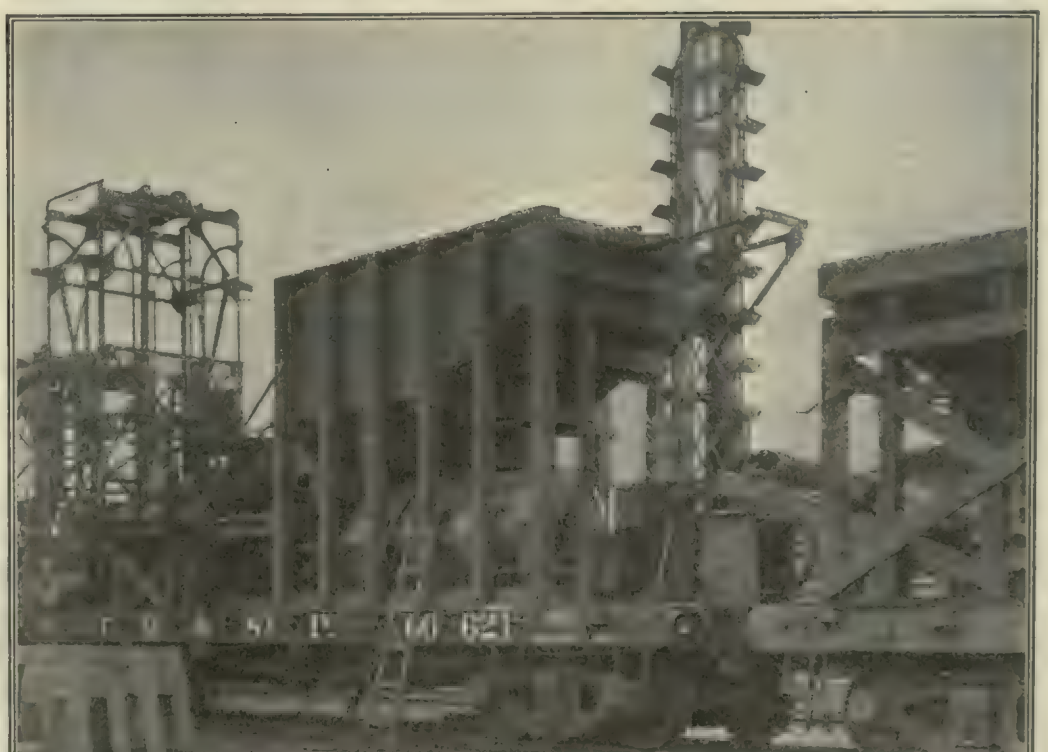
A CONCRETE train in service on the Chicago, Milwaukee & St. Paul Railway carries its aggregate in two cars which are filled by gravity from large storage bins and which discharge into the hopper on the mixer car by means of belt conveyors and a bucket elevator. On the mixer car is mounted a collapsible tower with two bucket hoists for discharging concrete into the forms. The plant, which was designed primarily for tunnel work, and which is at present engaged in lining the central portion of a long tunnel, is entirely operated by compressed air supplied through a pipe line to the point of work.

The gravel cars, which are interchangeable, were made by constructing on standard 42-ft. flat cars bins subdivided into five pockets, which are hoppered in all four directions. At the bottom of each pocket is a gate and chute for discharging aggregate upon 16-in. troughed belt conveyors, one of which extends the full length of each car and has a capacity of 30 yd. per hour. Each of these conveyors is raised at the head end of the car so as to overlap either the next conveyor or the boot of the elevator on the mixer car, depending on the position of the gravel car in the train. These overlapping ends of the conveyors are carried on hinged frames and can readily be raised up by means of small winches so as not to project beyond the ends of the cars. Both of these conveyors and the bucket elevator are run through a series of chain drives by an air motor on the mixer. This drives the bucket elevator, which loads the bins over the mixer, by means of a chain and sprockets. The chains which connect the sprocket on the boot shaft of the bucket elevator with that on the forward end of the conveyor on the next car, and which connect the sprocket at the rear end of this conveyor with the forward end of the conveyor on the last car, can be quickly removed for switching and replaced when the train is in position for concreting.

The concrete mixing and placing plant is mounted on a third standard 42-ft. flat car. It consists of the gravel bucket elevator, which is collapsible and has a capacity equal to that of the belt conveyors, a 100-cu. ft. compressed-air receiver, the 8-hp. air motor operating the conveyor system, a 13-cu. yd. gravel storage bin, a No. 1

TWO HOISTS SERVE EITHER SIDE WALL

chain belt concrete mixer with power loader and engine, and the collapsible concrete elevating tower which is equipped with two 1/3-yd. pivoted self-dumping elevator buckets and with air hoists for operating them. The power loader of the mixer is charged by gravity from the bin, and cement is supplied from a box car coupled in front of the mixer car. Water is supplied through a pipe line laid in the tunnel. The mixer discharges into a chute from which concrete may be directed into either one of the elevator buckets. These buckets are raised at the top of the tower and



HOPPER CARS, LOADED BY GRAVITY, DISCHARGE ON CONVEYORS LEADING TO MIXER CARS

dumped into chutes leading to the side-wall forms by drums and cables operated by the cylindrical air hoists. The mixer engine, the elevator motor and the bucket hoists are all supplied with air from the receiver, which is connected through a hose to the air line extending into the tunnel from the compressor plant at the portal.

The carrying capacity of the plant provides for two hours' continuous concreting, as it is used only between train movements. The gravel cars are loaded at the tunnel portal from overhead bins with a selected pit-run gravel from which the coarse material has been screened. The plant, with the cement car, is then moved into the tunnel and spotted by a locomotive, which is immediately withdrawn. The chain drive of the conveyor system is then connected, together with the water and air lines, and the plant is ready for operation. About 500 cu. ft. of free air per minute at 80 lb. pressure is required for its operation. An average output of 20 to 24 cu. yd. of concrete per hour is realized, with a maximum output of 26 cu. yd. A force of thirteen men is required.

The plant, which was designed by the engineering department of the Chicago, Milwaukee & St. Paul Railway, of which C. F. Loweth is chief engineer and H. C. Lothholz engineer of design, has been in continuous use for about a year in lining the central portion of the 8800-ft. St. Paul Pass tunnel in the Bitter Root Mountains. The pneumatic process is being used for lining the ends of the tunnel.

Trusses Changed for Girders Without Falsework

By C. L. KETCHAM
Pleasanton, Kan.

TWO through-truss spans have recently been replaced by four deck-girder spans and dismantled without the use of falsework in the river in reconstructing the 306-ft. bridge of the St. Louis & San Francisco Railroad over the Grand River in Oklahoma. The new girder spans were handled by the carrying cars built by this railroad for bridge reconstruction and described in the Engineering Record of May 6, 1916, page 622. Before these cars, carrying a new girder span, were run out on the old bridge, all rivets had been replaced with bolts in the old floor system between the old and new piers prepared to carry the deck-girder span. While the new span hung suspended from the cars, the track beneath it was torn up, the bolts removed and the old floor system lowered to scaffolding hung from the old trusses. As soon as this was out of the way, the carrying cars lowered the new span in place and the track was again connected across it. The greatest length of time track was blocked in making the change with any of the four girder spans was one hour and thirteen minutes.

Each of the new spans was 77 ft. long and weighed 50 tons. When two of them had been set inside one of the old truss spans heavy cross-timbers secured underneath the girders by hanger rods were placed under the panel points of the old span and used to support it during dismantling. The entire change was made at a labor cost of about $1400, which is probably less than the cost of falsework alone for the ordinary method. Moreover, two floods occurred during the work which were large enough to have swept away any falsework that might have been placed in the river.

Chute Rides "Bicycle" Around Building Floor

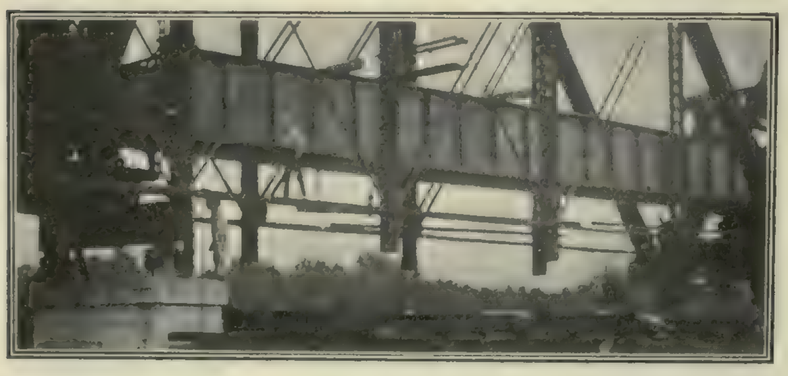
THE ACCOMPANYING photograph shows a handy rig made in less than an hour out of a pair of wheels from an old concrete buggy and a few planks and reinforcing rods, used to ride the end of the concrete chute around over the area being poured, and christened a "bicycle" by T. J. Wallenta, superintendent for the Malkin Construction Company, of Memphis, who made it. As will be observed from the photograph, the "boxes" of this vehicle are carefully covered with pieces of plank to prevent them from being filled with grout. The machine saves proportionally a great deal of labor over the ordinary practice of using small wooden horses, which were at first employed on this building, as anyone can appreciate who has watched four or five "hunkies," ankle deep in concrete, clustered around the end of such a chute in an effort to raise it and carry it to a new position. It is so easy to move the chute that the concrete can be put directly in place with little trouble, and the shoveling required is considerably reduced.

"BICYCLE" CARRIES END OF CHUTE

The device is being employed in pouring the floor slabs in the Overland Building at Memphis.

New Zealand Railways Develop

According to a statement by the minister of railways, there were on March 31, 1916, 2970 miles of railway in New Zealand, compared to 2955 miles at the end of the previous year. The construction cost of these lines at the close of the past fiscal year was $181,691,167, with gross earnings of $22,134,574, compared to a revenue of $19,979,206 for the previous fiscal year.



FALSEWORK FOR REPLACING THROUGH SPANS WITH DECK-GIRDER BRIDGE HUNG FIRST FROM FORMER, THEN FROM LATTER

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Thacher Patent Invalid Declares Iowa Court

Judge of District Court Rules There Was No Infringement—No Action Brought Until Long After Patent Was Issued

Judge Wade, of the U. S. District Court for Southern Iowa, on Sept. 12 dismissed the case of Thacher vs. the Board of Supervisors of Polk County, Iowa, et al, in which the defendants were sued for infringement of Thacher's patent (U. S. Patent No. 617,615) for concrete-arch reinforcement. Judge Wade's opinion agrees with the previous ruling of Judge Rose in the Baltimore case (see Engineering Record of Feb. 26, page 274) that the patent to Von Emperger embodies the idea upon which the Thacher patent was issued, but holds that the Von Emperger patent was actually in anticipation. He also holds that the proof furnished to the patent office to establish the fact that Thacher's invention antedated the Von Emperger patent is not sufficient, with the evidence in this case, to justify sustaining the patent, which is exactly contrary to the finding of Judge Rose.

The opinion agrees with a decision by Judge Thomas that the Thacher patent is specifically limited by the language "each bar of a pair being independent of the other." It states that there was no infringement in this case, as the bars used in the construction in issue are a part of a rigid or semi-rigid structure consisting of longitudinal rods with transverse and lattice bars all firmly bound together by wire ties at intersections in such a manner that they act together. It is held on the evidence given by Dean Marston, of the engineering college of Iowa University, that the element of independence of each bar upon which the patent was secured is not present in the structures considered.

No Infringement, Judge Says

"Without further discussion of the evidence," the judge continues, "I am convinced that there is no infringement in this case. I am also of the opinion that the plaintiff is estopped by laches from asserting any such construction of his patent as would bring the structure involved in this case within its meaning.

"This patent was issued in 1899; it expired before this case was tried. During all the years from the issuance of the patent up to the present, the plaintiff has been in close touch with concrete construction all over the United States. For years bridges and other structures have been erected which come as near infringing the plaintiff's patent as do the structures in controversy, and no action was ever brought by the plaintiff until 1913 and 1914—fourteen or fifteen years after the issue of his patent.

Protest Filed Just Before Patent Expired

"The plaintiff permitted individuals and municipalities to proceed apparently in good faith, with private and public work, and made no protest until a comparatively short time before his patent expired. In fact, I am convinced that the plaintiff's present view of the construction of his patent as including structures such as those in controversy is a discovery made by him or some one else within recent years. I do not believe, during all these years when he quietly allowed those he now claims to be infringers to proceed without asserting any right, that he understood or believed that these structures came within the claims of his patent."

The bill was therefore decreed dismissed with judgment against the plaintiff for costs.

Break in Pipe Causes Flood in New York Tunnel

Opening of a joint Sept. 26 in the bend of a 20-in. water main under the Steinway tube, near Forty-second Street and Park Avenue, New York City, caused a flood of water which delayed traffic for several hours. No lives were lost, no injuries sustained and little damage was done.

The cause of the opening of the joint has not yet been definitely decided. The pipe was laid by the Department of Water Supply, Gas and Electricity after the contract was let. The contractor claims that the work was defective. The theory has also been advanced that overhead traffic loosened the lead calking in an elbow of the pipe.

National Safety Council to Meet at Detroit October 17 to 20

A typographical error in last week's issue caused the news item on the meeting of the National Safety Council to read as though the convention had taken place. As was evident, despite the error, the event will take place next month.

Fire and Accident Prevention Day to Be Observed October 9

The National Fire Protection Association and the National Safety Council are uniting this year in urging the nation-wide observance of fire and accident prevention day on Oct. 9, the anniversary of the great Chicago fire. A poster has been designed and suggested programs of observance of the day worked out. This is the first organized attempt to promote the general observance of fire-prevention day throughout North America.

Paving Brick Men Meet October 5 and 6

The notice of the annual meeting of the National Paving Brick Manufacturers' Association as announced in the Sept. 2 issue was not clearly stated. The convention will be opened Oct. 5 in the Deming Hotel at Terre Haute. The following day (Oct. 6) will be devoted to inspection trips and construction demonstrations.

New York Board of Appeals Inaugurates Bulletin

The Board of Standards and Appeals of New York City published last week the first issue of the regular bulletin required by law. The object of the journal is to keep the public informed as fully and promptly as possible of all rules adopted by the board and of other action in regard to building requirements in the city. The bulletin will be issued weekly, each issue to contain announcements, notices of hearings to be held and of tests to be conducted under the board's supervision; rules, amendments and repeals made by the board; every order, requirement, decision or determination relating to the construction, alteration, equipment or occupancy of buildings; minutes of meetings; the calendar of the meeting following and other matters of interest bearing upon the work.

The bulletin is issued for free distribution. Rudolph P. Miller is chairman and Daniel Sullivan secretary of the board, with offices in the Municipal Building. Meetings will be held Thursday afternoon of each week, and all will be open to the public.

Testing Society Adopts Revised Standards

Standard Cement Specifications Among Those Accepted as Result of Letter Ballot—Become Effective January 1, 1917

Among the list of proposed standards, all of which were adopted as a result of the required letter ballot of the American Society for Testing Materials canvassed Sept. 1, are the revised standard specifications and tests for Portland cement. By action at the last annual meeting (see Engineering Record, July 8, page 59) these will not become effective until Jan. 1, 1917. The executive committee will consider certain changes in form, as distinguished from substance, at its next quarterly meeting, to be held Oct. 10.

Through the adoption of the amendments to the by-laws the publication of the year book has been discontinued, and instead a biennial publication, beginning this year, and called the "A. S. T. M. Standards," will be inaugurated. The 1916 volume, which will contain about 800 pages, is expected to be ready by the end of October, at a list price to nonmembers of $7.50 in cloth binding.

New Dallas (Texas) Terminal Opened

The new $5,000,000 union passenger terminal at Dallas, Tex., was recently opened to the public. Its design and features are about the same as of the one at Kansas City.

Reading Opens New Bridge Over Susquehanna at Milton

The new bridge of the Philadelphia & Reading Railway across the Susquehanna River at Milton, Pa., was opened for traffic Sept. 10. The construction of the bridge was described in the Engineering Record of May 20, page 676.

Lack of Road and Concrete Contractors

That Kentucky has not enough road contractors or contractors capable of doing good reinforced-concrete work is the belief of Rodman Wiley, state road commissioner. "I think it would be well," he states, "for contractors to investigate the prospects in Kentucky."

Think Quicksand Would Render Hydraulic Grading Unsafe

Because of quicksand discovered in considerable quantity along its right-of-way, the New York, Chicago & St. Louis (Nickel Plate) Railroad believes the proposed use of the hydraulic method of excavating 750,000 cu. yd. of material along its tracks between Detroit Avenue and Fulton Road, in connection with grade-crossing elimination on the West Side in Cleveland, would endanger adjoining buildings. The company has therefore asked that it be allowed to use steam shovels instead, and place the material alongside its tracks east of Cleveland instead of sluicing it into Walworth Run, as contemplated.

The city has refused to sanction the change, inasmuch as the railroad had agreed to fill Walworth Run, and to make the projects possible the municipal electric-lighting plant had spent $40,000 carrying power to the motors that were to operate the pumps. The waterworks had also laid a 30-in. main to carry the 7,000,000 gal. of water daily to the excavation. The matter is still pending.

The cost of eliminating the grade crossings is estimated at $2,100,000, of which the city is to pay $765,000.

Commercial Organization Offers Prizes to Engineers

Three honorariums, $50, $30 and $20, are offered by the engineers' subdivision of the Chicago Association of Commerce for the three best papers, not to exceed 3000 words, on any one of the following subjects: (1) "Engineering and Civic Progress," (2) "The Engineer of the Future," (3) "The Business Relation of the Engineer to the Commercial World." The contest is open to undergraduates and graduates of any recognized school of engineering in the United States during the years 1915 and 1916.

Relationship of the engineer and of engineering to the business and professional world, how best to realize the conceived ideal of engineering, concrete examples illustrative of the true significance of engineering, such as a brief prospectus of a proposed work or a short, crisp, readable news article on a piece of engineering construction, are suggested lines for development.

The judges of the relative merits of the papers will be F. H. Newell, professor of civil engineering, University of Illinois; John W. Alvord, consulting engineer, Chicago, and John F. Hayford, director, College of Engineering, Northwestern University.

All papers should be mailed to the Chicago Association of Commerce, Otis Building, marked "Engineers' Subdivision Contest," and must reach there not later than Nov. 1, 1916.

A Forest of Signals

Among the many wild and ignorant statements made on the floor of Congress during the "consideration" of the "eight-hour" law and during its subsequent defense by democratic members, the blue ribbon should undoubtedly be awarded to one by Senator James A. Reed of Missouri, which is worth repeating as illustrating the amount of information on the subject possessed by some "statesmen" who voted for the bill. He says:

"I talked with a man who is manifestly more than half a nervous wreck. He used to pull the Twentieth Century Limited between Chicago and New York. He told me that by actual mathematics it could be demonstrated that upon that run the engineer holding that throttle had to read and record in his own brains six signals every second. Eight hours a day is long enough for that kind of labor. Eight hours is long enough for the passengers to ride behind a man under that kind of a strain."

We do not blame the Senator for becoming excited about the six signals per second, but a little "actual mathematics" would have shown him that a train running 60 miles an hour traverses 88 ft. in a second, and he is doubtless enough of a traveler to know that the scenery along the New York Central is not obscured by a signal every 14 ft. The artless credulity shown by statesmen of the Reed and La Follette type when they are talking to members of the labor unions is only equaled by the impossibility of getting into their heads a single real fact or truth regarding railway matters.—*Railway Age Gazette.*

Develop New Set of Formulas for Flow in Wood-Stave Pipe

A new highly technical bulletin on the flow of water in wood-stave pipe has been prepared by F. C. Scobey, irrigation engineer in the U. S. Department of Agriculture. The work is based on results obtained through experiments on the flow in wood-stave pipes from 8 to 13½ in. diameter. From the results of all experiments a new set of formulas for the flow of water in stave pipes has been deduced. These are also printed in the booklet. Engineers may obtain copies of the volume—Bulletin 376—by request to the Agricultural Department, Washington.

Engineering Society to Bring Out Popular Engineering Magazine

A magazine to advertise the work of the engineer among men who are not engineers is the purpose of a journal the Cleveland Engineering Society is bringing out with the assistance of eleven other organizations. The idea is to get distribution through engineering schools and societies. Fifteen universities and thirteen societies are on the list of distributors. More are desired and must send in their orders early, as the edition will be limited. The copies are 25 cents each and will contain 100 pages, two-thirds of which will be pictures.

The tentative table of contents includes the names of Prof. F. H. Newell, University of Illinois; Prof. George J. Johnson, Case School of Applied Science; S. W. Stratton, U. S. Bureau of Standards; Prof. H. S. Jacoby, Cornell University; Rudolph Hering, consulting engineer; A. W. Johnson, New York Central Lines, and Clemens Herschel, president of the American Society of Civil Engineers.

The organizations which have expressed a desire to help with the magazine are as follows: American Society of Mechanical Engineers; Engineers' Club, Dayton; Civil Engineers' Society, St. Paul; Detroit Engineering Society; Engineers' Club, Baltimore; Engineering Association of the South; Washington Society of Engineers; Kansas Engineering Society; Ohio Engineering Society; Engineers' Club of St. Louis and American Association of Engineers.

National Educational Association to Draft Standards for School Planning

The schoolhouse standardization committee of the National Educational Association will, Oct. 2, issue its first bulletin calling attention to the waste and lack of system in schoolhouse construction.

The committee appeals for information from all local authorities with the view of determining those standards which pertain to schoolhouses and which have already been accepted by states, cities and trade organizations and by the educational boards. From these returns it hopes to draft standards for school planning to be reported to the next meeting of the association.

Charged with Using Pennsylvania State Labor to Do Farm Work

Charges of using state-paid laborers to do work on his farm have been filed against H. E. Miller, road foreman, by Arthur S. Clay, assistant engineer in the Pennsylvania Highway Department. The accused man, who had charge of the repair of state highways in the vicinity of Butler, has been arrested and, with his assistant, suspended from service.

An Important Correction

In the obituary notes of last week's issue was a paragraph on F. L. Clapp. Too late to prevent publication of the article, it was discovered that an error had been made in its preparation. The F. L. Clapp who died is not the engineer of that name who is well known to technical men in the East and whose biography was published. The names of the two men were the same and even the initials identical. Furthermore, the two engineers were both located in the neighborhood of Boston and engaged in the same fields. In preparing the note the activities of the Messrs. Clapp were not correctly recorded. This explains the confusion of the two men's biographies, but in no way expresses the Engineering Record's regret for the occurrence. The biography given in last week's issue therefore represents the activities of Frank Lemuel Clapp, formerly of the New York Board of Water Supply, and now with Fay, Spofford & Thorndike, consulting engineers, of Boston, who is "very much alive."

Would Make Top Deck of Eads Bridge at St. Louis Free

Electrification of the Eads Bridge over the Mississippi River at St. Louis and the tunnel under the business section of the city, which is owned by the Terminal Railroad Association, and the construction of three downtown underground suburban stations are advocated in the annual report of the director of public utilities. The cost, estimated at $1,000,000, would be borne by the railroads, in return for which the railroads would be given the use of the free bridge. The upper deck of the Eads Bridge would then be turned over to the city for a consideration, the toll of 5 cents for pedestrians would be abolished and street-car fare would be reduced from 10 to 5 cents. The plans have been made by C. E. Smith, consulting engineer of the Department of Public Utilities.

Engineering Society Activities

The Harvard Engineering Society of New York will hold its first fall meeting this evening at the Harvard Club in that city, following an afternoon visit to the Hell Gate bridge. H. W. Hudson, construction engineer on the bridge, will give an illustrated lecture on that work.

The Engineers' Club of St. Louis held a meeting Sept. 27 at the Planters Hotel in connection with the convention of the Smoke Prevention Association. John J. O'Connor, Jr., of the University of Pittsburgh, presented an illustrated paper on soot fall studies.

The Efficiency Society of America will hold the annual session of its trustees and board of direction Oct. 7 and 9 at the Hotel McAlpin, New York City.

The Engineers' Society of Western Pennsylvania, at its Sept. 26 meeting, heard Patrick Mullen, mine inspector for the H. C. Frick Coke Company, discuss new mining methods as practised by his firm.

The Brooklyn Engineers' Club will hold its regular meeting Thursday, Oct. 12. G. Laurence Knight, of the Edison Electric Illuminating Company, will read an illustrated paper on construction of foundations for large turbo-generators and other apparatus under difficult subsurface conditions.

The American Society of Mechanical Engineers' New York section will meet Oct. 10. Dr. C. L. Reese, chemical director of E. I. du Pont de Nemours & Co., will lecture on explosives, giving special attention to their use for industrial purposes. A dinner will precede the meeting.

The American Association of Engineers will hold its second annual booster dinner in Chicago at the City Club Oct. 6. C. Francis Harding, professor of electrical engineering at Purdue University, will give the principal address on "Marketing Engineering Ability." John Ericson, city engineer, will tell of his experiences in hiring engineers. W. H. Finley, chief engineer, Chicago & North Western Railway, and Isham Randolph, consulting engineer, both members, are on the program.

The Western Society of Engineers was addressed Sept. 25 by Clinton B. Stewart, consulting engineer, of Madison, Wis. B. E. Grant, president, announced that the board of direction had elected D. W. Roper, formerly second vice-president, to the first vice-presidency to fill the vacancy caused by the death of C. H. Cartlidge. H. J. Burt was elected to fill Mr. Roper's place. The society has become a member of the Chicago Association of Commerce, as the board had felt the necessity of closer relations with business interests in private as well as civic affairs. Prof. C. T. Johnston will speak Oct. 2 on "The Engineer and Public Service."

What Engineers and Contractors Are Doing

W. F. FOURRIER has been made assistant engineer of the Atchison, Topeka & Santa Fé Railway's coast lines, with headquarters at Needles, Cal. He succeeds B. H. Quinlan, resigned.

A. T. HARDIN, vice-president of the New York Central Railroad, has been made vice-president as well of the Michigan Central, the Cleveland, Cincinnati, Chicago & St. Louis and the Ottawa & New York railways. Mr. Hardin is an engineer and advanced through the maintenance-of-way department of the New York Central, being engineer maintenance of way from 1903 to 1905

GERALD BAGNALL, who for the past 16 years has been assistant engineer in the second Portland district of the War Department, with headquarters at Portland, Ore., has been transferred to Kansas City. Mr. Bagnall will be assistant in the office of Lieut.-Col. James F. McIndoe, who is directing the Missouri River improvement work. Mr. Bagnall has had many years' experience on Mississippi River projects and has also been in the government service at Galveston. During the years spent in the Portland district he has been identified with jetty construction at the mouth of the Columbia River as well as with channel work there and in the 108 miles of river between Portland and the sea. As the north jetty will be finished next year and the new work will consist principally of the construction of dikes and permanent improvements in the river, it is believed that no appointment will be made to fill Mr. Bagnall's place.

R. P. BOYD, formerly assistant state highway engineer of Alabama, is now associated with James W. Billingsley, consulting engineer, of New Orleans. He will have direct charge of $400,000 worth of gravel road construction in Ouachita parish.

J. B. CONVERSE, of Selma, Ala., succeeds R. P. Boyd, whose resignation as assistant state highway engineer of Alabama is noted in this issue.

FRANK P. KEMON, superintendent of construction for the Robert Grace Contracting Company, has been transferred from Harrisburg, Pa., to Crown Point, Ind. His firm has 40 miles of new line under construction near that point for the Erie Railroad, on which Mr. Kemon will direct the concrete work.

C. C. CARPENTER, formerly in the employ of McArthur Brothers Company, is now with the Robert Grace Contracting Company. He is directing work on the contract his firm has with the Erie Railroad for a bridge near Johnson City, N. Y.

W. W. EWING, special investigator for the U. S. Bureau of Foreign and Domestic Commerce, recently visited Cincinnati as a guest of the Chamber of Commerce of that city. As has been noted in the Engineering Record, Mr. Ewing, who is an engineer and has had extensive experience with international engineering and equipment companies, will leave next month for South America. He will gather material for an exhaustive report on markets for construction materials and machinery in the countries he intends to visit. Mr. Ewing has completed his tour of large manufacturing cities of the United States, which he made to confer with American companies.

H. A. LANE has been promoted from assistant engineer of surveys to assistant to the chief engineer of the Baltimore & Ohio Railroad. Mr. Lane entered the railroad engineering field in 1895 as rodman on the engineering corps of the New York, New Haven & Hartford Railroad. In 1901 he was made assistant engineer in charge of the northern half of improvements for the abolition of grade crossings at Fall River, Mass., a work costing $1,600,000. He entered the employ of the Baltimore & Ohio in 1902 in the office of the assistant engineer of surveys. In 1907 when that road began its campaign for the betterment of its line, Mr. Lane was given charge of operations for freight terminal betterments. He was made assistant engineer of surveys in 1910, in which capacity he remained until his recent promotion.

JOHN V. SPRAGUE, who has been connected with the engineering department of New Haven, Conn., for the last four years, has resigned, effective Oct. 1. For the past year he has been in charge of the office and field work of the bureau. He has resigned to become associated with Thomas F. Maher, a local paving and sewer contractor. The new company has opened offices in the Chamber of Commerce Building. Mr. Sprague is a graduate of Trinity College.

C. B. MCCULLOUGH has resigned as assistant chief engineer of the Iowa highway commission to take charge of the course in structural engineering at the Oregon Agricultural College. Since his graduation from the Iowa State College in 1910 Mr. McCullough has spent most of his time in the employ of the Iowa commission. As its designing engineer he had charge of the preparation of nearly all of the standard concrete designs now in use. Since May, 1915, he has held the position of assistant chief engineer in charge of concrete pavement investigations and experimental road work.

W. L. DARLING has resigned as chief engineer of the Northern Pacific Railway effective Oct. 1. He has, with the exception of a few years, been connected with the Northern Pacific since 1889. He acquired his first railroad experience with the same road in 1879. His plans for the future have not been announced.

H. E. STEVENS, formerly bridge engineer of the Northern Pacific Railway, will succeed W. L. Darling as chief engineer Oct. 1 Mr. Darling's resignation is noted elsewhere in this issue.

F. H. TILLINGHAST and W. PARKER IRELAND have formed the engineering firm of Tillinghast & Ireland, consulting and constructing engineers, with offices in the Forum Building, Sacramento, Cal., and the Nixon Building, Reno, Nev. They will practise irrigation, drainage, hydraulic and sanitary engineering. Mr. Tillinghast has been in the employ of the U. S. Reclamation Service for the past twelve years in charge of construction of irrigation works, the most recent of which is the Lahontan dam of the Truckee-Carson project in Nevada. He was graduated from Brown University in 1899, after which he took a postgraduate course in hydraulics at Massachusetts Institute of Technology. He spent a year with the Chicago Great Western Railway, and for a few months in 1901 practised in New York City, following which he was successively with the Choctaw, Oklahoma & Gulf Railroad and the Catawba Power Company. He joined the U. S. Geological Survey in 1902, but resigned two years later to become resident hydrographer in New York state and later in Washington, D. C. He joined the U. S. Reclamation Service in 1904. Mr. Ireland was formerly in the water department of Chicago, later hydraulic engineer with Puget Sound extension of the Chicago, Milwaukee & St. Paul Railway, and until recently constructing engineer with the State Engineering Department of California.

ERNEST B. HUSSEY, consulting civil engineer and president of the Engineers' Club of Seattle, has been appointed a member of the Seattle Community Trust Board, established to receive and disburse funds for charitable purposes.

A. J. FASBINDER has resigned as designing engineer for the Bollinger-Andrews Construction Company, of Verona, Pa., to take a similar position with the Carnegie Steel Company at Homestead, Pa. After graduation from the Copenhagen (Denmark) Polytechnic School in 1902 Mr. Fasbinder came to the United States, where for six years he was engaged in designing heavy mill and mining machinery and buildings. He spent the following three years in Mexico, devoting a large part of his time to a study of mining problems, after which he went to Tampico to direct refinery, pump-station and pipe-line construction. He returned to the East about two years ago.

LIEUT. D. D. GUILFOIL, Company A, Illinois Engineers, stationed at Camp Wilson, San Antonio, has resigned his commission and returned to his position of engineering salesman with Sauerman Brothers, Chicago.

H. A. MILLER, formerly with the construction department of E. I. Du Pont de Nemours & Company, Inc., at Hopewell, Va., has been made general manager of the Culpepper Granite Company, Buena, Va.

G. E. QUICK, formerly connected with the promotion department of the Universal Portland Cement Company at Chicago, is now superintendent for the M. J. Hoffman Construction Company of Evansville, Ind. Mr. Quick is located at Danville, Ill., where he is directing the erection of reinforced-concrete sheds for the new station of the Chicago & Eastern Illinois Railroad.

ROBERT LENNOX STEWART, who has been in charge of the New York office of the Casper Ranger Construction Company for the past year, has resigned to enter the employ of the Bridgeport office of the Austin Company.

Obituary Notes

FRANK E. SHEDD, vice-president and chief engineer of the engineering firm of Lockwood, Greene & Company, Boston, died in that city, Sept. 23. Mr. Shedd was born at Sharon, N. H., in 1856 and was graduated from the civil engineering department of Dartmouth College in 1880. The succeeding year was spent in topographic work with the U. S. Coast and Geodetic Survey, following which Mr. Shedd was, for four years, employed on general city surveys and construction at Lowell and Boston. During parts of 1886 and 1887 he was engineer for the contractors erecting the Washington mills at Lawrence, Mass. For the last thirty years he had been associated with Lockwood, Greene & Company since 1900 as vice-president. He had specialized in mill engineering and hydraulic work. Mr. Shedd was a member of many engineering societies and well known to engineers in New England.

Civil Service Examinations

New York City—Applications for position as assistant engineer will be received until Oct. 9 at room 1400 Municipal Building, New York City. Salary $1,200 to $1,350.

New York State—Examination Nov. 4 for junior assistant in engineering departments at salary $901 to $1,200. Address civil service commissioner at Albany.

United States—Approximately thirty vacancies in the Corps of Engineers, U. S. A., will be filled from candidates who pass an examination to be held about Jan. 29, 1917. All applicants who are not eligible for appointment as junior engineer in the engineer bureau of the War Department must take an examination to be held Oct. 11 and 12. Further information can be secured from the secretary of any civil service district.

Examinations Previously Announced

Date		See Eng. Record
Oct. 7.	Illinois junior highway engineer	Sept. 23
Oct. 11.	U. S. junior civil engineer	Sept. 16

Tractor and Trailer Turned in 31-Foot Circle

Flexibility in handling a motor tractor and trailer is probably one of the first requirements of contractors. This requirement, among others, is asserted to be fulfilled by the outfit shown in the picture. It is manufactured by the Watson Wagon Company, of Canastota, N. Y. The equipment has been tried for more than a year on heavy contracting work.

The tractor and trailer can be turned in a 31-ft. circle without backing. By backing only once the turn can be made in a 20-ft. circle. It is also claimed that the outfit can be turned on a 12-ft. roadway by a driver possessing ordinary skill. Another advantage of the short-turn feature is the leverage that can be brought to bear in pulling out of a hole.

The engine is supported by special springs on a subframe entirely independent of the main frame so that none of the trailer load comes on the special springs, which are designed to support only the constant weight of the engine, driver's cab and gasoline tank. The load on

TRACTOR CAN BE USED WITH OTHER KINDS OF TRAILERS FOR HAULING LUMBER

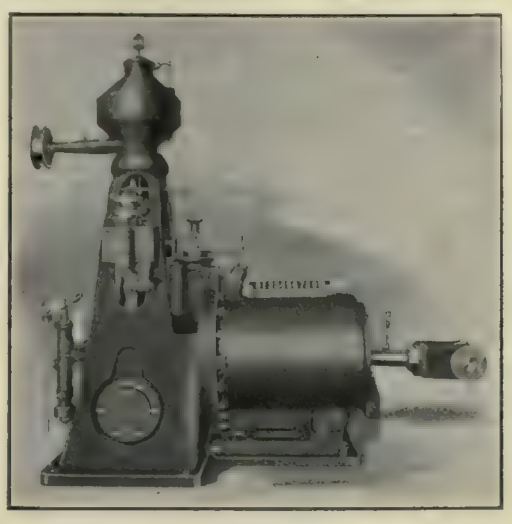
the main frame is carried by the usual set of heavy springs. This method of construction protects the engine and the vital parts of the car from undue vibration and shock.

Another feature of this new equipment is the distribution of the load, more than 60 per cent of which is carried on the steel tires of the trailer. The new equipment is constructed so that the standard trailer unit is a bottom dump, similar to the Watson bottom-dumping wagon, but much stouter and heavier. Trailers of the other design can be readily substituted for hauling lumber and other materials.

A New Waterwheel Governor

A new type of waterwheel governor, to be known as Type T, has been developed and recently placed on the market by the Lombard Governor Company of Ashland, Mass. Although this governor is primarily intended for direct connection to wicket-gate turbines, it may also be applied to cylinder gate wheels. It is built in all sizes from 3000 ft.-lb. output to 30,000 ft.-lb. output, this range making it applicable to all wicket-gate turbines up to 8000 hp. under 50-ft. head. For units requiring more energy to handle the gates a Type T actuator is used in conjunction with servomotors furnished by the wheel builders.

In the accompanying illustration the governor is shown arranged for direct connection to a horizontal gate shaft. It is also furnished with a sub-base which forms both a steady bearing and a support for a vertical gate shaft. The unit may be operated on either the open or the closed system and is driven by a novel design of rotary pump which may be



NEW TYPE OF WATERWHEEL GOVERNOR

either belt or motor driven. The pump is equipped with a special unloading valve.

The makers claim that this governor is unusually steady under constant load, quickly regains equilibrium under sudden load change, and gives the same degree of speed regulation which is obtained with other Lombard governors of recent design. One of its outstanding features is that its foot-pounds of output may be very easily increased without changing the governor setting or altering the gate rigging or the governor connections thereto. The entire range of governor sizes is obtained with only two governor frames with the cylinders interchangeable.

Hauling Contractor Buys 50 Motor Trucks

What is asserted to be the largest transaction between an automobile manufacturer and a contractor took place recently when Stedman Bent, hauling contractor, of Philadelphia, purchased 50 White 5-ton trucks.

Mr. Bent is thought to be the first contractor to go into the motor-haulage field on such a gigantic scale. His efforts are backed up by carefully kept cost records, and he is surrounded by a staff of transportation experts who have worked out a system whereby the purchaser pays only for the actual work. He is prepared to do hauling of any nature by the day, week or month, or by the yard or ton, and in this way render service to any contractor, merchant or manufacturer.

The purchase of 50 trucks brings Mr. Bent's

CONTRACTOR WHO HAS 61 TRUCKS SAYS ONE DOES WORK OF NINE TEAMS

fleet to a total of 61, the first of which was bought in February of this year. In hauling dirt from cellar excavations Mr. Bent estimates that one of his trucks can do the work of nine teams, hauling three times as much on a single trip and making three or four times as many trips as a team.

800 Miles Across Roadless Ground Made in 13 Days by Motor Truck

What is thought to be a new record in transportation annals has just been established by the U. S. Army truck train 13 in its overland run from Columbus, N. M., to San Antonio, Tex.

More than 800 miles were negotiated in 13 days' actual running time. Two days were spent in El Paso and two on the road, making the total elapsed time 17 days. With the exception of a stretch of about 30 miles leading into San Antonio, there was practically no road at all. The greater part of the route was across trackless desert, whose tractive surface was a thin sun-baked layer over the sand. Sometimes it was necessary for the men to build roads for the trucks of firewood taken from the chuck trucks. Fifty miles were made in this way. It was also necessary to ford streams and pull through long stretches of gumbo mud.

Through all these unfavorable conditions the train of 3-ton Riker trucks, built by the Locomobile Company of America, had to carry its own supplies, gasoline for the machine and subsistence and water for the men. The train was operating as an independent unit and could not secure supplies from any outside source.

Switzerland Wants Catalogs

The American consul at Geneva, Switzerland, advises the foreign trade committee of the Chicago Association of Commerce that a special room for catalogs of American manufacturers has been set aside in the new large quarters of the legation. Concerns interested are requested to supply late editions and data useful to commercial inquirers.

Get Patents on Words

Patents have been granted the Permutit Company, New York City, covering several words used in connection with the company's trademark. The words "permutize," "permutized," "zerowater" and "zerohardness" may be used only in referring to the Permutit Company.

First Issue of Pan-American Record

The initial issue of the *Pan-American Record*, the new house organ of the Pan-American Petroleum & Transport Company, was published this month. The issue, which is well illustrated, contains a history of the company and its subsidiaries, as well as news of the activities of the organization.

Business Notes

G. S. Green Company, New York City, will hereafter carry a complete line of the products of the Dobbie Foundry & Machine Company and act as that company's sales representative in the territory formerly handled directly from the factory.

H. Gries has been made sales manager of the new export department of the Lynchburg Foundry Company. His office is at 90 Wall Street, New York City.

Royal C. Wise, sales engineer and specialist in pumping machinery, Chicago, has removed his office to the Monadnock Block.

The Imperial Brass Manufacturing Company, Chicago, is about to start construction on an addition to its plant which will double the present space.

The Federal Motor Truck Company of Detroit recently held a conference at Cedar Point, Ohio, at which 150 of the company's representatives were present.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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The Chemists

LAST WEEK a suggestion was made in New York that the chemists should be brought into closer fellowship with the engineers, and that one way of bringing this about would be to have them take quarters in the Engineering Societies Building. The suggestion, it seems to this journal, is a most happy one. To dilate upon the interdependence of chemistry and engineering is to insult the intelligence of engineering readers. The interdependence is such as to need no demonstration. Why, then, should not a closer relationship be developed between the chemists and engineers as citizens interested in the industrial welfare of our country, as technical men imbued with the same high ideals and working to the same common end—maximum efficiency in the use of our natural resources? We trust that the movement will rapidly gather strength, that the close scientific relation between the two fields will quickly be paralleled by equally close society and personal relations. The engineers know that they would be benefited; we trust that the chemists will see equal, or at least very considerable, advantages.

Professional Unity

WE are moving fast. Even the most casual observer cannot help but notice that never has there been such rapid progress toward professional unity, toward forms of activities which would give the engineer a large place in the nation's life. Never before have local engineering societies done such excellent work. Never have their members, through committees and civic organizations, helped so much toward the solution of public problems of an engineering character. Nationally, the clearest index of the present professional disposition is the determination of the American Society of Civil Engineers to join with the other three leading engineering societies in a common home in New York City. The Naval Consulting Board demonstrated in a public way what the engineers could do on a public problem. Now there is a movement on foot to continue its organization in order that the engineer may exercise a larger influence on public life. Nor is the advance movement confined entirely within the profession. As briefly stated in this journal on Sept. 23, conferences are under way between engineers, the applied scientists and the pure scientists looking for closer co-operation on matters that affect the public good. The chemists have been members of the Naval Consulting Board, and now it is informally proposed that they be invited to make their home with the engineers in the United Societies Building. Truly these are great days for the profession and, clearly, we are merely at the beginning of things. We are only laying the groundwork. What will be the superstructure?

Uniform Highway Cost Accounting

TIME and again at highway conventions one hears on the floor and in the corridors talk about the cost of work. Invariably explanation of the units and additional data are asked for in order that listeners may translate the figures into a form comparable with their own cost records. In other words, there is need for a standard method of reporting highway construction costs. It does not matter so much what the units are or what the method of subdivision is. Uniformity of records is the important consideration. There is now a means by which uniformity in these costs can be brought about. The Office of Public Roads specifies in the rules under which the $75,000,000 federal-aid appropriation will be expended that it may require unit costs be kept on any project on forms supplied by the office. Since all states will probably take advantage of the federal appropriation the government's form will come to their attention and will necessarily influence the cost-keeping records. The form has not yet been determined upon, but doubtless, with the experience of the office, it will adequately fit the needs of highway engineers and contractors. It will be a boon to the road-building art if through this means a standard method of reporting road costs is adopted by the highway organizations of this country.

Concrete Road Resurfacing

HAVING been a pioneer in concrete road building, Wayne County, Michigan, has been looked upon as a source of information on good concrete road practice. It has developed systems and methods, has experimented and tried out processes in order to select anything that would allow it to improve on its construction standards. Those interested in the possibilities of concrete in road improvement will watch with interest another of Wayne County's pioneer steps—the using of concrete as a resurfacing material. No concrete roads in Wayne County have as yet worn out, but Edward N. Hines, who is responsible for the experiment, realizes that some day perhaps a concrete road may need restoration, and his faith in concrete is such as to make him believe that nothing will restore such a road so well as the original material. The details are described on page 434. A 3-inch slab reinforced and of such a rich mixture as 1:1½:2½ is a pretty husky wearing surface. Many of the California roads laid on earth are only 1 in. thicker. The work should be looked upon in its true light. It is an experiment and should be regarded as such for some time to come. The cost for the job described is not as low as might be desired. The construction is as yet only an experiment and standardized methods once evolved, provided the experiment proves itself worthy and graduates into standard practice, will probably reduce the cost to a reasonable figure.

New York Sympathetic Strike

BRIEF mention was made in this journal last week of the threat made at New York City to call out all union labor in sympathy with the strikers of the city's electric transportation lines. The call involved approximately three-quarters of a million workers. It was predicted last week that less than 200,000 would go out. As a matter of fact, the number was only about 60,000—a clear demonstration that labor thinks for itself, that those who have contracts with employers will carry them out regardless of the dictates of irresponsible leaders. The federal precedent emboldened the leaders to make the try. It was not sufficiently influential, however, with the rank and file to tie up the whole industrial life of New York.

Business and Engineering

IN the offer of a money prize by the engineers' subdivision of the Chicago Association of Commerce for papers which will make the young engineer early grasp his relation to the business and professional world there is more significance than appears on the surface. The great portion of the work of this association, which is conceded to be a model for all other similar organizations, is done largely by committees, but the membership is divided into seventy-eight sub-divisions according to business affiliations. The engineers hold meetings at regular intervals throughout the year to discuss business problems of the profession. Among the topics to which attention keeps reverting are the education of public officials and laymen in engineering and the advantages of employing real engineers. Finally it was concluded to attempt to encourage as many of the younger men as possible in the process of doing the educating. The efforts put forth will be a better reward to the men participating than the actual prizes. Only after several months' consideration by a committee of the brainiest business men in Chicago was the prize money appropriated. To devote money to such a purpose was creating a new precedent, and they wanted to be sure it was a good one. When business comes half way or more to meet the young engineer he should appreciate and welcome his opportunity. May the papers be numerous.

Commercial Possibilities with Activated-Sewage Sludge

FROM statements made before the American Chemical Society at its convention in New York last week it appears that the recovery of nitrogen, as a fertilizer base, from sewage sludge, on a commercially practicable scale, is at last well within the range of actual accomplishment. The announcement is of signal importance, and its influence will be felt far beyond the field of sanitary engineering. The facts upon which this prediction is made are contained in the paper, on page 444, by William R. Copeland, chemist in charge of the Milwaukee Sewage Testing Station, which is followed (page 445) by a discussion by George W. Fuller, consulting engineer, New York City. Of course, everyone has known that sewage contains valuable chemical ingredients hitherto allowed to run to waste, and it is not news, either, to learn that nitrogen may be extracted from sludge. The outstanding feature of Mr. Copeland's investigation, however, is that this result appears now to be commercially practicable.

In the earlier types of sewage treatment plant plain sedimentation or septicization was resorted to. Then came the Imhoff tank, with its separation of settling and sludge-digestion chambers. In all of these processes the nitrogen content of the sludge amounted to only from 1.2 to 3 per cent—much less than would be expected from the composition of the raw sewage. This diminution of nitrogen, however, is readily accounted for by the nature of the process of treatment. Some of it passed away in the form of colloidal matter with the tank effluent and a substantial portion was lost by conversion into gases which escaped directly to the atmosphere. With the newer form of sewage treatment by the activated-sludge method these channels of escape for the nitrogen are effectively blocked, for one of the distinctive features of the process is that nitrogen-carrying colloidal and suspended matters of the sewage are collected in the sludge.

The Milwaukee data show that dry sludge from the activated-sludge process contains about twice as much nitrogen as the sludge from other processes. In this condition we have the master key with which to unlock the treasure stored up in sewage sludge. On a basis of 10 per cent moisture the activated sludge at Milwaukee shows a nitrogen content, figured as ammonia, of from 4.6 to 5 per cent, as against only 1½ to 3 per cent of nitrogen from sludges produced by other processes. At present prices nitrogen, according to Mr. Copeland, is worth $2.50 per unit, or per cent. In normal times the value of this product would be about $2 per unit. Summing up the situation Mr. Copeland's figures indicate that the dried sludge from the activated process (10 per cent moisture) is worth from $9 to $15 per ton, while the total cost of getting this product and placing it on the market, including all overhead expenses, will range from $8 to $12 per ton. It is pointed out, also, that this cost may be materially reduced in the case of large plants.

If sewage treatment plants can be made to produce, at a profit, nitrogen as a base for high-grade fertilizers their field of usefulness will be very materially widened. Reduced operating costs certainly will have a decided influence in stimulating sewage plant construction, with a consequent reduction in the number of nuisance-producing water courses throughout the country. It may be, therefore, that the Milwaukee work foreshadows a sanitary improvement program of national proportions.

Will It Rise to Its Opportunity?

NEXT WEEK the American Society of Municipal Improvements will meet in Newark, N. J. Will it take the steps needed to place its work on the high plane of our other national engineering societies?

As at present conducted, its procedure in the making of specifications is a reflection on the American engineering profession. Specification-making, when a part of the function of any society, is considered one of its most important activities. Consequently in organizations of recognized standing a practice has grown up which insures the very closest scrutiny of proposed specifications in order that the final result may represent the best work of the organization and that all possible flaws will be detected and all objections calmly considered.

The American Society for Testing Materials is the leading engineering body in this country which formulates and adopts specifications. When a new subject is to be taken up its procedure is to appoint a committee. This body, after due consideration, brings in a tentative specification, which must run the following gauntlet before final adoption:

1. Publication in advance of an annual meeting.

2. Consideration at that meeting. The meeting may either refer the specification back to the committee, or may order it printed in the year book as a tentative specification for a two-year period.

3. Consideration in an annual meeting two years later. In the intervening two years amendments may have been proposed and changes made. In that event the specification, as amended and changed, is printed in advance of the second meeting.

4. Consideration at this second meeting, at which the specification may be again referred back to the committee or may be passed to letter ballot of the members.

5. Approval by letter ballot, in which each member of the society is entitled to vote.

It is patent that this procedure gives an opportunity for all objections to be heard and every clause to be scrutinized. There can be no star-chambering. There can be no manipulation by manufacturers without the fact becoming known. It is this careful procedure which has given the work of the American Society for Testing Materials so enviable a standing.

Contrast this deliberate, careful policy with that of the American Society of Municipal Improvements. The *Proceedings* of the 1915 convention of that society, pages 535 and 536, lays down the following procedure: "That the president direct the subcommittees to consider more fully their reports prior to the date of the convention and that the chairman of each committee transmit an advance copy of his report for publication with the advance copies of papers; also that the subcommittees meet on the day preceding the first day of the convention and report to the general committee on the first or second day of the convention. And that when a majority of the subcommittee is not in attendance at the convention the president be authorized to appoint additional members of such subcommittees from the members present." The general committee refererred to is a board of five on standard specifications, which sits at convention time to pass on the work of its subcommittees.

This procedure is merely suggestive; it is not obligatory. There is no compulsory advance printing, so that the membership may carefully scrutinize what they will be expected to vote upon. As a matter of fact, in the past it has not been unusual for members of subcommittees to have no specifications ready previous to their appearance in the convention city. Everything is done with a rush, without that calm consideration, that openness which is absolutely essential if the engineering public is to have respect for the result. We submit that even experienced engineers are not competent in a day or two to pass judgment on a complicated specification. It needs study. It needs analysis. Both are impossible in the brief sittings of the committees.

Moreover, there are necessarily commercial interests involved in some of the specifications. Since they are not published in advance rival manufacturers find it necessary to come in force to fight for what they consider their rights. As a result, the commercial brawls at the conventions have been nothing short of disgraceful.

But some will contend that no bad specifications have been adopted. Even should that be the case, thanks are not due to the system or to the scrutiny of the membership but rather to the ability of a few able men and to the strenuous fights of rival manufacturers. Those who want some light on the society's procedure are advised to read the discussion on pages 522 to 529 and 537 to 553 of the *Proceedings* of the Dayton meeting. They tell about the adoption of a patented specification as one of the standards of the society.

The American Society of Municipal Improvements can become a force for great good, and that is why the Engineering Record urges the reform of its procedure. So long as it follows its present course it will be distrusted by the profession, and the fine work it is doing in the presentation of technical papers will be more than counterbalanced and vitiated. This year while its program is absurdly long, it presents some very excellent material. It is regrettable that its specification-making procedure does not comport with the excellence of its other work.

Engineering Expression on Public Questions

THE Council of National Defense, established by federal law, has taken over the work of the Naval Consulting Board, and that body's organization, therefore, is ready for dissolution. It has performed a great public work. It has demonstrated what an influence engineers are capable of exercising and what work they can do on public problems of an engineering character.

Shall that organization, formed and equipped to carry out the engineers' part in a great national work, be disbanded? Or shall it be made the agency through which the engineer henceforth will project himself into public affairs? These are the questions that were raised last week in New York City before a group of representative engineers called together by W. L. Saunders.

At the outset, let us lay down the proposition that the engineer needs some agency for public expression. That, the Engineering Record holds, is no longer open for discussion. The engineering profession has indicated clearly its attitude by its approval of the public activities of local and national engineering societies.

Then remains the question, What shall that agency be?

At first blush, most engineers, we believe, will object to the establishment of a new organization. They will feel that the existing national bodies should be the agency for expression. These bodies are well established. Their memberships are large and representative. Their standing is of the highest. Their organizations have been perfected.

Can the national engineering societies be brought to play their part in such a program of public expression? That question points to the difficulty of relying upon the national engineering societies to do this work. Their expressed object is to advance professional knowledge and to secure the maintenance of high standards in the profession. Their activities, however, have kept pace with the times; their constitutions have not. Despite their activities in public affairs, there is undoubtedly a large number of their members who are not yet won over to the new point of view, and who would especially object to the virile work that needs to be done. In time, no doubt, the entire membership will favor more active participation in public affairs.

While the Naval Consulting Board's organization would be untrammeled by precedent, and would have public activity as its main object, there would be some difficulties in its way. While no one would be eligible to membership in the new body unless he belonged to one of the national engineering bodies, the new organization could not have the prestige of the existing ones. Its membership would be smaller and less representative. Much would need to be done to knit it together and to recruit a membership large enough to be effective.

Something should be done; some agency provided to bring the engineers' influence to bear on our national life. If the committee appointed at Mr. Saunders' meeting believes, on inquiry, that the national societies will not assume the function and agree to exercise it with vigor, then there is call for perpetuation of the Naval Consulting Board's organization. At best, however, in the judgment of the Engineering Record, that organization would be a temporary one, and, if formed, should stand ready a few years hence to pass back to the national societies this public service function which they, better than any other body, can exercise.

All the Evidence In on the Quebec Bridge Case

SINCE the loss of the suspended span of the Quebec Bridge on Sept. 11 two principal explanations have been offered by correspondents of this journal for the initial failure. The first was that the sections of the rocker-joint castings were insufficient or improper in design; the second, that the support was in unstable equilibrium.

Instead of printing these discussions, all of which were prepared without full data as to the details of the rocker-joint and of the lower ends of the lifting stirrup, the Engineering Record considered it better to withhold them until all the evidence was presented. In this issue the remaining pertinent data are published.

Before entering on a brief discussion of the data, the Engineering Record wishes to put on record the candor with which the Board of Engineers and the officers of the St. Lawrence Bridge Company have met every inquiry regarding the accident. Everything asked for has been given; every facility afforded to put the profession in possession of information that might shed light on the cause of failure.

As to the castings, the tests and analysis of specimens leave no ground for criticism as to the character of the metal. The composition is up to specifications; the strength and ductility very satisfactory. There were no rejections, and the inspection was careful. No details are available to show the history of the annealing; the usual practice of the Canadian Steel Foundries, Ltd., which furnished the castings, was followed.

The computations reveal an interesting condition. If the load were to be carried entirely in direct compression the stresses that would have developed in an intermediate casting without wings would be well within the limits of good practice. Manifestly the design of an intermediate member that would act only in compression was out of the question. Longitudinal stability was required not only during hoisting, but while the span was on the bents at Sillery Cove. But the addition of the longitudinal wings actually weakened the casting, or, to put it in a better way, required the casting to take bending stresses. These were limited by the designers (with their assumption of stress distribution) to 20,000 lb. per square inch. It will be noted that these stresses are checked by an alternative assumption as to stress distribution. The factor of safety, however, it seems to this journal, was too low for a member in such a responsible position and made of such material. The success of the whole unprecedented hoisting operation was directly involved.

While, in the opinion of this journal, a higher factor of safety would have been advisable, the only conclusion that seems warranted is that the failure was due to a defect in the metal.

The second explanation of the initial cause of failure has been that the support was in unstable equilibrium. The drawings shown elsewhere in this issue indicate that the lowest pin of the stirrup system was but 3½ in. above the transverse pin between the suspended span and the intermediate casting. There was a large pin through diaphragms in the lifting girder itself, but movement about this pin was effectively prevented by the connections between the stub link and the cover plates of the girders.

With the very small vertical distance, 3½ in., between the lower pin of the suspended span and the transverse pin carrying the span, any error in exactly centering the latter pin and castings on the supporting girder would tend to tip the latter and the stub link to which it was attached. Excess loading would therefore be thrown in one wing of the rocker casting, and the tipping would tend to cause the casting and span to slip off the greased longitudinal pin. Friction and the light ⅜-in. centering plates only prevented slipping. Nevertheless, the system was in stable equilibrium, provided the central relation of all of the parts was maintained.

Furthermore, when the inquiry comes down to a review of the facts, as opposed to the theory of slippage, the answer can only be that slipping did not occur. We know positively, from the evidence afforded by the southwest lifting girder, that the span went off diagonally—that it did not slide off the hanger. Furthermore, the picture of the span going into the river, published in this journal Sept. 16, distinctly shows three of the corners seated on the girders, while the fourth corner, the southwest one, was under water and 60 to 70 ft. lower than the other three. Under very extreme conditions, therefore, the supports held their load in place, even though the figures and the drawings show a dangerous dependence on pin friction and accuracy in shop work.

In the judgment of this journal the case of the suspended span of the Quebec Bridge is closed. Fortunately, sufficient evidence was preserved on the girder to show exactly what happened. This evidence, combined with the detailed drawings, leaves it to every engineer to draw his own conclusions. Some will believe, as does this journal, that greater factors of safety should have been used in the intermediate castings and the suspension details. While engineers are entitled to these beliefs, however, it should be distinctly borne in mind that under most severe punishment three of the intermediate castings proved their sufficiency, as did also the suspension details which have been called into question.

BY JULY 1, 640,000 SQUARE FEET OF SLAB HAD BEEN COMPLETED IN 34 WORKING DAYS

Addition to Detroit Plant Sets New Mark for Rapid Concrete Construction

Six-Story Automobile Factory, 164 x 842 Feet, Completed with Three Concrete Mixers at a Rate Exceeding Construction of Philadelphia Building

EXTRAORDINARY speed, considerably exceeding that made in constructing the Baldwin Locomotive Works plant described in the Engineering Record of Aug. 5, 1916, page 160, was made in erecting the 842 x 164-ft. six-story reinforced-concrete addition to the Ford Motor Company's plant at Detroit, accepted from the builders, the George A. Fuller Company, on Aug. 1 last. Whereas the Baldwin plant, exclusive of the ground floor, contained 320,000 sq. ft. of slab, poured in 41 days elapsed time, the Ford plant on the same basis required 640,000 sq. ft. of slab, which was poured in 62 days elapsed time. In both cases the ground floor slab was also poured within this time. Owing to the fact that the operation of the existing plant could not be interfered with, only one end of the building was accessible to the contractor, and all the material required, amounting to more than 2000 carloads, had to be transported from this end through the center of the building on a double-track industrial railway. This layout was facilitated by a central craneway the length of the building, extending to the roof, in which were located three concrete towers and three brick hoists. Concrete was mixed at the base of each tower, the materials being delivered separately in cars. The record made in construction is the more remarkable because the finish floors were laid homogeneously with the slab under Master Builders' specifications, and had to be allowed to harden 24 hours and covered with shavings before the next tier forms could be started. Moreover, slotted inserts, crossing the width of the building every 6 ft., had to be set and leveled.

Footing Construction Requires 43 Days

Ground for the building was broken on March 19 last. Unsatisfactory soil conditions developed, however, which delayed the completion of the footings until May 1. It was found advisable to lower the footings in some cases to a depth of 25 ft. below the lot level, and a total of 18,000 cu. yd. of excavation was required. The only form work completed before May 1 was a few parts of the first tier, and no concrete above the footings had been poured. The concrete work was entirely completed on July 1, including the roof, which was particularly difficult to form because of the complicated concrete beam work necessary for the craneway and craneway skylight. This skylight itself is carried on steel trusses.

The building was planned in general with panels 22 ft. square and with uniform 12-ft. story heights. Also, practically the entire space between the exterior columns and the spandrel beams at the outside edges of the floor slabs was filled with steel sash to give the maximum amount of light. On the other hand, in addition to the difficulties with forming the skylight and craneway beams, the columns were hollow cylinders reinforced on each face with spiral steel. This construction permitted carrying the ventilating ducts in the columns. Moreover, the lighting and power conduits were carried in the slab, there being more than 6000 floor boxes. The floor slabs themselves were 8½ in. thick and of the mushroom type, with drop heads at the columns. While the interior columns were all round, the exterior and craneway columns were square. The columns also contain a large number of socket inserts. The heating and ventilating plant is installed in eight pent houses on the roof, and will be operated with steam from the company's main heating plant.

Industrial Railway Supplies Materials

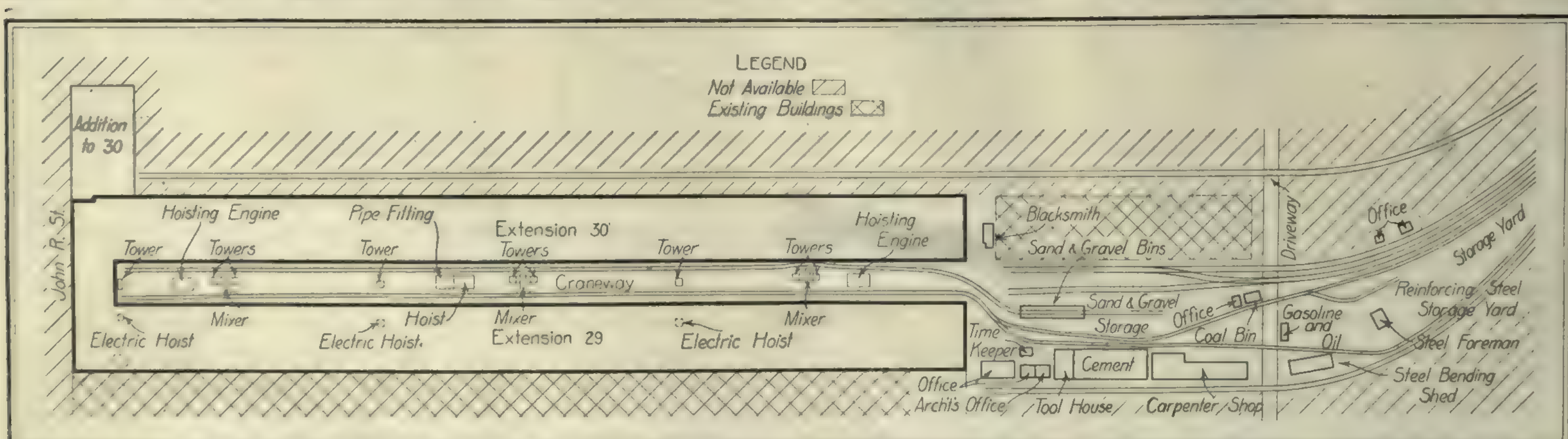
As may be seen from the layout drawing reproduced herewith, all the materials were received at one end of the building, and had to be conveyed through it on a double-track industrial railway. This railway supplied six towers located near the center line of the building in the craneway. Three of them at which mixing plants were located were used exclusively for handling concrete, while the other three were used as brick hoists, and mounted the booms which handled the reinforcing steel and forms.

It had been intended to place the ¾-yd. Smith mixers below ground at each of these towers so as to feed them by gravity. The soil conditions disclosed, however, made this impossible without running the risk of disturbing the soil under adjacent footings. Wheeling to the mixers was therefore necessary, but was reduced to a minimum by dumping the industrial trains as close as possible to the mixers. As may be seen from the drawing, these trains were loaded by gravity from sand and gravel bins which were filled from railroad cars by a locomotive crane with a grab bucket. Because existing railroad tracks made it difficult to locate the cement shed adjacent to the bins, it was necessary to distribute the cement in separate trains.

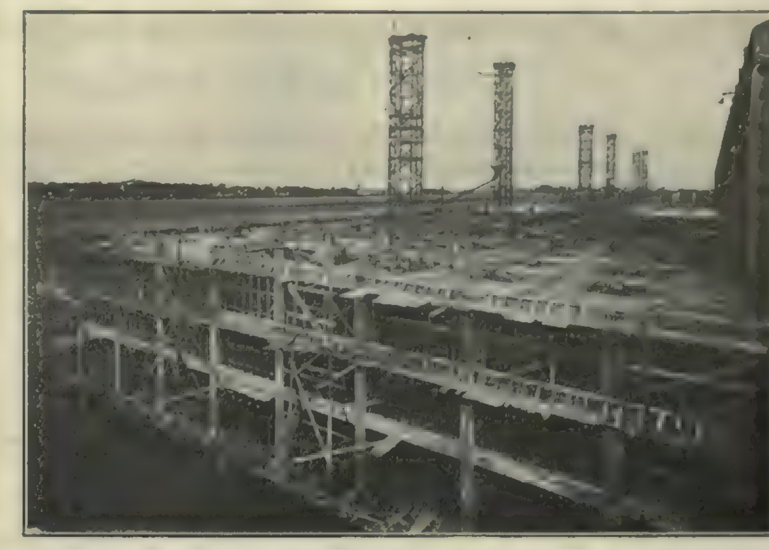
Three Mixing Plants Used

Three mixing plants were used in place of two of larger capacity, so that one mixer might be stopped at any time for overhauling without delaying the work. Each machine was inspected daily and kept to its maximum efficiency, and the usual delays from this source were entirely avoided. The concrete was spouted to hoppers on the floors and distributed by buggies.

It was necessary to unload all the rein-



OPERATION OF SURROUNDING AUTOMOBILE PLANT LEFT RESTRICTED YARD SPACE AND ALLOWED ACCESS TO BUILDING ONLY AT ONE END

THREE CONCRETE PLANTS IN CRANEWAY POURED ENTIRE BUILDING—FOOTING CONSTRUCTION AT LEFT; RIGHT SHOWS THIRD FLOOR FORMED

forcing steel about 400 ft. from the building, as indicated in the drawing. This also had to be delivered to the building by industrial cars. The two gasoline locomotives, made by the J. B. Fate Company, and the fourteen Lakewood cars which delivered all of the materials used in the building were, according to the contractor's statement, in as good condition at the end of the job as when purchased.

Forms Handled in Panels

All of the wood forms, including those for the footings, were made in sectional panels at the mill on the site. These forms, in making which 2,000,000 ft. b.m. of lumber was used, were designed to facilitate stripping and re-erecting. Wood was used for all the form work except the interior circular columns, for which metal forms were employed.

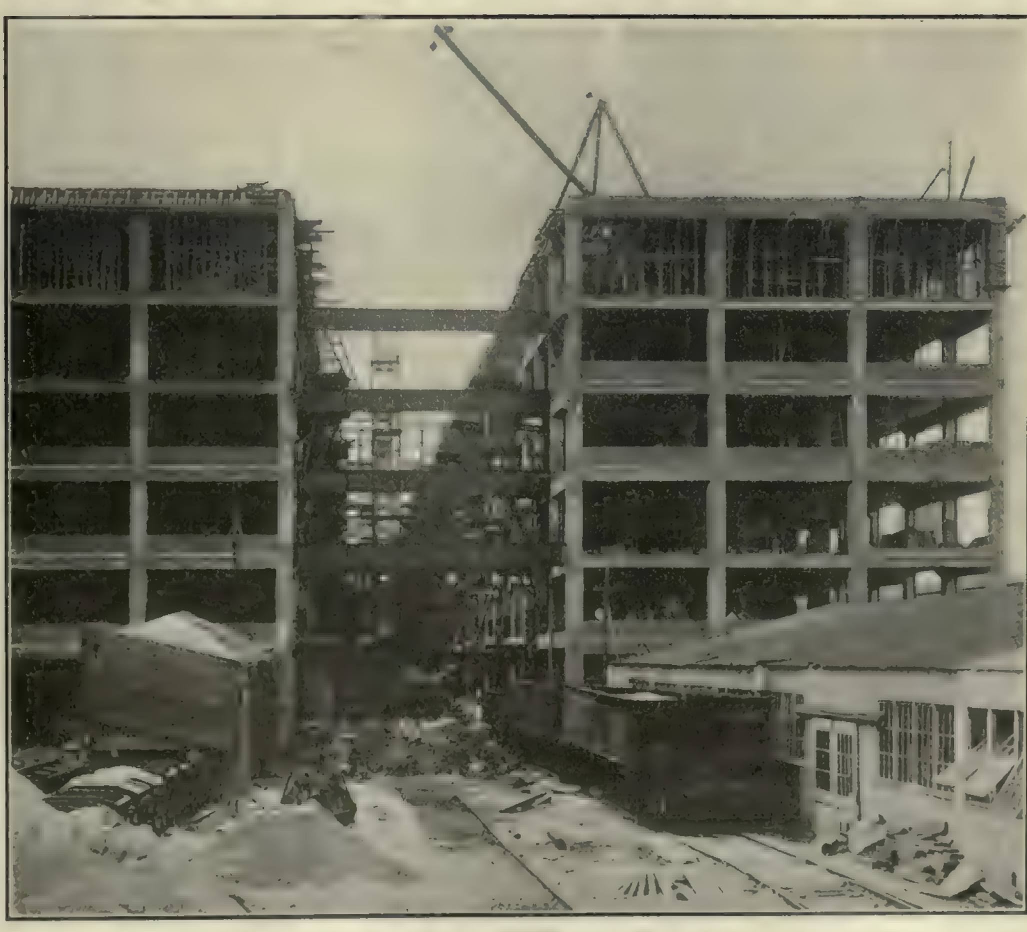
Reshoring and its consequent loss of time were entirely avoided by designing the panel forms for the decking so that the slab could be stripped without disturbing one line of shores. Cast-iron chairs were used to support the reinforcing bars and also the wood screed for floor finish.

Night Work Avoided

It was necessary to employ two shifts of concrete finishers and concrete gangs, but other trades worked only a single shift. A force of nearly 2000 men was employed. The operations of setting forms, steel and floor inserts and pouring concrete followed so closely that each operation was in continuous progress on two floors at all times. Concrete was poured at an average rate of nearly 1000 cu. yd. per day.

As compared with 25 days actual working time on the Baldwin plant at Philadelphia, the actual working time on the Ford Building was 34 days, 28 of the 62 days elapsed time having been lost through rain, Sundays and one holiday. Exclusive of the roof, the actual number of square feet formed and poured each working day was 21,000. The difficulty of constructing the roof forms brought this average down to 18,500 ft. for the entire building. This compares with 12,800 sq. ft. per working day averaged at the Philadelphia building, not counting in either case the ground-floor slab.

The building, including both engineering and mechanical features, was designed by Albert Kahn, architect, of Detroit, and built under his supervision by the George A. Fuller Company, with A. G. Cassel as superintendent and David Shearer as assistant superintendent. Frank Bailey represented the architect on the work.



THESE TRACKS THROUGH CENTRAL CRANEWAY FURNISHED ONLY ACCESS TO BUILDING

Cheaper to Build the New Than Maintain the Old

THERE has been discussion in recent years on the great need of a deep-water channel to connect Sacramento, Cal., with the sea. The city lies about 50 miles by river from Suisun Bay, an arm of San Francisco Bay, and it has been maintained that a deep-water route is one of the city's greatest needs.

The Sacramento River, which passes through the city and flows directly into Suisun Bay, has been many times surveyed, and United States engineers have estimated that it would cost about $400,000 a year to maintain a 15-ft. channel to the bay. But this depth is not considered sufficient, and surveys made under the direction of the state engineering department are reported to indicate that the maintenance of a 30-ft. channel would be about $1,000,000 per annum.

Because this annual expenditure was considered unwarranted, an examination of other means of accomplishing the same end was undertaken. It was found that a ship canal could be built from the south border of the city, a distance of 35 miles, to deep water on the San Joaquin River, by way of the old city drainage ditch, Snodgrass and Georgiana sloughs. By using this route it will be possible to take advantage of natural waterways for 14 of the 35 miles, which will keep the total cost of excavation down to about $1,000,000 for a 30-ft. canal with a bottom width of 150 ft. This figure would not, of course, include costs of right-of-way, wharves or other incidental work; but the ship canal would be practically free from the necessity of annual dredging to remove silt brought down during the flood-water stage, whereas dredging would be necessary in the river channel.

What Was the Cause of the Initial Failure at the Quebec Bridge?

Computations and Specifications for Steel Rocker Casting Presented—Relative Positions of Transverse Pins Shown

CONSIDERATION of the question raised by the editorial in the issue of Sept. 23, as to the probable initial cause of the failure at the southwest lifting stirrup of the suspended span of the Quebec bridge must be based upon full information regarding the various details at the point in question.

Through the courtesy of the St. Lawrence Bridge Company this information, together with the specifications and results of the tests of a specimen from the heat for the rocker-joint castings, is here presented. Several letters have been received pointing out the possibility of unstable equilibrium or of a twisting moment tending to cause the girder to tip and the rocker to slide off the lower pin. In order to give the readers of the Engineering Record full information on these points, the details of the stub-link connection to the stirrup support and the relative location of the various pins are here reproduced, together with details for the castings and the stirrup girders.

That the corner castings at the southeast corner (initial failure occurred at the southwest corner) of the span must have been subjected to at least 100 per cent excess loading is shown by the fact that some of the main hanger links at this corner have been measured and found to be permanently elongated about ⅜ in. in their length of 30 ft. This would occur in the vicinity of the net section at the pin-holes. The unit stress must have exceeded the elastic limit and probably more than doubled the 17,000 lb. unit stress in these sections actually existing previous to the accident. Yet under this punishment, the castings at this corner, the evidence published in this journal Sept. 23 showed, did not break.

Specifications for Castings

The following abstracts from the specifications for the steel castings cover the most important requirements:

"*Furnace*—Steel for castings shall be made in an open-hearth furnace.

"*Stock*—At least one-third of all stock used for steel castings shall be pig iron; and, when scrap is used, it shall be of a kind and quality satisfactory to the engineer. (The proportion of pig iron shall be left to the discretion of the manufacturer. See letter from Board of Engineers, Feb. 12, 1913.)

"*Decarburization*—During the reduction of the steel in the furnace it shall not be decarburized below 0.10 of 1 per cent.

"*Use of Iron Ore, Etc.*—In making steel for castings, the use of iron ore, ferro-silicon, ferro-manganese and spiegeleisen will be allowed according to usual and good practice.

"*Chemical Requirements*—The ladle test of steel for castings shall not contain more than the following proportions of the elements named:

		Per Cent
Phosphorus	Basic steel	0.04
	Acid steel	0.06
Sulphur		0.05
Manganese		0.75
Silicon		0.35

"*Annealing*—All steel castings shall be carefully and thoroughly annealed in a manner approved by the engineer, and shall have a fine-grained or silky fracture.

"*Soundness of Castings*—All castings shall be sound and free from shrinkage cracks, and as free from sand holes and blow holes as the latest and best practice can produce. The engineer shall be the final judge as to whether a defect is sufficient cause for rejection. Every casting which contains a blowhole, or blowholes, or any other cavity or flaw of such size, and so placed as to injure it materially, shall be rejected.

"*Welding of Castings*—No electric or other welding or patching of defects in castings shall be done, unless authorized by the engineer. Any such welding or patching done without the engineer's consent shall cause the rejection of the casting.

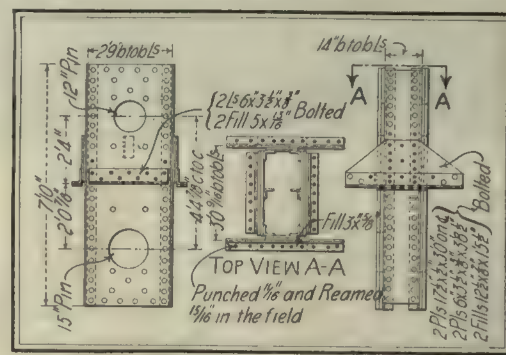
"*Physical Tests*—Test pieces taken from coupons on the annealed castings shall show an ultimate strength of not less than 65,000 lb. per square inch, an elastic limit of at least 35,000 lb. per square inch, and an elongation of not less than 20 per cent in 2 in. They shall bend without cracking 120 deg. around a rod twice the thickness of the test piece."

Results of Test

A test piece from the heat for the rocker castings satisfied all the requirements of the specifications, the ½-in. specimen having an elastic limit of 36,300 and an ultimate strength of 69,700 lb. per square inch, with 29 per cent elongation in 2 in. and 44.7 per cent reduction of area. The chemical analysis showed: Carbon, 0.26 per cent; phosphorus, 0.033 per cent; manganese, 0.55 per cent, and sulphur, 0.032 per cent.

Computations for Rocker Casting

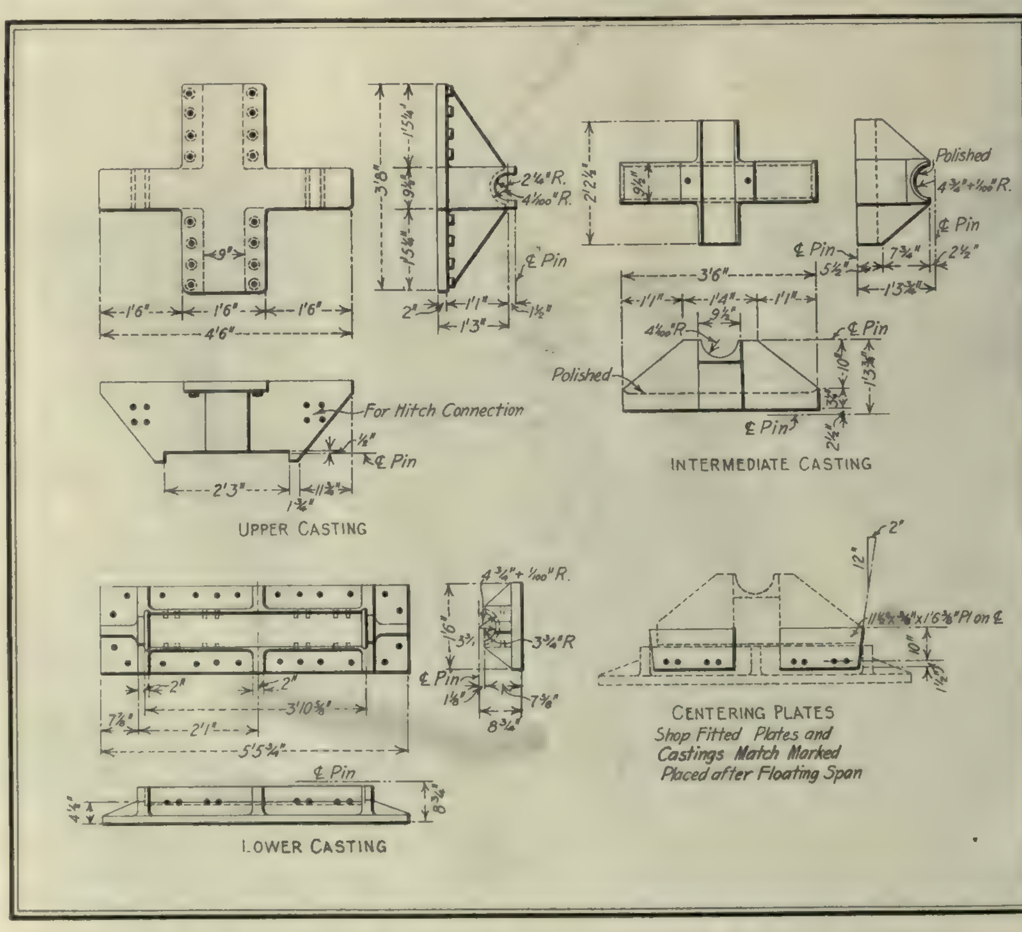
The total load assumed in the design of the details at each corner of the span was 3,000,000 lb., including 20 per cent for impact and wind. The allowable bending fiber stress was 20,000 lb. per square inch in the castings and 30,000 lb. per square inch in the pins. The method used for the computation was to determine from the known section moduli of the castings and pins the



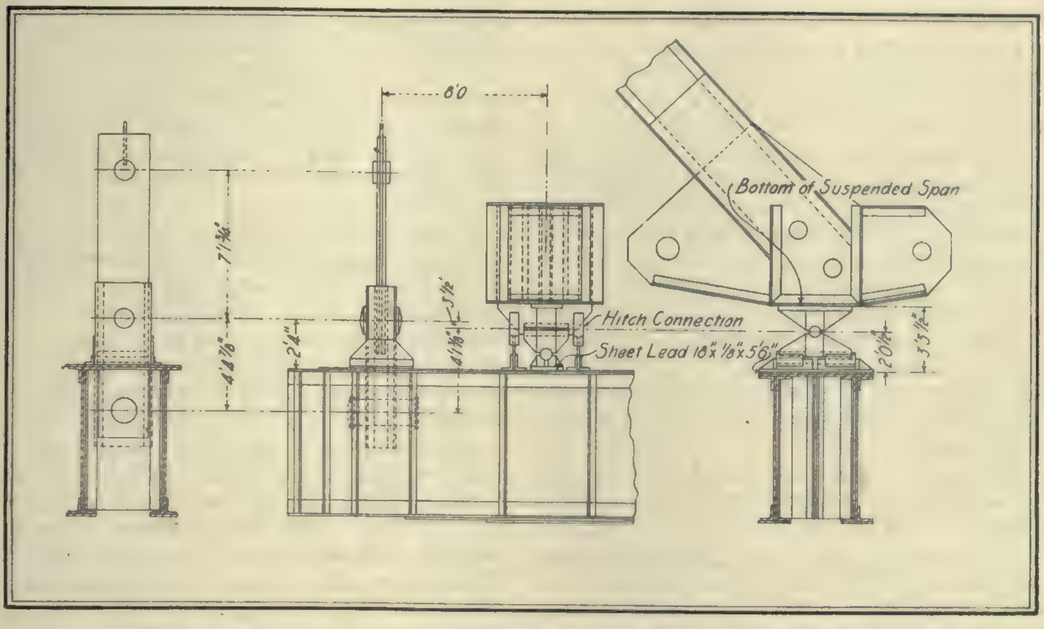
DETAILS OF CONNECTION BETWEEN STUB LINKS AND SUPPORTING GIRDERS

As seen in the photograph on page 371 of the issue of Sept. 23, a number of drift pins still remained in this connection at the time of the accident, yet no distortion was observed.

amount of the longitudinal distribution of an assumed uniformly distributed loading on pin and castings as in Figs. 1 to 3. The lower longitudinal pin was designed on the basis of an 8-in. diameter, but was changed later to 9½ in. at the suggestion of the Board of Engineers. As shown in the computations reproduced in the table herewith. the longitudinal wings of the rocker casting distribute the load over 25.1 in. of the 8-in. pin, giving a bearing unit stress of 15,000 lb. per square inch. This pin would distribute the load over 29.1 in. on the lower cast-



DETAILS OF CASTINGS—DIMENSIONS FOR INTERMEDIATE OR ROCKER CASTING



LOCATION OF HANGER PINS, STUB LINK PINS, CASTINGS AND END PINS OF SPAN

ing without exceeding the allowable pin fiber stress, and the lower casting would distribute the load over 31.9 in. of the top of the stirrup girders. For the 9½-in. pin actually used, these lengths are increased to 31.8 and 34.6 in. respectively. The actual dimensions of these castings are given on one of the drawings, and the details of the stirrup girders and diaphragms on another. The distance between the webs of the two girders of the stirrup support is seen to be 4 ft., the total length of the casting being 5 ft. 6 in.

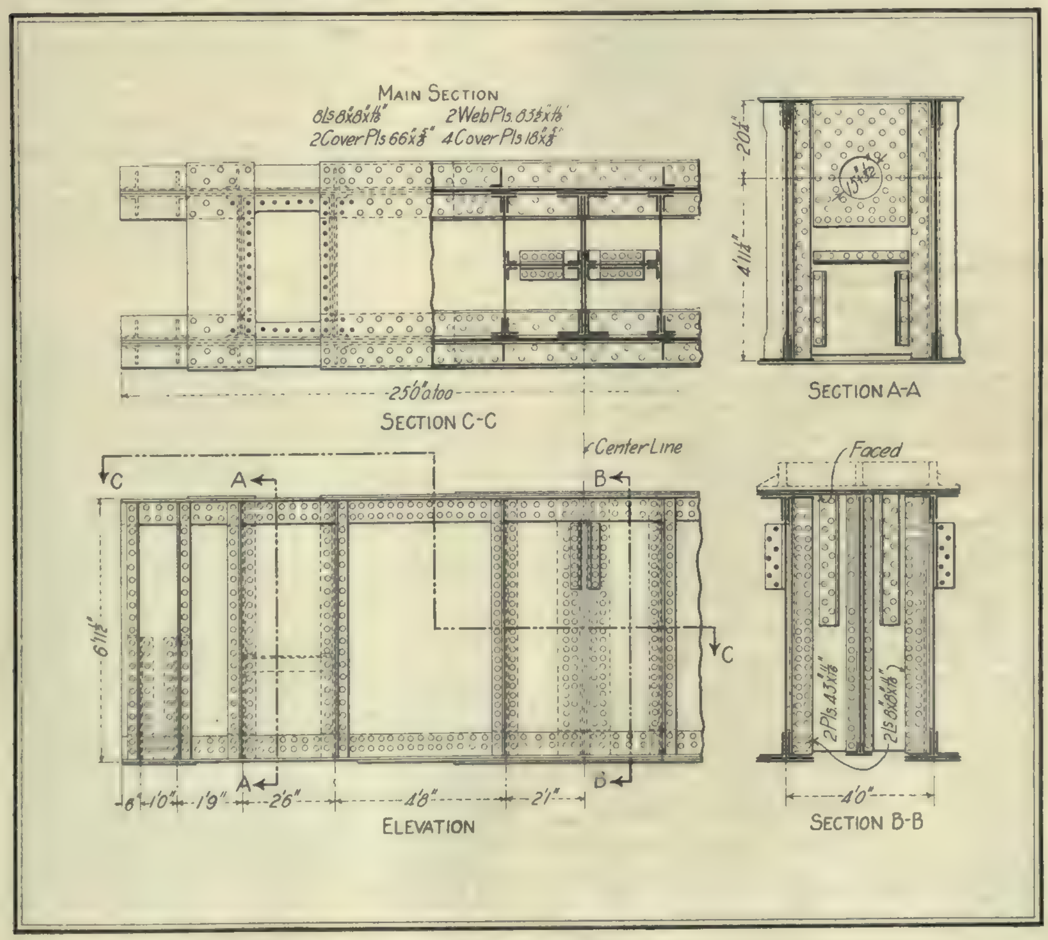
The possibilities of exceeding the allowable fiber stresses in the castings and pins as actually detailed, based upon usual assumptions of uniform load distribution along the pin, are obvious. For example, as shown in the computations in the table, the unit fiber stress in the longitudinal wing, based upon a uniform distribution of 2,550,000 lb. (assuming the total weight at 5100 tons, without impact, as existing at the time of failure) over the 39.5 in. actual bearing length of the rocker casting, is found to be 38,400 lb. per square inch. If friction at 10 per cent on the transverse pin, due to deflection of the suspended span or other causes, be assumed to cause uniformly varying pressure on the longitudinal pin, a total of 42,400 lb. per square inch is obtained, which means a factor of safety of 1.65. As some of these castings probably carried twice this load without failure, it is evident that the assumed uniform distribution here discussed did not take place.

Assuming that the total load of 2,550,000 is distributed over the full 39.5-in. bearing of the rocker casting as a uniformly varying pressure from zero at the outer end to a uniform pressure for 9½ in. at the center, there is obtained a unit stress in the casting about equal to the allowable value of 20,000 lb. per square inch. It will be noted that the rocker casting would have had lower unit stress in bending if the longitudinal wings or arms had been made only about 25 in. long in bearing on the lower pin. The increase in length was made for the purpose of increasing the longitudinal stability.

The castings were furnished by the Longue Pointe plant of the Canadian Steel Foundries, Ltd. The metal was made by the acid open-hearth process. No castings were rejected, none were repaired, and they were inspected by both the bridge company's engineers and the Board of Engineers.

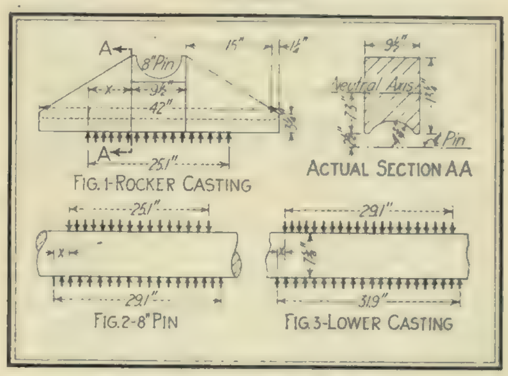
STABILITY

The question why a pin connection between the stub link and the supporting stirrup was adopted when a rigid attachment is furnished at the top of the girders, as shown in one of the drawings, is answered by the fact that these girders were first used as supports for the steel falsework framing and this pin joint was the detail there required. This also explains the sole plates on the ends of these girders. The question of stability is discussed editorially in this issue.



PART ELEVATION AND SECTIONS OF SUPPORTING STIRRUP WITH DIAPHRAGMS

Computations for Load Distribution and Stresses



ROCKER CASTING (SEE FIG. 1)

Load per unit length $= \dfrac{3,000,000}{9\frac{1}{2} + 2x}$

$M = \dfrac{3,000,000}{9\frac{1}{2} + 2x} \times \dfrac{x^2}{2}$

Section modulus = 182.5

Allowable M = 20,000 × 182.5 = 3,650,000

Therefore

$$\frac{3x^2}{19 + 4x} = 3.65$$

$$x = 7.8 \text{ in.}$$

Casting distributes load over 9.5 + (7.8 × 2) = 25.1 in.

Bearing unit stress $= \dfrac{3,000,000}{25.1 \times 8} = 15,000$ lb.

8-INCH PIN (SEE FIG. 2)

M = 1,500,000 x/2

Section modulus = 50

Allowable M = 30,000 × 50 = 1,500,000

Therefore

$$1.5\,x/2 = 1.5$$

$$x = 2 \text{ in.}$$

8-in. pin distributes load over 25.1 + (2 × 2) = 29.1 in.

LOWER CASTING (SEE FIG. 3)

M = 1,500,000 x/2

Section modulus = 52.3

Allowable M = 20,000 × 52.3 = 1,046,000

Therefore

$$x = \frac{1.046}{1.5} \times 2 = 1.4 \text{ in.}$$

Casting distributes load over 29.1 + (1.4 x 2) = 31.9 in.

COMPUTED STRESS IN ROCKER CASTING (SEE SECTION AA, FIG. 1)

Assuming 2,550,000 lb. uniformly distributed

Load per unit length $= \dfrac{2,550,000}{39.5} = 64,500$

$M = \dfrac{64,500 \times 15^2}{2} = 7,260,000$

Section modulus $= \dfrac{1380}{7.3} = 189$

Tensile bending unit stress $= \dfrac{7,260,000}{189} = 38,400$ lb.

Oregon Engineer Discusses Personal Advertising

"Acquaintance of One Engineer Is Worth, to an Engineer, That of Half a Dozen Other Men"

HOW MANY ENGINEERS do you know and how many know you? How can your list of engineer acquaintances be broadened at not too great an expenditure? The answer, as given in the September *Bulletin* of the Oregon Society of Engineers, is: "Join a local engineering society." Don't stop at merely "joining," continues the article, but be a real live unit—get to know every other member. When there is a lecture, enter into a helpful discussion—even offer to give a lecture yourself and contribute to engineering publications. The editor of the *Bulletin* dwells more in detail on these subjects in the following quoted paragraphs. He says:

"Some of you may be old enough to remember the phrase, 'Keeping everlastingly at it brings success,' and to remember the little old-fashioned ads in which it appeared. Others may have absorbed the idea conveyed in that other slogan, 'It pays to advertise,' and yet have been unable to see where it has paid you.

"Many engineers have a notion that acquaintanceship with other engineers, while agreeable enough, so far as it goes, doesn't really amount to anything where dollars and cents are concerned; and these deluded individuals are expending their substance in 'putting up a front' and otherwise cultivating the acquaintance of men of other professions.

"Now I am not going to say anything against the other professions, nor the men in them, but I honestly believe that for practical purposes the acquaintance of one engineer is worth to an engineer that of half a dozen other men. In my own case it has proved true. Total strangers have walked into my office and given me better jobs than I knew were available—sent to me by engineer friends—while the best that I could get out of the other acquaintances might be a chance to stake out a lot—at half price—as a neighborly act, you know. And they make a fellow feel at the same time that they are giving him the work largely as an act of charity.

Suggests Engineering Co-operation

"There are four or five hundred engineers in and around Portland. How many of them do you know? How many of them know of you? If you were asked to design a bridge or a power station, and were too busy or didn't know how, could you recommend a man to do the work? Or to reverse the case, how many of the five hundred engineers in this vicinity know your specialty and your qualifications?

"I'm willing to bet that they are mighty few. Maybe it is just as well, too, for frequently those who know me tell me that I have missed my calling; and they may be right about it. Quien sabe?

"You may have missed your calling, also, in which case the greater the secrecy surrounding you, the greater will be your chances of success as an engineer.

"But supposing that you are an engineer, and a good one, which is, after all, the only assumption that we can proceed upon, can you not see that it will be distinctly to your advantage to have all of the other good engineers in the community know what you can do and how well you can do it, as well as to know some of the things that you have done in the past?

Be a Good Mixer

"Perhaps you are employed now, and are satisfied with the surroundings and salary, and that there is no prospect of a change. Hundreds of others have been in the same circumstances one day, and the next have been left high and dry, through no fault of their own, with no job, and no knowledge of how to get one. Wouldn't their chance of immediate re-employment have been increased greatly if they had been widely and favorably known among the engineers of their town?

"Possibly. But how could they or you achieve such a result without too great a cost?

"By joining a local engineering society, and by attending the meetings and when there by 'mixing.' Make it a point to meet one or two or a dozen new engineers every month. Find out what they have done and are doing and hope to do, and don't be too modest. Let them know who you are and what part of the world your work supports.

"Search out the chairman of the program committee and drop a hint that you have some interesting lantern slides showing a work upon which you were engaged before coming here and if properly pressed will consent to show them to the society and explain the peculiarities of the work.

Contribute to Lectures and Publications

"Look up the publication committee chairman and tell him that you have written, or will be glad to write, a description of some of your experiences in China or Nebraska, as the case may be, if he can use such matter to advantage—which you bet he can.

"When a subject is up for discussion upon which you are informed or wish information, tell what you know, or ask such questions as will bring out the information you seek. Others will thank you, and will form a favorable opinion of your professional skill.

"And if you are in private practice, supplement these methods with a card in the society's year book and another in its journal. This will keep your name before those who can do you the most good."

Experiments with Concrete for Road Resurfacing

In Wayne County, Michigan, 3-Inch Reinforced Surface Was Laid on Six-Year-Old Pavement After Sprinkling with Hot Tar

THE POSSIBILITY of using concrete as a resurfacing material, if for any reason it is necessary to bring an old concrete road back to a condition equal to new, is being experimented with in Wayne County, Michigan. Edward N. Hines, chairman of the Board of County Road Commissioners, presented a paper at the general meeting of the Portland Cement Association Sept. 13, at Detroit, in which he outlined the experiment he is trying out. The following notes are taken from the paper and from the discussion which followed its reading.

Experiment on Grand River Road

Wayne County has a large and constantly growing mileage of concrete roads. Some day in the far distant future it may be necessary to resurface some of them, and to determine the suitability of concrete for this purpose a section of the Grand River Road built in 1910 has been made the subject of a resurfacing experiment. This stretch was chosen because of the heavy mixed traffic using the highway. Therefore a severe test would be exacted of the resurfacing, tending to prove or disprove its value.

Grand River Road, where this experiment is being carried on, was built of two-course construction, 16 ft. wide and 6½ in. thick. The bottom course was 1:2½:5 and the wearing course, which is 2½ in. thick, was 1:2:3. It was laid in 25-ft. sections, with ¼-in. tar-paper strips cutting entirely through the concrete. The surface was struck off with a template, but owing to the fact that concrete road work in 1910 in Wayne County was in its infancy, workmen and finishers were not as careful then as they are now to secure a true, even surface. This also seemed to mark the stretch of road chosen as ideal for the resurfacing experiment.

Resurfacing

Territory served by the Grand River Road has built up rapidly since the highway was paved, and while attempting the resurfacing it was decided to increase the pavement width to 20 ft., better to accommodate the rapidly increasing traffic. In order to do this the slightly rounded edges of the original pavement which had been finished with a 3-in. radius were broken off and new concrete added to bring the pavement to the required width. A 1:2:4 mixture laid 6 in. deep was placed. Before proceeding with the resurfacing all Tarvia that had been used for maintenance purposes was removed from cracks and holes, which were filled with concrete to make an even surface 20 ft. wide. Where expansion joints were spalled to any extent the old concrete was broken away sufficiently to give a bond for new concrete on both sides of the joint. Expansion felt was then placed and the whole surface brought to an even grade.

When the old pavement had been redressed in this manner, there was applied a 3-in. layer of 1:1½:2½ concrete, in which Marquette (Mich.) traprock graded from ¼ to 1 in. and washed and screened bank sand were used as aggregates. In no place is the resurfacing less than 3 in. thick, reinforced with No. 26 triangular mesh.

Tar for Bond

No attempt was made to bond the top course to the old concrete in the usual way. That is, no rigid bond was attempted. The surface of the old concrete was first sprinkled with water, after which a mixture of Tarvia A and Tarvia X was sprinkled on hot immediately before placing the new wearing surface. Falling on the moistened old concrete, the Tarvia spread in a very thin layer and was immediately chilled, thus forming an even coat over the old surface.

Expansion joints in the resurfacing course were made to coincide exactly with expansion joints in the old pavement. A 3 x 4-in. scantling 20 ft. long was laid over the old joint and the concrete deposited as though no joint were to be made. Afterward the scantling was removed and armor-plates with expansion felt between them, suspended from installing bars, were set in place so that the felt of the new joint exactly met the tar paper of the joint in the old pavement. A Baker automatic finishing machine was used to finish the surface.

Before this work was undertaken experiments had been made to point out the advisability of the procedure that finally prevailed. Small slabs of concrete were made, a coat of Tarvia put on top and another course of concrete deposited. Not only was it found impossible to separate these two layers after the concrete had thoroughly hardened, but a blow on the upper surface sufficient to crack the top course would also crack the bottom one.

The usual protective measures were taken to prevent the concrete from drying out, and it was sprinkled daily for two weeks. Traffic was permitted to use the road after twenty-five days.

Mr. Hines made it plain that the work should be regarded purely as an experiment and its results awaited before any general plans are made for its use.

Omaha Coagulant Plant Uses Improved Alum Process

Manufacture of Aluminum and Iron Sulphate Combined — Heat from Lime Slakers Transferred to Alum Solution

IN the new coagulant house of the Metropolitan Water District of Omaha aluminum sulphate cake is made from bauxite and sulphuric acid. A hot normal solution of the aluminum sulphate is passed over scrap iron on its way to the water to be treated, thereby making it a basic aluminum ferrous sulphate. Lime is used to complete the reaction, and the heat liberated in its slaking is transferred to the alum solution, raising the latter to about 100 deg. Fahr.

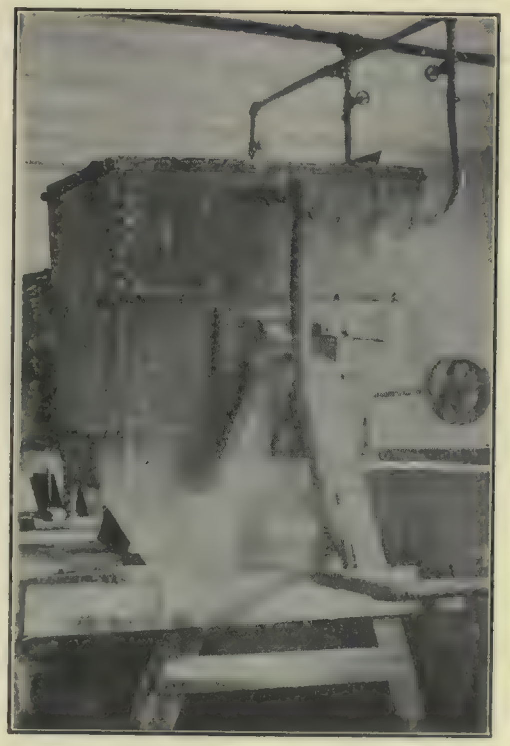
Experiments on a large scale had been carried out on this method to determine the controlling factors and to ascertain the sizes necessary before the present plant was designed. These experiments were concluded about the time the alum-making plant at Columbus, Ohio, proved to be successful and construction was held up until this new feature could be added. The war broke at about this time and skyrocketed chemical costs to such an extent that the alum-making plant was all the more a desirable addition, and it was felt that the whole process might as well be undertaken. At present even the making of sulphuric acid is under consideration.

The alum plant is essentially similar to the one at Columbus, but much simplified because no steam is added. The acid reacting on the bauxite forms enough heat and the quantities are apportioned accurately by weighing into a steel tank having a capacity of about 2000 lb. The materials are agitated with steel stirring paddles, motor-driven, for 5 minutes. A 6-in. plug in the bottom is then raised and the liquor flows into a 13 x 25-ft. concrete tank 3 ft. deep. The reaction will be completed on this floor, no evaporation being necessary, as the right amount of water for crystallization is condensed in the 53-deg. Baumé acid used.

MUSLIN BAGS COLLECT DUST OF PULVERIZED BAUXITE

The acid (60 deg. Baumé) is bought by the carload and stored in a 10,000-gal. tank to the north of the building. It is unloaded by compressed air through a 1½-in. lead pipe to a 1000-gal. diluting tank, from which it flows by gravity to the acid-weighing tank on a suspended scale over the reaction tank.

The bauxite is purchased from the American Bauxite Company, Bauxite, Salem County, Ark., at \$8 per ton. The freight brings the cost at Omaha to \$12 per ton.



LIME-SLAKING TANKS ARE JACKETED TO CONSERVE HEAT

At the plant the bauxite is put through a Ramond pulverizer and ejected by a blower into a cyclone collector on the floor above. The surplus air from the cyclone passes into a series of muslin bags, the lower ends of which open into a large cone, thus allowing the air to escape and the fine dust to be recovered.

SLAKING HEAT UTILIZED

Aluminum sulphate in a normal solution (12 per cent) feeds through the jackets of the lime slakers. The latter are steel tanks, lead lined, on trunnions surrounded by a wooden tank, making a tight compartment for the alum about 4 in. in thickness, sides and bottom. The top is open and the trunnions permit dumping into circular concrete mixing tanks for making milk of lime. The alum lines to and from the interspace are rubber hose to give the necessary flexibility.

A simple wooden tank, 8 x 12 ft. in plan by 2 ft. deep, has six compartments made by under-and-over baffles. The solution remains in the iron vat about 120 minutes and takes up the equivalent of 100 lb. or iron per day when the water treated is 20,000,000 gal. daily, with 1.5 gr. per gallon. The feed is regulated through an orifice box with a glass ballcock, the jet dropping into a funnel and being sucked into a 1½-in. pipe 10 ft. above the floor by a water ejector which discharges into the supply under a total head of 15 ft. The murky lime is taken from the mixers in the same way by an ejector. Various points of entry for cleaning out scale are provided and a long run of rubber hose is used instead of iron pipe.

CHEMICAL PLANT HOUSE WAS DESIGNED FOR ARCHITECTURAL APPEARANCE

The water for treatment has already had a sedimentation period of 12 hours in three basins not baffled, but very carefully provided at inlet and outlet with weirs for distribution over the end cross-section. Coagulant and lime are added simultaneously into a mixing flume, 5 ft. wide and 10 ft. deep, with baffles spaced 15 ft. apart for 240 ft. along this flume. Following this thorough mixing the water enters the basins for a further period of 24 to 30 hours and a skimming at the outlet of each basin, except in the last basin, which has the outlet 15 ft. below the level of the water.

RESULTS SATISFACTORY

Before the plant was put into operation and for several years with the old plant the turbidity of the water supply of Omaha has been reduced from 5000 to 10,000 down to 1, 2 and rarely 10 parts per 1,000,000. Bacterial counts are rarely more than 50 and B. coli in the effluent are rarely found. Chlorine takes care of the organisms in liquid form since the recent installation of a Wallace & Tiernan outfit. Previous to that time for five years a bleach plant with concrete mixing tanks was operated.

The alum-iron process was developed by Andrew Jacobson, chemist in charge of the plant at Florence, working under the direction of George T. Prince, chief engineer for the Omaha Metropolitan Water District, of which R. B. Howell is general manager. H. S. Nixon, assistant engineer, has charge of the construction and execution of the work. Charles P. Hoover, Columbus, Ohio, was the consulting engineer.

Mineral Output from Alaska Increases

The annual statement of the production of gold, silver and copper in Alaska in 1915 shows that the value of the total mineral output from that section during that year was \$32,854,229. The value for 1914 was \$19,065,666.

Cameron Septic Patents Expired This Week

Status of Infringement Claims Against Imhoff Tanks Discussed in Light of Recent Developments

By GEORGE W. FULLER
Consulting Engineer, New York

For several months past the Engineering Record has received frequent inquiries, emanating for the most part from cities and towns in the Middle West, as to the status of the Cameron and the Imhoff sewage tank patent claims. Apparently there exists much confusion regarding this question, and threats of litigation on the part of the Cameron company have led many engineers to ask about the validity of its claims. The fact that the Cameron patents expired this week (Oct. 3, 1916) makes George W. Fuller's statement a timely one.—EDITOR.

THE Cameron and Imhoff patents relating to single-story and two-story septic tanks respectively for the treatment of sewage have been discussed at length for a number of years. The patent issued in the United States to Cameron and associates covered both apparatus and process claims, but the Circuit Court of Appeals, Second Circuit, in the Saratoga (N. Y.) case decided that while the Cameron process claims were valid, the apparatus claims were invalid (see Engineering Record, Jan. 25, 1908, page 99).

The principal Imhoff patent refers to apparatus whereby a two-story settling or septic tank is so arranged as to prevent the gases and rising particles in the lower or sludge-digestion chamber from disturbing the contents in the upper or settling compartment.

BRITISH PATENT DATED 1895

An apparatus patent was issued in England to Cameron in November, 1895, for the regular 14-year life of British patents. Based on the procedure then in vogue in the United States, a patent of British origin would continue in effect in this country only throughout the period when it would be effective in the country of its origin. On this basis the Cameron patents expired in November, 1909, both in England and in the United States.

The International Treaty of Brussels in 1902, to which the United States subscribed, adopted, among other things, a ruling that patents of foreign origin were to have the same life as patents of domestic origin. The Cameron patent, containing both apparatus and process claims in the United States, was issued on Oct. 3, 1899, which, excluding the significance of its foreign origin, would normally give it a life of 17 years, or until Oct. 3, 1916.

Whether the Brussels treaty was so adopted by the United States in such form as to make its patent provisions retroactive or not is a question upon which decisions have varied in different district courts of the United States.

In the Knoxville, Iowa, case it was arranged by counsel that the question of the life of the Cameron patent in the United States should be taken before the United States Supreme Court under certain stipulations as to the identity between the British and United States patents. The decision in this Knoxville case, which went against the Cameron patent, did not exploit the difference between the process claims of the United States patent issued to Cameron and the apparatus claims constituting his earlier English patent, and which apparatus claims, more or less modified, were declared, in the Saratoga decision, to be invalid.

In 1915 the United States District Court held in the Winchester, Ky., case that the Cameron British patents for apparatus did not affect the continuance of the life of the valid process claims of the Cameron United States patent. This virtually ruled that the Cameron septic process claims continued to live until Oct. 3, 1916.

Obviously a license to use the Imhoff apparatus has no bearing upon the infringement of the Cameron process patent by the Imhoff tank.

Whether or not the Cameron process claims are infringed by two-story septic tanks of the Imhoff type has never come up for adjudication. Opinions have been expressed for and against the infringement by those more or less familiar in a technical and legal way with such matters. The most that can be said at present is that it is an open question.

Since the Winchester, Ky., decision in September, 1915, this question of infringement of the Cameron patent by Imhoff tanks has been made the basis of a number of written demands by the Cameron company for settlement of alleged infringement by operators of Imhoff tanks. But such demands have been met with a counter movement by the National Septic Process Protective League (see Engineering Record, March 25, 1916, page 433).

So far as now known no suits have been instituted against the operators of Imhoff tanks for infringement of the process claims of the Cameron patent. In the event that no suits were so instituted on or before Oct. 3, 1916, then it is our understanding that no suit in equity with prayer to enjoin the use of Imhoff tanks can later be commenced. But without attempting to exploit the legal phases of the matter, it is our understanding that a suit at law to recover damages from those who, prior to the expiration of the Cameron patent, made use of septic tanks of either the one or two-story type, may be brought subsequent to that date, but within the period prescribed by the statute of limitations.

[In answer to an inquiry regarding future litigation of patent claims, the Engineering Record has received from the Cameron Septic Tank Company of Chicago the following telegram:

"Answering your wire, the expiring of Cameron Patent 634423, Oct. 3, does not end either litigation or claims for infringing use of septic process in either Imhoff or any other form of septic tank prior hereto, because statute of limitations for recovery of royalties and other patent damages does not run out for six years, or until Oct. 3, 1922. In fact, only last week we sued Shelbyville, Ky., both under the patent and for connivance with the so-called National Septic Process Protective League, which has headquarters at Marshalltown, Iowa, and was recently organized to obstruct the collection of our established license fees for the use of the septic process."—EDITOR.]

Railroads Made Big Gain in Year Ended June 30

Report of Bureau of Railway Economics Shows 41.7 Per Cent Increase in Operating Income

GROSS operating revenues for the fiscal year ended June 30 on the large steam railroads of the United States have just been reported by the Bureau of Railway Economics. They totaled $3,396,808,234, or $14,818 per mile of line, as against $12,678 per mile for the previous year, showing an increase of 16.9 per cent. Operating expenses were $2,220,004,233, or $9,684 per mile, as against $8,915 for 1914-15, an increase of 8.6 per cent. Net operating revenue, therefore, was $1,176,804,001, or $5,134 per mile, as against $3,763—an increase of 36.4 per cent; and operating income was $1,029,241,804, or $4,490 per mile, as compared with $3,169 for the previous year—an increase of 41.7 per cent. Taxes were $146,754,477 or $640 per mile—an increase over those of 1914-15 of 8.4 per cent.

EARNINGS BY DISTRICTS

Considering the three districts, the most marked gains were in the Eastern and Southern districts, where the operating incomes per mile increased 52.4 and 51.2 per cent respectively. The gain in the Western district was only 29.5 per cent. In the Eastern district total operating revenues increased 20.3 per cent, attaining the figure of $26,239 per mile. Operating expenses also increased 10.8 per cent. Operating income was $7,753 per mile. In the Southern district the total revenues of $11,611 per mile represented a gain of 15.5 per cent. Operating expenses increased only 4.8 per cent, consequently the operating income of $3,428 per mile showed the gain of 51.2 per cent already mentioned. In the Western district the $10,615 per mile total revenue was 14.0 per cent more than in the preceding year, but operating expenses also went up 7.9 per cent. Operating income was $3,337 per mile. In each district the freight increases in total revenue in per cent were considerably greater than the total increase, while the corresponding percentages of increase for passenger and mail business were small. The Southern and Western districts suffered 10-per cent increases in taxes, as against 5.6 per cent for the Eastern district.

JUNE RETURNS

For the month of June for the whole country the percentages of increase were respectively 19.0, 16.2, 24.6 and 25.9 for total operating revenues, operating expenses, net operating revenue and operating income. The gains in total revenues were about the same in per cent for all districts; but an increase of 20.9 per cent in operating expenses for the Eastern district as against only 6.4 per cent for the Southern is reflected in an increase of 18.6 per cent operating income for the Eastern as against 55.3 per cent for the Southern. In the latter district, however, the operating ratio was 72.4 in June, 1915, while in the former it was only 66.0, and in June, 1916, the ratios were respectively 65.1 and 66.6.

For the fiscal year for the entire country the operating ratio was 70.3 in 1914-15 and 65.4 to 1915-16. For the year 1913-14 this ratio was 72.7.

Low-Lift Pumping Plant Uses Distillate Fuel

Two Pumping Units Have, Each, a Capacity of Fifty-Nine Cubic Feet per Second at Two-Foot Lift—Plant Drains Land Near New Orleans

By B. S. NELSON
Engineer and Construction Superintendent for A. M. Lockett & Company

THE DRAINING of the wet lands of southern Louisiana has attracted the attention of landowners and capitalists, as it has proved practicable to drain land that has long been thought useless for any purpose, and valued at $2 or $3 to $10 per acre. By a moderate expenditure in a drainage plant and canal system areas are converted into rich farmlands worth from $100 to $300 per acre. There are several millions of acres of such land in Louisiana, and the past drainage work is only a small part of what will be done in the near future.

As is usual in any new development, there has been considerable diversity of opinion among engineers as to the type of pumping plant best suited to drainage work. A number of engineers, seeing the possibilities in the drainage field, have specialized in this work and made careful studies of the pumping-plant problems. This has led to the compiling of rainfall and runoff data which, to a certain extent, has standardized the needed capacity per acre and the lift. No one type of prime mover is favored, but the tendency is all toward some form of internal-combustion engine. The centrifugal pump is universally used, as it is adapted to moving large volumes of water at low lifts. Most of the pumping is done at 4 to 5-ft. lifts.

DISTRICT COMPRISES 1700 ACRES

The Fourth Jefferson Drainage District, in the parish of Jefferson, adjacent to the city of New Orleans, comprises about 1700 acres. The territory starts near Lake Pontchartrain and extends back about 3 miles along the Seventeenth Street canal, which is one of the main outfalls of the New Orleans drainage system. The Jefferson plant—the general arrangement of which is shown—discharges into this outfall canal and thence to Lake Pontchartrain, which is practically an arm of the Gulf of Mexico. This installation is a good example of what is being done in this line.

The pumping equipment consists of two duplicate units, each with a capacity of 59 cu. ft. per second at 2-ft. lift and capable of pumping at any head between zero and 10 ft.—the capacity decreasing as the head increases. The pumps are of the Worthington 30-in. double-suction slow-speed drainage class with special radial and axial-flow type of impellers having a nearly constant horsepower input at all heads.

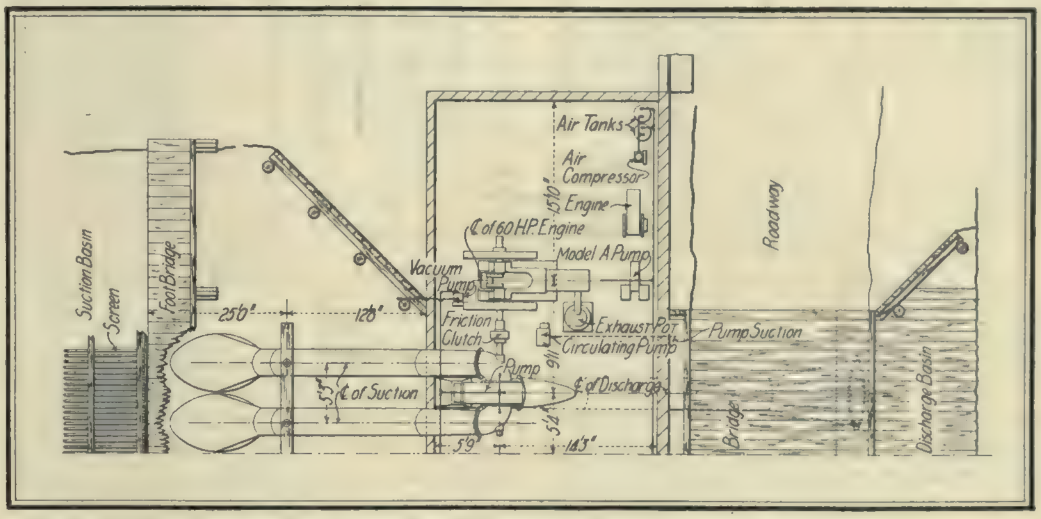
The pumps are direct-connected through friction-clutch couplings to 60-hp. 190 r.p.m. Ingeco distillate engines designed to operate on cheap distillate of 39 Baumé gravity costing about 4 cents per gallon delivered at the plant. The engines are started on gasoline, run for a few minutes until the jackets warm up, and then switched to distillate by throwing the handle of a six-way cock.

Batteries are unnecessary, as the engines are fitted with oscillating magnetos suitable for starting as well as running—a valuable feature for an isolated plant.

Each pump is primed by means of a rotary vacuum pump driven through a friction drive from the flywheel of the main engine. These pumps are cross-connected so that either main unit can be primed from either vacuum pump. The vacuum-pump suctions are connected to the top of the main pump casing and also to both suction elbows, so that the pumps may be primed either before or after the clutch is thrown in.

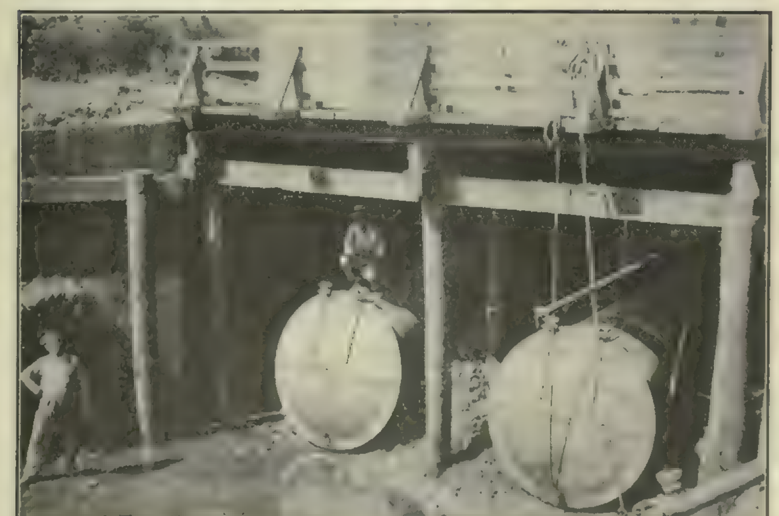
Water is supplied by two rotary pumps belted off the hub of the clutch coupling, one to each unit. Each of these pumps is of ample size to supply water to both main engines and to the water-sealed glands of the main pumps. To insure a supply of water in starting and if anything should go wrong with the circulating pumps, a 500-gal. elevated tank was erected. This furnishes an hour's supply for one engine, and is so piped that should the pump stop working water would still flow to the jackets. An added advantage of this arrangement is that it gives a constant head of water on the jackets at all times.

Other auxiliaries in the plant consist of a $3\frac{1}{2}$ x $3\frac{1}{2}$-in. air-cooled air compressor belted to a $2\frac{1}{2}$-hp. kerosene engine for the air-starting system. The compressor delivers to two $1\frac{1}{2}$ x 6-ft. brazed-steel air tanks which, when charged to 90-lb. pressure, give air for several starts of the main engine. The engines are started by a hand-operated lever admitting air on the explosion stroke. The auxiliary engine is also belted to a 4 x 5-in. Deane single-cylinder double-acting power pump used for transferring fuel oil from a barge in the outfall canal to the main storage tank.



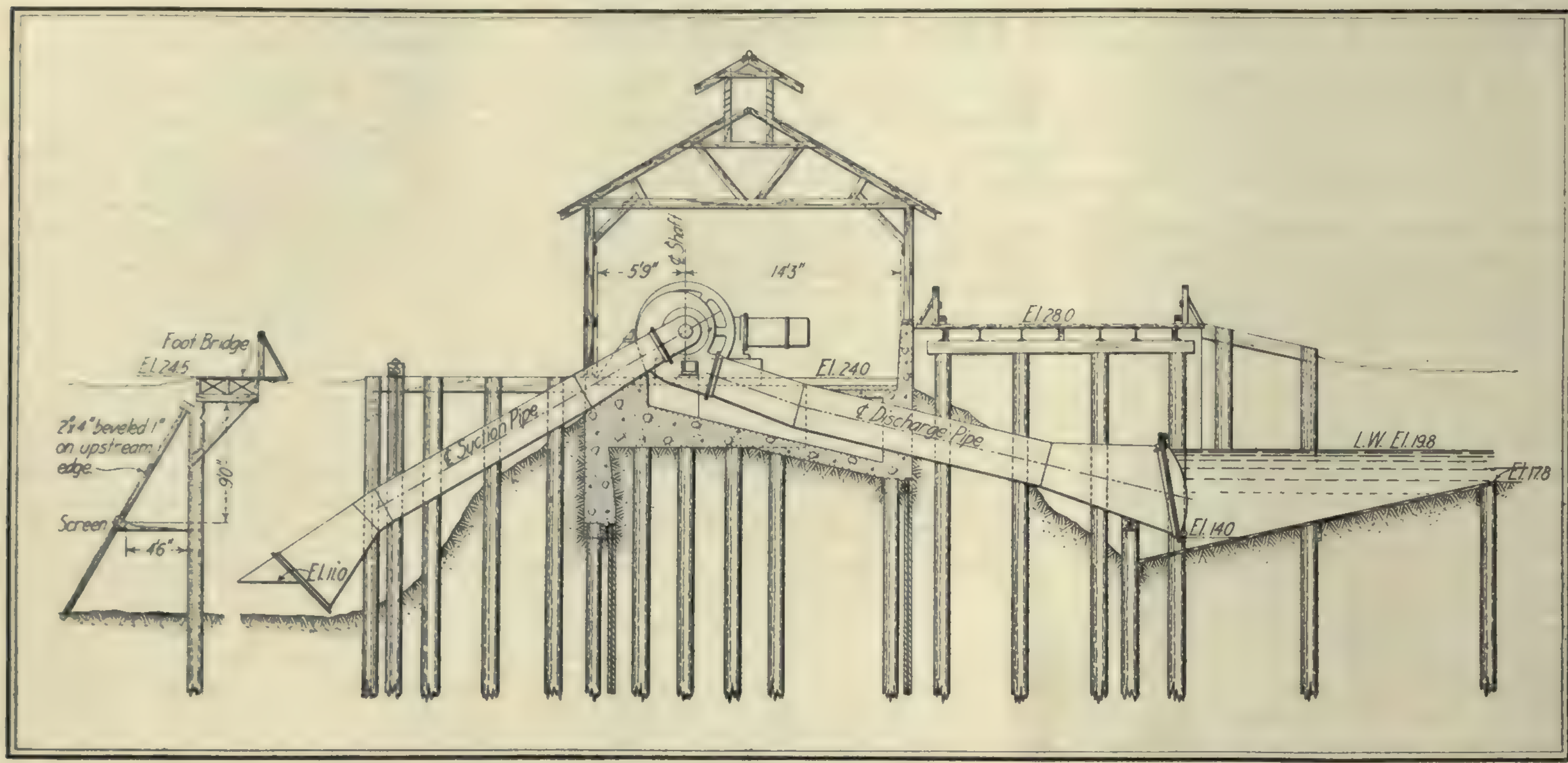
PLAN OF SIDE OF PLANT CONTAINING AIR-COMPRESSING EQUIPMENT

This storage tank is a 3310-gal. vertical galvanized corrugated iron tank set 100 ft. away from the building and elevated about 1 ft. from the ground. There are two 125-gal. auxiliary fuel tanks buried under the ground just outside the building. One of these is for distillate and the other for gasoline. A small fuel pump on the engine takes oil from either of these tanks and pumps it to the vaporizer, where the surplus oil overflows back to the tank.



OUTFALL CANAL PAVED WITH WOODEN APRON 2 INCHES THICK

SCREEN CATCHES GRASS AND TRASH OTHERWISE DRAWN INTO PUMPS



WEIGHT OF FOUNDATIONS AND MACHINERY CARRIED ON 40-FOOT ROUND PILES—FOOT BRIDGE BUILT ON TOP OF SCREEN

The suction and discharge pipes on the main pumps are shown on the drawings. These pipes are of ¼-in. riveted steel, of such size and design as to reduce the loss of head to about 0.5 ft. This is done by making the cross-section of the straight pipe such as to reduce the velocity to a point where the friction loss is only 0.25 ft., and using long taper increasers and liberal bell mouths to reduce the loss due to velocity head. These calculations were made for the capacity at a normal working head of 4 to 5 ft.

Flap valves are used on the discharge pipes, not for the usual purpose of priming the pumps, but to prevent water running back into the district in the event of an unusually high tide in Lake Pontchartrain.

The plant is practically a narrow dam across the canal set just back of the outside levee—the usual arrangement of drainage plants in this territory. Seepage is prevented by a double line of Martinez piling 24 ft. long. One line of piles at the front of the plant extends 45 ft. on either side of the center of the canal; the other is on the suction side, and only as long as the building. There are also short sheet-pile wing walls on the suction and discharge sides of the plant. The outfall canal is paved with a wooden apron 2 in. thick, extending about 20 ft. in front of the ends of the discharge pipe.

The weight of the foundations and machinery is carried on 40-ft. round piles, each carrying a load of 8 tons. All piling that extend above the water line are creosoted. All foundations are of 1:3:5 concrete made with washed gravel. The retaining walls on the suction and discharge sides of the plant extend below the water line and are reinforced with square twisted bars.

The pump and engine foundations are monolithic, tied to each other and to the front and rear walls by reinforcement. The floor slab is reinforced to allow the setting of the heaviest part of the machinery on it. The top 4 in. of the floor is ordinary cement pavement.

The building is of wood-frame construction covered with corrugated galvanized iron. Ample lighting is provided by plenty of windows and by painting all interior woodwork white.

As the levee in which the plant is built is also a road, a bridge of 24-ft. span had to be provided over the outfall canal with a 16-ft. roadway. In the suction basin, about 50 ft. back of the plant, a screen was built to keep trash out of the pump.

The plant was designed and installed by A. M. Lockett & Company, Limited, of New Orleans. The specifications were prepared by A. M. Shaw, consulting engineer for the drainage district, and the construction work and working details were supervised by the author.

Plans Proposed for Boston Fire-Service System

Insurance Interests Do Not Look with Favor on Project for Small-Capacity Pumping Station

SUBSTANTIAL changes in the design of the Boston high-pressure fire-service system have been recommended in a report submitted to Mayor Curley by Joseph Rourke, engineer in charge of the work. Mr. Rourke advocates a smaller pumping station than had been originally planned and the increased use of fire engines. Comment by representatives of the insurance interests at Boston is unfavorable to the proposed economies of the Rourke report. The underwriters will probably refuse to remove the advance in fire-insurance rates which was placed upon buildings and their contents within the Boston conflagration area at the time of the San Francisco fire unless the high-pressure pumping station is built so that the original 24,000 gal. per minute can be attained. F. E. Cabot, secretary of the Boston Board of Fire Underwriters, is quoted as saying: "If the Rourke plan were followed out and Boston had a conflagration, the city's fire-fighting forces would be in the same predicament as the United States Army if we went to war to-morrow. I am told that we have ammunition enough to last just twenty-five minutes if we fired all our big guns at a foe. That's just about what the situation would be for the Boston fire fighters, substituting water for powder and shells." Through the courtesy of Edward F. Murphy, commissioner of public works, the following summary of Mr. Rourke's report is given:

Previous Plans

Previous designs for the pumping installation for high-pressure fire service have been based upon a capacity of 18,000 gal. per minute at 300 lb. delivery pressure, with provision for the future addition of 6000 gal. per minute. A plant of this size requires considerable land, and discussion of various sites finally led to the favorable consideration of a site in the Charles River Basin, off the Charles bank. In 1911 a reduction in insurance rates equal to 15 per cent added at the time of the San Francisco fire was promised by the Boston Board of Fire Underwriters upon completion of a high-pressure system satisfactory to that body. At the time this totaled from $100,000 to $125,000 a year. No fire engines at present in the high value district can be permanently transferred elsewhere. A million dollars was originally considered enough to spend in this special protection, which now offers little financial return to the city. Mr. Rourke holds that this outlay should not be exceeded when there is little or no return in prospect upon it.

Investment in the streets now totals $457,000, including all expenses since the organization of the service, and there is $162,000 worth of pipe-line materials now on hand ready to install. The cash assets are about $319,000. To complete the system of 14.35 miles of gridiron as originally planned with a large station in the Basin will require a total of about $1,500,000, and with large yearly fixed charges due to the station alone.

A decided tendency has recently been shown from the legislative standpoint toward fire-prevention enactments. Due to the powers vested in the Fire Prevention Commissioner in 1914 and in the Building Commissioner of Boston, which are being vigorously utilized, it appears that there may be little need for a high-pressure serv-

ice in the district proposed within ten years, due principally to the remarkable acceleration in the use of sprinkler equipment in the past two years in hazardous-risk buildings within the district and elsewhere.

SMALL PUMPING STATION

The efficiency of high-pressure fire service is chiefly due to providing good streams of water at a satisfactory pressure directly from hydrants in the minimum time. Mr. Rourke maintains that reasonable requirements for the Boston high-value district would be fulfilled by a small pumping station of about 6500 gal. per minute capacity at 240 lb. delivery pressure, which is the equivalent of more than twenty good fire streams, or about thirteen ordinary fire engines. At 125 lb. delivery pressure nearly 12,000 gal. can be supplied by this station. All of this may be available within five minutes of the alarm, and 2000 gal. can be secured within 1.5 min., which will always anticipate its application to the fire. Additional supply, if desired, can be furnished by fire engines drawing water from the ordinary distribution systems and pumping direct into high-pressure hydrants, and by fireboats in extreme emergency. Portable fire engines, in the opinion of Mr. Rourke, possess the added advantage of being able to respond to fires in any location, besides furnishing a reserve for the high-pressure area, while the reserve capacity of a large pumping station is available only for its hydrant service in a limited area. It is recommended that if a 6500-gal. station is decided upon, it be located on the Charles River embankment. Another possible location adjoins the park in the North End, where there are at present a fireboat and crew quarters.

ELECTRIC POWER FOR HIGH-PRESSURE STATION

Regarding electric power for the high-pressure station, Mr. Rourke states that negotiations with the Boston Edison company have not been entirely satisfactory and that these imply considerable annual fixed charges which would be absent were a gas-engine centrifugal pumping plant adopted. Advantages accrue to the presence of gas in storage, and the only question arises as to the speed with which a unit could be put in commission. Electrically driven pumps are admittedly faster, but the small difference in time is unimportant, as the demand for water at the fire may easily be anticipated with either gas or electric service. It is figured that with the small gas engine plant the money now available and materials on hand will enable the installation of a gridiron pipe system of 11.5 miles with hydrant service, whereas with the large pumping station and present appropriation, only 6.5 miles (the present system) with one feeder could be provided.

White Bridges Mark Auto Trail

White-lead paint is now being applied to all the bridges in Richardson County, Nebraska, on the Omaha-Kansas City trail. The county commissioners are doing this to mark the road properly, to make it impossible for automobile drivers to miss an approach at night and at the same time to protect the structures from weather. In the case of concrete culverts, only the iron handrails are painted. It is expected that the other counties along this route will also adopt this scheme.

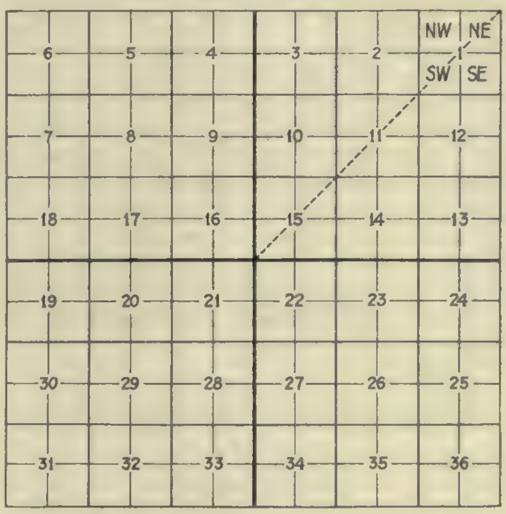
Distribution of Traffic on a Rectangular System of Roads Analyzed

In Any Large Area 15 or 20 Per Cent of Roads Carry 80 or 85 Per Cent of Traffic, and Expenditures Should Be Governed Accordingly

By E. W. JAMES
Chief of Maintenance, Office of Public Roads and Rural Engineering, Washington, D. C.

THE QUESTION of the distribution of traffic over a system of roads is significant in that its solution will, to a large degree, determine the relative importance of various roads and furnish an essential factor in determining the total mileage that it is economical to improve. The indeterminate conditions to be considered in such a problem are many, and the only practicable method of arriving at a general solution is deductive. We can then test our result by comparing it with actual observed or recorded instances.

To give the matter definite form, we will make the following general assumptions: (1) The roads are laid out in a township according to the theoretical system in use on public lands of the United States, and the main market point is at the center. (2) The discussion uses the quarter section of



TYPICAL ARRANGEMENT OF TOWNSHIP ROADS

land as the unit. (3) All hauling originating in any quarter section leaves from the middle point on the most advantageous side of the quarter with respect to the haul, and follows the best route to town.

These general assumptions will hold for all cases, but in addition a series of secondary assumptions of great importance must be made to approximate the various conditions under which traffic may originate and use the roads.

UNIFORM DEVELOPMENT ASSUMED

In the first case we will assume (1) that all quarter sections, regardless of location, agricultural condition or distance from the town are settled, developed and equally productive, and (2) that there are four cardinal roads improved, extending north, east, south and west from the center to the township lines. The plat of the township shows the rectangular layout of the roads under the general assumption and the four main roads improved, according to the special assumption for this case.

The quarter sections are referred to in the usual way, NW-1, SE-1, etc., and only the area south and east of the dotted line and north of the main east road is considered. There are, then, eight such areas symmetrically divided and symmetrically located around the central point of the township.

Table 1 shows the amount of traffic originating in each quarter section and passing over the roads lying in the area considered, and also shows the traffic produced on each mile of road. The roads are indicated by naming the sections lying on each side of each mile using x for all area outside the township.

Let T be the amount of traffic produced on 1 mile of road by the uniform conditions existing in each quarter section. Then, in the area considered, $T/2$ traffic is produced by each half of a quarter section in such area. The traffic on each road is, therefore, found by multiplying the traffic produced on 1 mile by the fraction of a mile traversed. For instance, the half of the quarter section NE-1 produces $T/2$ traffic on 1 mile, and therefore produces $T/2 \times 3/4$, or $3/8$ traffic on the road 1-x, since the traffic enters the mile of road 1-x at the middle point of the quarter section NE-1 and traverses $3/4$ of a mile on this piece of road.

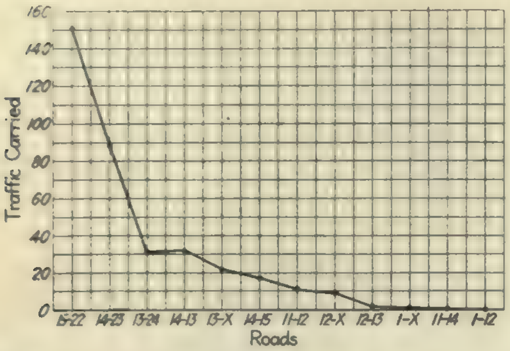
From this table we find the total traffic passing over the roads of the area is $53.23T$, and the total traffic for the whole township would be $426T$.

TRAFFIC ON TYPE ROADS

Passing now to Table 2, we can tabulate the roads representing a symmetrical group, the traffic passing over each group, the length of each group and the various percentages of the total road mileage that carry various percentages of the total traffic. Each section of road in the area considered has its counterpart in every other such area. Therefore, each such mile is typical of a group composed of 4 or 8 miles, according to the location of the particular type road, whether it is or is not common to two of the symmetrical areas. Thus road 15-22, being common to the triangular areas above and below the east road, is typical of a group of four, and road 14-13, lying wholly within the area under consideration, is typical of a group of eight. We find, for instance, that 4 miles of road, or 4.8 per cent of the total, carry 32.6 per cent of all the traffic; that 14.3 per cent of the roads carry 68.3 per cent of the traffic; that 23.8 per cent of the roads carry 78.6 per cent of the traffic, etc. By interpolating, 25 per cent of the roads carry about 80 per cent of the traffic.

DEVELOPMENT NOT UNIFORM

One of the special assumptions made in this case is to the effect that development is equal over all areas under consideration. Obviously this assumption presupposes conditions altogether too uniform and regular. Observation discloses that development and production are not uniform for all areas. Population and development are both in the nature of accretions to a central nucleus. The census records, traffic censuses as taken on highways, all our general observations, indicate harmoniously that development is greatest near a center of population.



RELATIVE IMPORTANCE OF TYPE ROADS SHOWN GRAPHICALLY

The degree of irregularity of actual development is not itself constant, nor is it easily determinable for any given locality. We may assume, then, some more or less regular change in uniformity of distribution and adjust the results to accord with actual conditions as our judgment directs.

Instead of a constant production for each area, let us now assume (1) a varied development decreasing inversely as the distance from the center, and retain our former assumption (2) that there are four main improved roads. Using again the common system of land subdivision and calling *T*, as before, the amount of traffic produced on 1 mile by a certain production *P*, we can tabulate the various quarter sections and calculate the number of *P* for each. *P* may be considered as a certain constant quantity of traffic-creating produce raised on a quarter section.

Table 3 shows the various typical or symmetrical quarter sections, the distance of their centers from the center of the township, and the number of *P* produced by each.

Continuing in Table 4 as in Table 1, we find the traffic on each mile of road. Then in Table 5 we show the various percentages of road mileage that carry various percentages of traffic.

From this table we find that 4 miles of road, or 4.8 per cent of the total mileage, carry 39.3 per cent of the total traffic, that 9.5 per cent of the roads carry 63 per cent of the traffic, and that 14.3 per cent of the roads carry 71 per cent of the traffic.

As a third case we can change assumption (1), that measures distances in straight lines between the center of the township and the center of each quarter section, to the assumption that the effective distance of the quarter section from the center is the distance that the farmer actually travels along the road from his quarter section to the town.

We could continue this system of investigation by assuming a different set of improved roads. For instance, the four main improved roads could be assumed to extend northeast, southeast, southwest and northwest, and we should get a new set of percentages. It appears that the percentage of traffic as compared with the percentage of roads would tend to increase slightly as our assumptions approached actual conditions. The increases would, however, be smaller and smaller.

As the system becomes more and more irregular by the introduction of half and quarter section-line roads, the total mileage increases, and the main roads near town, toward which traffic converges in all cases, become a smaller and smaller percentage of the road mileage. Similarly, as the road system becomes more and more radial, the total mileage is increased and consequently the percentage of miles represented by the trunk roads near town becomes smaller. For such irregularities tend to be introduced near the limits of the area rather than near town; otherwise the area would lose its rural and assume suburban or urban characteristics, in which case it would no longer be within the scope of this discussion. Thus we have a continual tendency as irregularities are introduced for a smaller and smaller percentage of the road system to carry any given percentage of traffic.

A Few Roads Carry Most of Traffic

The limits cannot, of course, be definitely set, and almost certainly would not be the same in any two cases; but various estimates made by engineers as the results of actual observations are to the effect that 80 or 85 per cent of all the traffic in any large area, such as a county or state, is carried on 15 or 20 per cent of the roads. Pennsylvania has adopted a system of state roads approximating 10 per cent of the total mileage, and has done so with the intent of having all main roads in the system; New Jersey has had the same percentage recommended by its commissioner.

Referring now to the original statement of the question, we can draw some interesting conclusions from the tabular computations shown above.

With respect to the relative importance of various roads, for instance, we find under the first case, where *T* is assumed equal for all quarter sections, that road 14–13 carries as heavy a traffic as 13–24, and should of course be the first spur road built. Road 13–24 is selected, however, as a part of the system because it is one of a group of four symmetrical roads, whereas 13–14 is one of a group of eight, and because the omission of 13-24 in one township and its abutting road, 18–19, in another

TABLE 3—PRODUCTION OF VARIOUS QUARTER SECTIONS, AND DISTANCES FROM CENTER OF TOWNSHIP

Typical quarter sections, symmetrically located	Distances from quarter section to center of township, miles	Direct proportions of distances	Number of *P* produced by each quarter section
SW-15	0.35	1	100
SE-15	0.79	2.29	44
NE-15	1.05	[illegible]	33
SW-14	1.27	3.63	28
SE-14	1.46	4.17	24
NE-14	1.75	5	20
NW-14	1.76	5.03	20
SW-11	1.90	5.43	18
SE-11	2.15	6.14	16
NE-11	2.45	7	15
SW-13	2.26	6.46	[illegible]
SE-13	2.37	6.49	15
NE-13	2.57	7.34	13
NW-13	2.85	8.14	12
SW-12	3.15	9	11
SE-12	2.76	7.89	13
NE-12	2.85	8.14	12
NW-12	3.02	8.63	12
SW-1	3.26	9.31	11
SE-1	3.55	10.14	10
NE-1	3.85	11	9

TABLE 1—TRAFFIC ON EACH ROAD IN ONE-EIGHTH OF TOWNSHIP AREA UNDER UNIFORM DEVELOPMENT

Quarter section	Traffic produced (T)	Route and traffic on each road: 1-x	12-x	13-x	1-12	12-13	13-24	11-12	14-13	11-14	14-23	14-15	15-22
NE-1	*T*/2	0.37	0.50	0.50	....	....	0.50	....	....	....	0.50	....	0.50
SE-1	*T*	0.25	1.00	1.00	....	....	1.00	....	....	....	1.00	....	1.00
SW-1	*T*/2	....	....	....	0.12	....	....	0.50	0.50	....	0.50	....	0.50
NW-12	*T*	....	....	....	....	....	....	0.75	1.00	....	1.00	....	1.00
NE-12	*T*	....	0.75	1.00	....	....	1.00	....	....	....	1.00	....	1.00
SE-12	*T*	....	....	1.00	....	0.25	1.00	....	....	....	1.00	....	1.00
SW-12	*T*	....	....	....	....	0.25	....	....	1.00	....	1.00	....	1.00
NW-13	*T*	....	....	....	....	....	....	....	0.75	....	1.00	....	1.00
NE-13	*T*	....	....	0.75	....	....	1.00	....	....	....	1.00	....	1.00
SE-13	*T*	....	....	....	....	....	0.75	....	....	....	1.00	....	1.00
SW-13	*T*	....	....	....	....	....	0.25	....	....	....	1.00	....	1.00
NE-11	*T*/2	....	....	....	....	....	....	0.37	0.50	....	0.50	....	0 50
SE-11	*T*	....	....	....	....	....	....	0.25	1.00	....	1.00	....	1.00
SW-11	*T*/2	....	....	....	....	....	....	....	....	0.12	....	0.50	0.50
NW-14	*T*	....	....	....	....	....	....	....	....	....	....	0.75	1.00
NE-14	*T*	....	....	....	....	....	....	....	0.75	....	1.00	....	1.00
SE-14	*T*	....	....	....	....	....	....	....	....	....	0.75	....	1 00
SW-14	*T*	....	....	....	....	....	....	....	....	....	0.25	....	1.00
NE-15	*T*/2	....	....	....	....	....	....	....	....	....	....	0.37	0.50
SE-15	*T*	....	....	....	....	....	....	....	....	....	....	....	0.75
SW-15	*T*/2	....	....	....	....	....	....	....	....	....	....	....	0.12
		0.62	2.25	4.25	0.12	0.50	5.50	1.87	5.50	0.12	13.50	1.62	17.37

TABLE 4—TABLE 1 REVISED TO SHOW THE UNEQUAL DEVELOPMENT TO BE EXPECTED

Quarter section	Produce (*P*)	Route and traffic on each road: 1-x	12-x	13-x	1-12	12-13	13-24	11-12	14-13	11-14	14-23	14-15	15-22
NE-1	9	3.37	4.50	4.50	....	....	4 50	....	....	....	4.50	....	4.50
SE-1	10	2.50	10.00	10.00	....	....	10.00	....	....	....	10.00	....	10.00
SW-1	11	....	....	....	1.37	....	....	5.50	5.50	....	5.50	....	5.50
NW-12	12	....	....	....	....	....	....	8.00	12.00	....	12.00	....	12.00
NE-12	11	....	8.25	11.00	....	....	11 00	....	....	....	11.00	....	11.00
SE-12	12	....	....	12.00	....	3 00	12.00	....	....	....	12.00	....	12 00
SW-12	13	....	....	....	....	3.25	....	....	13 00	....	13 00	....	13.00
NW-13	15	....	....	....	....	....	....	....	11.25	....	15.00	....	15.00
NE-13	12	....	....	9.00	....	....	12 00	....	....	....	12.00	....	12 00
SE-13	13	....	....	....	....	....	9.75	....	....	....	13.00	....	13.00
SW-13	15	....	....	....	....	....	3.75	....	....	....	15 00	....	15.00
NE-11	15	....	....	....	....	....	....	5.62	7.50	....	7.50	....	7.50
SE-11	16	....	....	....	....	....	....	4.00	16.00	....	16 00	....	16.00
SW-11	20	....	....	....	....	....	....	....	....	2.50	....	10.00	10.00
NW-14	24	....	....	....	....	....	....	....	....	....	....	18.00	24.00
NE-14	18	....	....	....	....	....	....	....	13 50	....	18 00	....	18.00
SE-14	20	....	....	....	....	....	....	....	....	....	15 00	....	20.00
SW-14	28	....	....	....	....	....	....	....	....	....	7 00	....	28.00
NE-15	33	....	....	....	....	....	....	....	....	....	....	12.37	16 50
SE-15	44	....	....	....	....	....	....	....	....	....	....	....	33 00
SW-15	100	....	....	....	....	....	....	....	....	....	....	....	12.50
	451	5.87	22.75	46.50	1.37	6.25	63.00	23.12	78.75	2.50	186.50	40.37	308.50

TABLE 2—TRAFFIC AND PERCENTAGES OF TRAFFIC ON TYPE ROADS

Type road of symmetrical group	Total miles in group	Total of miles	Percentage of mileage	Traffic on type road of group	Total traffic on group	Percentage of traffic on group	Percentage of total traffic
15–22	4	4	4.8	17.37	139	32.6	32.6
14–23	4	8	9.5	13.50	108	25.4	58.0
13–24	4	12	14.3	5.50	44	10.3	68.3
14-13	8	20	23.8	5.50	44	10.3	78.6
13–x	8	28	32.3	4.25	34	8.0	86.6
12–x	8	36	42.8	2.25	18	4.2	90.8
11 12	8	44	52.3	1.87	15	3.5	94.3
14-15	8	52	61.8	1.62	13	3.1	97.4
1-x	8	[illegible]	71.3	0.62	5	1.2	98.6
12-13	8	68	80.8	0 50	4	0.9	99 5
11-14	8	76	90.3	0.12	1	0.2	99.7
1-12	8	84	100 0	0.12	1	0.2	99 9
				53.23	426	99 9	

TABLE 5—TABLE 2 SIMILARLY REVISED TO SHOW UNEQUAL DEVELOPMENT

Type road of symmetrical group	Total miles in group	Total of miles	Percentage of mileage	Traffic on each type road of group	Total traffic on group	Per cent of traffic on group	Percentage of total traffic
15–22	4	4	4.8	308.50	2468.00	39.3	39.3
14–23	4	8	9.5	186.50	1492 00	23.7	63.0
13–24	4	12	14.3	63.00	630.00	8 0	71.0
14–13	8	20	23.8	78.75	504.00	10.0	81.0
13-x	8	28	33.3	46.50	372.00	5.9	86.9
14–15	8	36	42.8	40.37	322.96	5.1	92.0
11–12	8	44	52.3	23.12	184.96	2.9	94.9
12–x	8	52	61.8	22.75	182.00	2.9	97.8
12–13	8	60	71.3	6.25	50.00	0.8	98.6
1-x	8	68	80.8	5.87	46.96	0 8	99 4
11–14	8	76	90 3	2.50	20.00	0.3	99.7
1–12	8	84	100.0	1.37	10 96	0.2	99 9
				785.48	6283 84	99 9	

township would leave a gap of 2 miles in the system of intertownship roads.

ORDER OF CONSTRUCTION OF LATERALS

Having completed the 12-mile system, then the order of construction of laterals would be first 13–14, second 13–x, third, 12–x. Notice that these roads do not parallel any part of the original system at a distance of less than 2 miles. Further, such parallel roads as 1–12 and 1–2, and 12–13 and 2–3, 11–14 and 11–10 are almost negligible so far as traffic from the farm to the town is concerned. They are used for travel between farms.

Passing to the second set of assumptions made, it is found that road 14–13 carries actually more traffic than 13–24. Consequently, it would appear still more important to build the spur road before the system is completed. But, as before, the construction of 13–14 as a type requires the construction of 8 miles, while the completion of the system by the construction of 13–24 requires the construction of but 4 miles. Further, the completion of a system at once accommodates and attracts through traffic, so that it is probable that, once built, road 13–24 and the group of which it is typical would become more important than 14–13. Again, the system of 12 miles, including the 13–24 group, carries a heavier traffic than any other system of 12 miles that can be selected.

RELATIVE IMPORTANCE OF ROADS SHOWN GRAPHICALLY

By plotting the various roads so as to show their relative importance as typical of their respective groups, we see that the first group of 4 miles to be built would be 4.6 times as important as the third group of 4 miles and about 1.7 times as important as the second group of 4 miles. Further, the remaining roads in the system rapidly become of more uniform but of much less relative importance.

This plot shows graphically the powerful incentive and its basis in sound reason for the high-class improvement of a few miles of road. It becomes apparent that for every dollar spent on the last 8 miles of a group of 76 miles there can be economically expended $298 on the first 4 miles of the group. Development of this point of view will furnish a powerful argument for the proper distribution of major expenditures of either annual road revenue or of the proceeds of a bond issue.

Area of Croton Watershed Is Corrected

Old Figure of 360.44 Square Miles Above New Croton Dam Is Superseded by Value of 375 Square Miles

INCORRECT figures for the area of the Croton watershed, from which New York City obtains the bulk of its supply, have been disclosed by investigations conducted during the last six years by the New York Department of Water Supply, Gas and Electricity. The revised figures fix the area above the new Croton dam at 375 square miles, instead of 360.44 square miles, the previously accepted value. The following statement regarding the revision, made for the benefit of those who make use of the Croton rainfall and runoff data, has been received from William W. Brush, acting chief engineer of the water department:

The area of the Croton watershed lying above the old Croton dam has been generally reported as 338.8 square miles for the last fifty years or more. To this area was added 21.6 square miles as tributary watershed between the old Croton dam and the new Croton dam, making the generally reported area of the Croton watershed lying above the new Croton dam as 360 square miles. In 1916 the engineers of the Bureau of Water Supply were convinced that these areas were incorrect, and as a result of investigations made during the past six years adopted 375 square miles as representing the correct area of the Croton watershed lying above the new Croton dam.

HISTORY OF THE WATERSHED SURVEYS

In 1857-58 a survey was made of the Croton watershed lying above the old Croton dam, and on page 12 of the annual report of the Croton Aqueduct Department, made to the Common Council of the City of New York, bearing date of Jan. 3, 1859, is found the following statement, which first came to the notice of the department in 1914: "The total area or watershed of the Croton above the commencement of the aqueduct is ascertained to be 352 square miles."

The watershed map prepared as a result of the survey was lithographed by J. Bien, then of 24 Vesey Street, about 1860. The title on this lithograph is: "Topographical map showing the entire watershed of Croton River above the Croton Aqueduct Dam; also the most available sites for the storage reservoirs, from minute surveys made during the years 1857-58." A table, together with an outline of the various subdivisions of the watershed, appears on this lithograph. The subdivisions do not include all portions of the watershed, but at the bottom of the table is a statement that the total area of the watershed is 338.82 square miles. The lithograph bears a graphic scale of miles which is approximately 4350 feet per inch.

THE 1889 MAP

In the early '80s the Aqueduct Commission had brought to its attention the probable inaccuracy of the 338.82 sq. miles as the area of the watershed, and on Jan. 23, 1889, authorized William E. Worthen, a well-known engineer of that time, to prepare a topographical map of the watershed, this map including also the area between the old and new Croton dams. Six field parties were immediately placed on the work under the direction of C. C. Vermeule and J. R. Bien, the latter being in charge of the primary and secondary triangulations which were started from and afterward checked on monuments and bench-marks of the United States government and of the aqueduct commission. As a result of these surveys a map was drawn on eight sheets, to a scale of 3 in. to the mile, bearing graphic scales of feet and miles, with parallels of latitude and longitude at intervals of one minute. This map bears the title "Aqueduct Commissioners' Topographical Map of Croton Watershed." Twenty-foot contours throughout and beyond the limits of the watershed are given, with numerical elevations at all summits, depressions, water levels, etc. The watershed line is well defined.

This map was finally delivered on July 24, 1889, and in 1890, by carefully scaling the parallels of longitude and latitude, using the graphic scale on the map, computing the areas of the various zones and adding to them in planimetered areas of the adjacent irregular portions, the following areas were obtained:

	Square Miles
Area of new Croton watershed	375.815
Area of old Croton watershed	352.84
Area of watershed between old and new dams	22.975

Controversy immediately arose as to the accuracy of the newly determined areas. The area of 22.975 square miles between the old and new dams was reduced in the proportion that the newly determined area of the watershed above the old Croton dam bore to the area given on the lithograph previously referred to, thus obtaining a reduced area of 22.06 square miles by the following proportions: 352.84:338.82::22.975: 22.06. The site of the new Croton dam was later moved slightly upstream and the adopted area above the new Croton dam was therefore changed to 360.44 square miles. Certain of the Aqueduct Commission engineers were never satisfied that this determination was correct, and from 1900 to 1903 the Aqueduct Commission used an area of 373 square miles, which was a compromise figure, and then returned to the figure previously used.

LATER CALCULATIONS

In 1909 calculations were made to determine, more correctly than by scaling, the area of the zones of latitude on the Worthen map, assuming the earth to be a sphere 40,000,000 m. in circumference at sea level and adding the planimetered irregular border. One meter was taken as equivalent to 3.280869 ft. The resultant area of the watershed was 374.979 square miles. Another computation was made at this time, following the method adopted by the U. S. Geodetic Survey, known as Clark's equivalent, with a resultant area of 375.55 square miles.

Since 1909 this matter has been considered from time to time, and it was finally agreed in the early part of 1916 by all the engineers now in the Bureau of Water Supply who had taken part in the investigation that an area of 375 square miles should be adopted.

The historical statement is largely based upon the notes kept by Assistant Engineer Jean P. Genthon, who was employed by the Aqueduct Commission since 1887, and who has conducted many of the investigations made of this subject, as well as performing the necessary computations both under the Aqueduct Commission and under the Bureau of Water Supply.

SUPPORTING DATA

The area of 360 square miles, previously used has its sole foundation on the printed area which appears on the lithograph copy of the map of 1858. The accuracy of this statement is disproved by (a) the printed report of the Croton Aqueduct Department for 1858, previously quoted; (b) by the planimetered and computed area of the watershed, shown on this lithograph of the 1858 map; (c) by errors found in the table of subdivisions given on the lithograph, the maximum error found being 10 square miles in an area given as 75 square miles, which should have been 85 square miles.

The newly adopted area of 375 square miles is supported by the following:

(a) By the area of the watershed determined from the lithograph of the 1858 map, using the graphic scale appearing on the

lithograph and the outline of the watershed as defined thereon.

(b) By the statement appearing in the annual report of the Croton Aqueduct Department for 1858.

(c) By the areas determined from the Worthen map by different methods which vary by less than 1 square mile.

Reason for Change

The Department of Water Supply, Gas and Electricity has changed the area for the watershed because it believes that an error in the watershed area of the Croton River should be corrected in justice to the engineering profession, which has in the past made and probably will in the future make frequent use of the record of rainfall and runoff of the Croton watershed, which constitutes one of the most valuable and most widely consulted watershed records in the United States.

It has not been considered necessary to attempt further field investigations, as there is no material difference in all the data that have been secured bearing on the area of the Croton watershed. The only difference appears in a note on a lithographed map, and this note is flatly contradicted by a printed statement which was undoubtedly based on the original map from which the lithograph was made, and the lithograph itself does not in any way uphold the note in question which appears thereon.

Springfield Coliseum Roof Supported by 200-Foot Arches Without Tie Rods

Rapid Erection of Steel Arch Trusses Marks Construction of 200 x 300-Foot Building—Foundation Piers Designed to Resist Arch Thrusts

MAIN arch trusses spanning nearly 200 ft., without tie rods at the floor level, support the roof of the Coliseum now being constructed as the main structure of the group of buildings being erected this year for the Eastern States Agricultural and Industrial Exposition at Springfield, Mass. The concrete foundation piers were designed to resist the arch thrusts, later modification in the design being required because of difficult foundation conditions. Furthermore, the main walls were supported upon reinforced-concrete beams connecting the arch piers, thus insuring a greater load on these piers to aid in resistance to sliding.

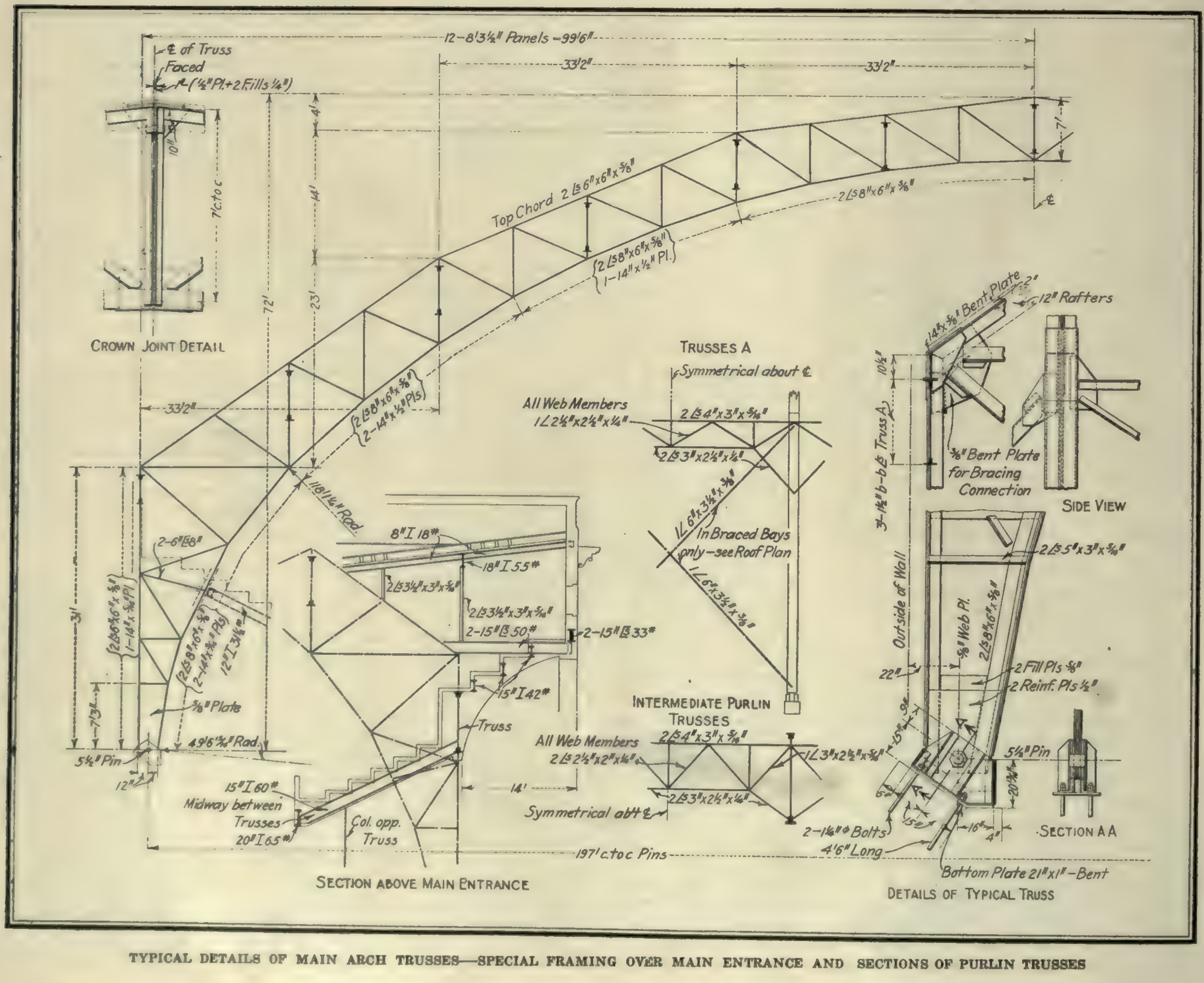
After the delay due to difficulties with high water in the foundation work, rapid progress was made in erecting the main steel frame and arch trusses. The ten trusses, which weighed about 30 tons each, were erected in about ten working days.

The Springfield Coliseum, so called, is the central structure of a group of eighteen or twenty buildings as planned, ten of which are to be erected this year. The other buildings are of ordinary mill construction, with brick walls. The central building is 200 x 305 ft. in plan and contains lecture rooms and exhibit spaces. Sloping amphitheater seats entirely surround a central space 96 x 200 ft. in size.

General Plan and Dimensions

Ten steel trusses spanning 197 ft. center to center of end pins and 72 ft. high support the main roof, which contains skylights in the interior bays. The spacing and form of these trusses were determined mainly by architectural considerations. The building is divided into eleven bays, and the end trusses carry the suspended framing for end walls, which in turn carries the I-beam rafters for the flat roofs in the end bays of the building. Diagonal angles in the plane of this roof, as shown in the quarter roof plan herewith, transfer wind pressure to the side walls.

The required excavation for lecture rooms and other purposes at the corners of the building precluded the use of tie rods between the ends of the end trusses 1 and 10. It was therefore decided to omit all tie rods throughout the building and make the foundation piers and end details practically



TYPICAL DETAILS OF MAIN ARCH TRUSSES—SPECIAL FRAMING OVER MAIN ENTRANCE AND SECTIONS OF PURLIN TRUSSES

SEVEN TRUSSES ERECTED—TRAVELER SEEN AT FAR END

ERECTION TRAVELER HAS TWO 95-FOOT BOOMS

the same throughout. Another consideration in the decision not to use tie rods was the fact that these rods would be within 2 ft. of the finished floor grade, which might seriously interfere with the installation of ammonia pipes and the use of the floor for ice skating or for marine basins in exhibits. The main piers at the ends of the arches were therefore designed as arch abutments to take the thrust.

DESIGN OF MAIN ARCHES

The main arches were designed as three-hinged trusses, with the usual pin ends, but with an abutting joint at the crown, as shown in an accompanying drawing. Bearing plates and faced surfaces were used at the top-chord joint, and an expansion joint with bolts and slotted holes was provided at the bottom-chord joint. The purlins between the main trusses were made vertical, as shown, using triangular trusses instead of I-beams both because estimated to be more economical and because it was believed to improve the appearance.

The live loads used for the design of the roof were those prescribed by the Massachusetts law—varying from 40 lb. per square foot of horizontal projection to 30 lb. per sloping square foot, depending on the angle of slope. The unit stresses adopted conform to the A. R. E. A. specifications. The amphitheater seats were designed of reinforced concrete, but had to be redesigned of wood because of the excessive costs of labor and materials during the past year. The framing of the seats, except at the front entrance, is independent of the main framing of the building.

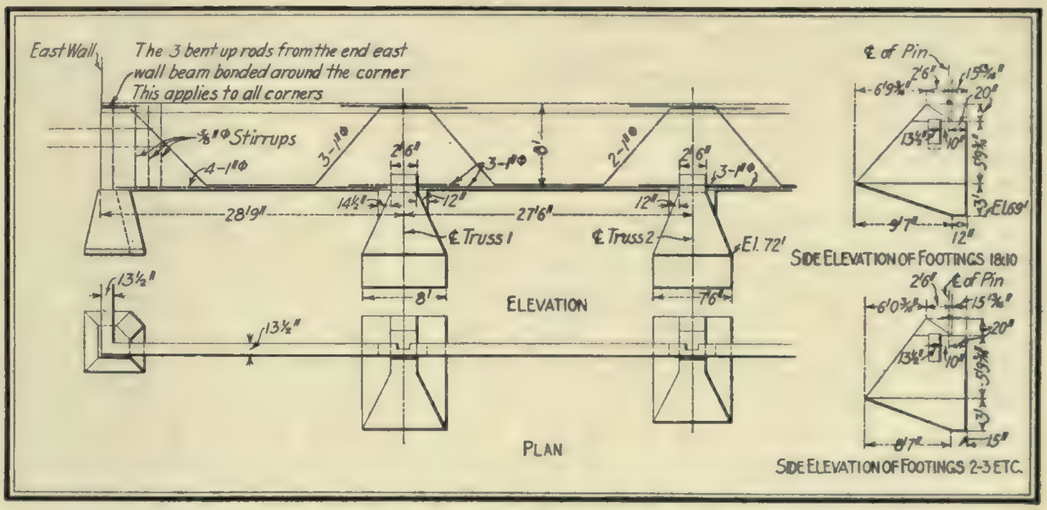
FOUNDATION PIERS AND BEAMS

The foundation piers for the arch trusses had to be modified twice to meet the conditions due to weather and river water. The site is located on the banks of the Westfield River, separated by a dike from the river water. Unusual high water this spring, however, created excessive pressure at the bottom of the foundations, so that the 3-in. sheet piling used could not hold it out. It was also found impossible to keep the water down by the use of force pumps, and finally it was found necessary to deposit the concrete under water by the use of orange-peel buckets opened very slowly so as to prevent washing. After about 3 ft. of concrete had been placed in this way, the remaining water was pumped out and the foundation poured in the usual manner.

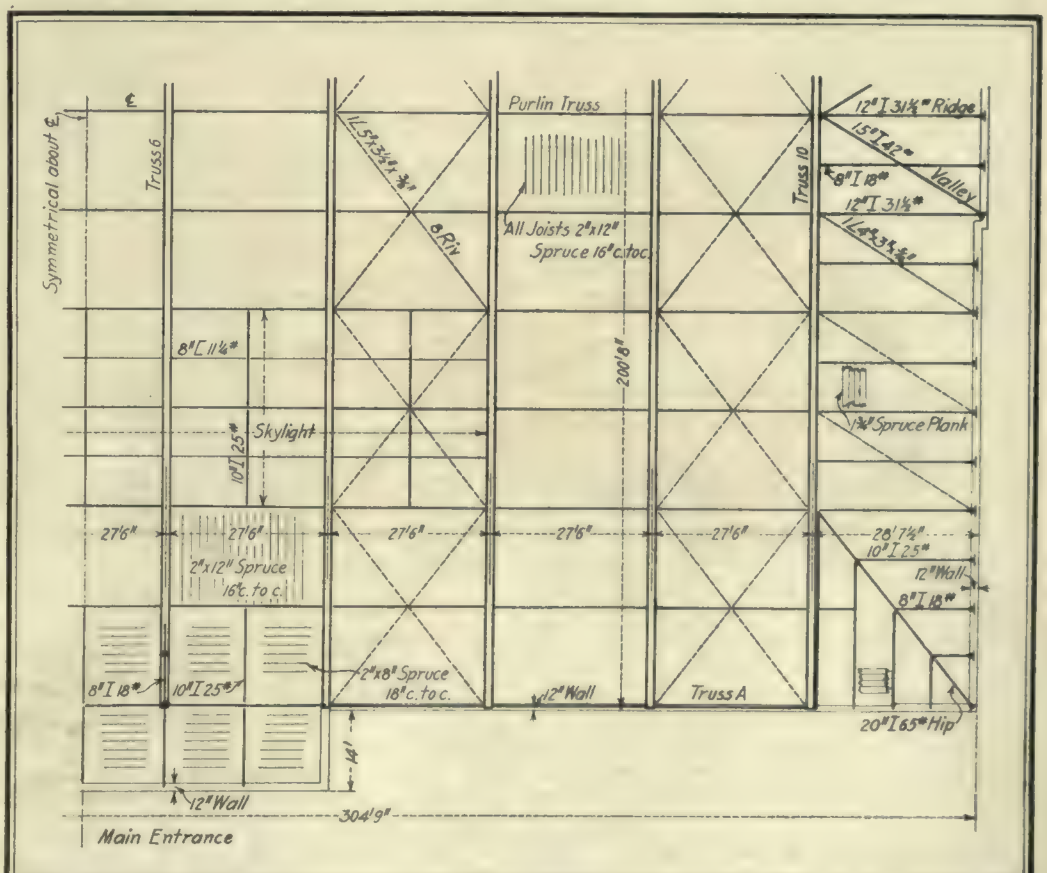
The changes in the design of the piers consisted essentially in making the bottom of the excavation level and depositing concrete to a depth of 2 ft. on the front or interior face and to a depth of 5 ft. on the rear face, the top surface of this mat then being perpendicular to the thrust of the arch. Five foundations in the rear were placed in this manner, when it was found possible to make the sloping surface at the bottom by excavating carefully under water with an orange-peel bucket. The 3-ft. mat was then deposited under as described above, the water pumped out and the remainder of the foundation cast.

The character of the soil, 3½ to 4 ft. of loam, 3½ to 4½ ft. of fine yellow sand (water at 7-ft. depth) and 3 ft. of river silt underlaid by coarse gray sand, made it economical to use reinforced-concrete beams between the main piers to support the outside brick walls of the building. These beams, shown in an accompanying drawing, varied from 8 to 9 ft. in depth, and were cast with pockets to allow the main trusses to be placed.

Rapid erection of the ten steel trusses was



FOUNDATIONS FOR MAIN TRUSSES DESIGNED TO RESIST ARCH THRUST



QUARTER ROOF PLAN SHOWS BRACED BAYS AND LOCATION OF TRUSSES

accomplished by a special traveler, 40 x 40 ft. in plan, with two stiffleg derricks having 80-ft. booms and 15-ft. outriggers, making a total length of boom of 95 ft. As the contract was let on March 8, and the entire erection was to be accomplished by June 8 under a penalty of $300 a day for the steel contractors, it was planned to begin erection of the steel trusses on May 10. Actual erection began on May 12, being delayed by the completion of the foundations, the truss shoes having been very carefully set by stretching a line over the pins, which were inserted in the holes. These pedestals were set on shim plates and grouted in position after being accurately tested. This accuracy greatly facilitated the erection. By May 28, with four days' idleness because of rain, the entire ten trusses were in place, and by June 6 the riveting was completed.

The exposed site, with strong winds, especially in the spring of the year, made it essential to hold the first two trusses securely in place during erection. The first truss was therefore held by the booms of two guy derricks used as ginpoles; the end posts were placed first and securely guyed, the next two sections on each side erected with the ginpoles and the two center sections raised by the traveler. This was done by May 18. With the whole truss thus securely guyed and the ginpoles still hooked up, the wind pressure was easily resisted. The traveler was moved and the end posts of the next truss erected. One half-truss was then hoisted complete by one boom of the traveler, and the other half by the other boom. The truss was bolted, guys were placed at the peak and two truss purlins on each side connected up. The booms were cut loose and the remaining purlins placed. This operation was then repeated until the trusses were completely erected.

DESIGNING AND CONSTRUCTION PERSONNEL

The building was designed by the architect, James H. Ritchie of Boston, supervising the engineering and architectural features. Associated with the architect on the engineering work were C. R. Perry, H. D. Billings and G. L. Dudley, of Boston. The steel was fabricated and erected by the Levering & Garrigues Company, of New York City. Fred T. Ley & Company, Inc., of Springfield, Mass., are the general contractors, with George S. Jewett superintendent on the work. The erection traveler was designed by J. M. Bell, vice-president, and the erection was superintended by Robert F. Gadd, New England manager of the Levering & Garrigues Company.

Road Conditions in Pennsylvania

Pennsylvania was found to have 2.22 miles of road per square mile of area—more than either of the other two Middle Atlantic states. The total mileage on Jan. 1, 1915, was 91,555.84, of which approximately 10,000 miles, or 10.9 per cent, were surfaced. The state had a highly organized highway department with 10,200 miles of road, designated as state highways, directly under its supervision and maintained at state expense. Contributions for maintenance were also made for some roads other than those designated as belonging to the state system. Although complete information in regard to revenues was not available for some jurisdictions, an estimate of road expenditures in the state for 1914 places the amount at more than $10,000,000, an increase over 1904 of 113.2 per cent.

Nitrogen Recovery from Sewage Sludge Reaches Commercially Practicable Stage

William R. Copeland, at American Chemical Society Meeting, Tells How Profits in Fertilizer Products May Be Expected from Activated-Sewage Wastes

THAT the recovery of nitrogen from sewage sludge has at last been brought within the range of commercial practicability was the impressive statement made by William R. Copeland, chemist in charge of the Milwaukee sewage-testing station, in a paper presented last week before the division of water, sewage and sanitation of the American Chemical Society, which held its annual convention in New York City, Sept. 25 to 30. The reclaiming of this byproduct for sale as fertilizer at a profit, it was held, is made possible by the development of the activated-sludge process of sewage treatment, for the sludge produced in plants of this type has been found to contain more than twice as much nitrogen as is present in sludges from Imhoff or plain sedimentation tanks. Extracts from Mr. Copeland's paper follow:

WHAT THE TABLES SHOW

Data given in tables accompanying Mr. Copeland's paper show that the sludge which has been obtained heretofore by the best known processes of sewage treatment (plain sedimentation, septic and Imhoff tanks) contained from 1.2 to 3.0 per cent of nitrogen. These figures are low and indicate that the sludge did not possess as much nitrogen as the amount contained by the raw sewage would lead us to expect. This condition may be explained by the fact that a large share of the colloidal matter carried by the sewage ran out in the effluent flowing away from the tanks and took nitrogen with it. In the case of chemical precipitation works the lime added drove nitrogen off in the form of ammonia and diluted the portion remaining by increasing the amount of inert mineral matter. Moreover, various authors state that from 10 to 60 per cent of the volume of the solids deposited by sewage in the sludge-digestion chambers of Imhoff tanks and other forms of septic tanks is converted into soluble or gaseous form. Much of the albuminoid ammonia is thus changed into free ammonia and free nitrogen which escape in the liquor or bubble out at the gas vents.

Within the last two years, however, a new method of sewage purification by the so-called "activated-sludge" process has been tried out in various cities of America and England. One of the distinctive features of this process is that the colloidal and suspended matters of the sewage are collected in the sludge. If this is not reaërated or overaërated the solids are not liquefied to such a large degree as they are in septic tanks, and therefore the nitrogen does not escape.

RATE OF SLUDGE ACCUMULATION

For example, the digested sludge accumulates in Imhoff tanks at a rate of from 4 to 10 cu. yd. per 1,000,000 gal. of sewage treated, whereas by the activated-sludge process 20 to 80 cu. yd. or more may be deposited in the settling tanks, varying widely, of course, with the strength of the sewage and the water content of the sludge.

The Milwaukee sewage-testing station carried on a series of experiments during the summer of 1915 where the city sewage was treated by the Imhoff and activated-sludge processes simultaneously. Analyses of the sewage effluents and sludges are given in Table 1.

Samples of digested sludge from the Imhoff tank and of the fresh activated sludge were also collected and analyzed in August and September. While it is not correct to say that these sludges represent all of the raw sewage passed through these tanks during August and September, it is fair to assume that they are typical of the sludge which was being produced by those processes at that season of the year. Therefore the analyses of the sludges are given in Table 2.

TABLE 1—ANALYSES OF MILWAUKEE CITY SEWAGE BEFORE AND AFTER TREATMENT BY IMHOFF TANK AND BY ACTIVATED SLUDGE

Period of test, 1915 / Source of sample	PARTS PER MILLION					
	Suspended matter	Nitrogen as Ammonia: Free	Nitrogen as Ammonia: Albuminoid	Nitrogen as Organic nitrogen	Nitrogen as Nitrite	Nitrogen as Nitrate
August:						
Sewage	253	14.6	7.88	29	0.15	0.13
Imhoff effluent.	105	16.2	6.10	27	0.19	0 13
Activated-sludge effluent	14	3.8	3.19	6	0.29	6.00
September:						
Sewage	300	13.5	8.81	29	0.25	0.14
Imhoff effluent.	116	15.4	7.10	27	0.12	0.09
Activated-sludge effluent	8	5.7	2.22	9	0.24	5.01

The data given in Table 1 show some interesting facts. For example, the Imhoff effluent contained on an average more than 100 parts per 1,000,000 of suspended matter, whereas the effluent from the activated-sludge process contained only about 10 parts per 1,000,000. The Imhoff effluent contained more free ammonia than the raw sewage, whereas the activated-sludge effluent contained only one-third as much. The Imhoff effluent contained almost as much albuminoid ammonia as the raw sewage, whereas the activated-sludge effluent contained only about one-third as much. The Imhoff effluent contained almost as much organic nitrogen as the raw sewage, whereas the activated sludge contained only one-third as much.

TABLE 2—ANALYSES OF SAMPLES OF IMHOFF AND ACTIVATED SLUDGES OBTAINED FROM MILWAUKEE SEWAGE

Date, 1915 / Source of sample	Nitrogen reported as NH_3 on basis of sludge dried to 10 per cent of moisture
August:	
Imhoff sludge	2.87
Imhoff sludge..................	3.82
Activated sludge	5.71
Activated sludge	4.97
Activated sludge	7.04
September:	
Imhoff sludge	3.88
Activated sludge	8.69
Activated sludge	9.00

What became of the nitrogen carried by the sewage? Evidently most of the nitrogen in the sewage treated by the Imhoff tank passed out in the suspended and colloidal matters carried by the effluent. The activated-sludge process, on the other hand, converted the free ammonia into nitrate and stored up the undissolved albuminoid ammonia and organic nitrogen, as indicated by the large amount of nitrate in the effluent and high nitrogen content of

the activated sludge. In short, analyses of this material when dry show that activated sludge contains from 4 to 4½ per cent of nitrogen, and sludge from certain industrial plants such as packing houses may carry even more.

When it comes to recovering this nitrogen, however, we meet with a serious difficulty, because as the sludge gathers in the settling tanks it contains from 98 to 99 per cent of moisture, and the bulk of this water must be removed before the dry material can be sold for fertilizer. Several methods of dewatering the sludge have been tried, such as settling, passing the mixture through centrifugal machines, pressing and drying.

COMBINATION OF SETTLING AND DECANTATION

The best information now available points to a combination of settling and decantation as a preliminary process. By this means the water will be cut down from about 99 to 96 per cent. On passing the concentrated residue through a press the moisture can be cut down to 75 per cent. The press cake can be dewatered in a drier to 10 per cent of moisture or less.

More than thirty samples of activated sludge have been dewatered by sedimentation, decantation and pressing at Milwaukee. It is an interesting and notable fact that two different types of press can handle the settled sludge without requiring the addition of lime. Many experts and manufacturers of presses have held heretofore that sewage sludge could not be pressed advantageously without lime because of the gummy or gelatinous nature of the colloids in the sludge; but the facts remain that the sludge is not as gummy as was expected and it presses fairly easily down to 75 per cent of moisture.

In order to try out the feasibility of further dewatering the sludge four samples of the press cake were sent to fertilizer plants and dried there on a commercial scale. Three of these tests were made in a steam-jacketed (indirect-heat) drier and one in a semi-direct heat drier. In each case the tests proved to be successful from three standpoints: (1) The sludge dried readily to a satisfactory mechanical condition; (2) the processes did not require much power; (3) little nitrogen if any was driven off or lost by drying. From the mechanical standpoint therefore the recovery of nitrogen in sewage sludge is practicable.

THE QUESTION OF COST

With regard to the question of cost, however, the situation at the time of writing is not so clear. The pieces of apparatus used for settling the raw sludge and drying the press cake were not designed to handle activated sludge in the most economical manner, but were requisitioned as being the best commercial apparatus available at the time. By comparing the behavior of activated sludge with such matters as packing-house tankage Mr. Copeland estimates that this sludge can be dewatered so that the recovery of the nitrogen in it will probably cost, upon present evidence, about $8 to $12 per ton of material containing 10 per cent of moisture, depending on a variety of local factors. These figures are intended to cover interest charges, depreciation, repairs and renewals, and a liberal provision for labor and fuel, as well as the cost of resettling and decanting of the water of the original sludge, and expenses for handling, freighting, and marketing the finished product. Obviously, the total cost per ton will be somewhat more in the case of a small plant than for a large one. For a very large plant, where fuel and labor are relatively cheap, it is possible that further experience will reduce the cost below the lower limit in the range here given.

The dried samples of sludge were analyzed and the data obtained are given in Table 3.

TABLE 3 — ANALYSES OF COMMERCIALLY DRIED ACTIVATED SLUDGE (BASIS OF 10 PER CENT MOISTURE)

Sample No.	Character of drier	Per cent of— Nitrogen as ammonia	Per cent of— Available phos. acid
1	Semi-direct heat........	4.36	0.70
2	Indirect heat	4.76	0.81
3	Indirect heat	4.56	0.47
4	Indirect heat	5.06	0.39
	Average of 4 samples.......	4.68	0.57

These analyses may be supplemented by the following tests in Table 4:

TABLE 4—SOME ADDITIONAL ANALYSES OF ACTIVATED SLUDGE PRESS CAKE

Date of collection	Per cent of nitrogen calculated to ammonia (basis of 10 per cent moisture)
May 3, 1916....................	5.74
June 20, 1916....................	4.65
June 13, 1916....................	4.88
June 14, 1916....................	4.92
June 16, 1916....................	5.01

The data obtained at Milwaukee as cited in Tables 3 and 4 indicate that dry activated sludge (basis of 10 per cent moisture) will contain 4.6 to 5 per cent of nitrogen figured as ammonia and 0.6 to 0.7 per cent of available phosphoric acid. In addition to this the Milwaukee data show that the dry product contains about ¼ to ½ per cent of potash and from 3 to 4 per cent of fatty material. At present prices the nitrogen is worth $2.50 per unit (or per cent). In normal times this nitrogen would be worth about $2 per unit. The phosphoric acid is worth about 50 cents, and the potash may be worth something in the future, although the best that can be said of it at present is that it will assure for the fertilizer a more ready sale.

The fat present in the Milwaukee sludge is negligible. It would not pay to recover the fat, nor will the fat injure the selling qualities of the dried sludge.

SUMMARY

Summing the whole situation up, then, we see that the dried sludge has a market value upon present figures of $9 to $15 per ton of material containing 10 per cent moisture. The total cost of getting this product and placing it on the market will probably run from $8 to $12 commercially per dry ton, depending on local conditions. For large plants this cost may possibly be reduced as a result of further experience.

The activated sludge containing 4 per cent or more of nitrogen is much nearer a commercial possibility than the sludges obtained by the older methods of treatment, such as chemical precipitation, septic tanks, or the Imhoff process, which data indicate to contain only 1½ to 3 per cent of nitrogen.

In case the question arises as to the possibility of finding a market for the dried activated sludge, it should be added that raw materials containing nitrogen, phosphoric acid and potash are capable of being worked up readily as a base for making high-grade fertilizers, and as they are not very plentiful they are in good demand. Presumably, however, large cities such as New York and Chicago, by installing this activated-sludge process, would produce so much raw material of this character that the product would have to be parceled out among a number of manufacturers. It is even possible that the production might be sufficient to reduce the price.

However, the dried sludge is a good fertilizer just as it stands and contains enough value to pay for sale and distribution in quite a large local market. The data given indicate therefore that the recovery of the nitrogen in sewage sludge has at last been brought within the range of a commercially practicable problem.

Dewatering of Sludge the Big Byproduct Problem

Discussion by George W. Fuller of W. R. Copeland's Paper on the Recovery of Nitrogen from Sewage Sludge

FOLLOWING the presentation of W. R. Copeland's paper (reproduced substantially in full in the preceding article) at the annual meeting of the American Chemical Society in New York last week, George W. Fuller, consulting engineer, of New York City, submitted the following discussion:

COPELAND'S DATA DECISIVE

Mr. Copeland's conservative statements on his observations at Milwaukee add materially to our practical knowledge on this subject. With the advent of the activated-sludge method of treatment it appears, in Mr. Copeland's opinion, that the handling of sludge so as to use it in a dry form as a fertilizer has now come within the range of commercial practicability. But a careful perusal of this paper indicates that he does not entertain such views concerning the sludge obtained from other processes.

Generally speaking, the data of Mr. Copeland show that dry sludge from the activated-sludge process contains about twice as much nitrogen as the sludge from other processes. His data bearing upon this matter are probably more decisive than those which have been brought together hitherto, and he explains clearly why it is that activated sludge is richer in fertilizing properties than are other sludges.

MOST NITROGEN IN ACTIVATED SLUDGE

Experience showed years ago that plain sedimentation removes about one-third of the total organic matter in ordinary sewages and that chemical precipitation removes about one-half. That which is removed by these tankage treatments normally appears in the accumulated sludge. The balance passes out of the tank with the effluent.

Table 1 of Mr. Copeland's paper shows that with the activated-sludge method the removal of organic matter is in the vicinity of 70 per cent. This seems perfectly logical in comparison with the results of plain sedimentation, owing to the fact that the activated-sludge treatment removes colloids and other nonsettling organic matters.

The data in this table further indicate that the Milwaukee Imhoff tanks, with their relatively short period of sedimentation, removed less organic matter by deposition than does plain sedimentation in larger tanks, as tested in earlier years.

When we consider the nitrogen content of

Imhoff tank sludge—and the same would be roughly true for sludge of single-story septic tanks—it is necessary to recognize clearly, as pointed out by Mr. Copeland, that there is a material reduction in organic matter, due to the liquefaction and ultimate gasification of organic matters in a form permitting their direct release into the atmosphere. Obviously, septicization must mean a loss of the nitrogen content and hence of the fertilizing value of sludge.

On the other hand, activated sludge, reinforced with the nitrogen content of colloidal and nonsettling matters, is not only spared the loss of nitrogen but is actually able to show a substantial gain in nitrogen as a result of containing some of the more or less oxidized nitrogen. The removal of free ammonia as shown in Table 1 is quite striking. Part of it doubtless passes to nitrates, but it would be interesting to know what proportion of it becomes available for fertilizing purposes by adherence to the solid sludge as dried.

Comparative Figures

Figured on a commercially dry basis (10 per cent moisture), Mr. Copeland's average figures show a nitrogen content which is compared with some other data from activated-sludge tests, as follows:

	Per Cent Nitrogen
Milwaukee data (Copeland)	4.40
Manchester, England (Ardern)	4.60
Salford, England (Melling)	3.75
Urbana, Ill. (Bartow)	3.5–6.4
Armour & Co. (Noble)	4.6
English range (Fowler)	4.0–6.0

Attention is called to the fact that all of the foregoing figures are expressed in terms of nitrogen and not of ammonia, as seems to be the custom in speaking of the composition of tankage from garbage works. Nitrogen is only 82 per cent of the ammonia content, and care must be taken in dealing with the analysis. Mention should also be made of the fact that many published analyses refer to absolutely dry sludge, whereas most of the data recently refer to commercially dry sludge with 10 per cent of moisture.

From a commercial standpoint it is highly important to know whether the analyzed samples of sludge are representative or not of the annual output of the plant. Where sewage from a separate system of sewers is treated, this is not so vital a matter as in the instance of the sewage from combined sewers, where the amount of mineral detritus is bound to vary materially. Obviously, mineral matter dilutes the organic sludge with inert material which, pound for pound, costs as much to dry and prepare for the fertilizer trade as in the case of organic matter free of street wash and industrial wastes.

Nitrogen Content as Plant Food

A good deal has been written, particularly in England, as to the availability of the nitrogen content as a plant food. It is not the intent to discuss that phase here, but it would appear that the activated-sludge method in this respect does not suffer by comparison with the sludge from other methods.

The availability of the nitrogen is discussed at some length in a paper by Dr. E. H. Tripp, describing the Dickson process of sludge treatment as practised at Dublin, Ireland, and printed in the *Journal* of the Society of Chemical Industry, May 31, 1915. In Dr. Tripp's article the nitrogen in the dry Dublin sludge is given as 2.51 and 2.26 per cent in the two analyses published. It is interesting to note that the Dublin sludge is not nearly so rich in nitrogen as that obtained without the activated-sludge method, and the same is practically true of the Bradford sludge, which is described in the Engineering Record of Jan. 21, 1911, page 80, as having an ammonia content of 2.61 per cent.

Dewatering in Three Stages

It is an altogether different matter to dewater activated sludge obtained from a settling tank in a flocculent condition and mixed with 99 per cent of water from what is the case with Imhoff sludge containing 87 per cent of water and mixed with gas, so distributed as to cause practically all of the solid matters to rise and allow the withdrawal of subnatant water.

Clearly, the first step is to resettle and remove by decantation as much surface water as practicable, as described by Mr. Copeland. This, he says, at Milwaukee allows them to get sludge of about 96 per cent water content. To carry this resettling too far seems to be impracticable, owing, among other things, to the fact that the activated sludge after settling and during storage seems to undergo putrefaction within a period of 24 hours or less. Further aëration for 4 or 5 days would make this settled sludge nonputrescible; but this treatment results in the consumption of a substantial portion of the available nitrogen.

The real problem is to dewater this resettled product. Mr. Fuller has given a good deal of attention to this matter recently and offers comments concerning the two latter stages of dewatering, as follows:

Mr. Copeland describes the use of Worthington presses for reducing the water content from about 96 to 77 per cent. Based on general experience, it will cost for a fairly sizable plant about $3 per ton of absolutely dry solids for pressing. For commercially dry sludge with 10 per cent moisture this figure would be about $2.70 per ton. This makes no allowances for interest, depreciation, or overhead charges.

Yeast-Fermentation Process

The Dickson yeast-fermentation process might allow this result to be accomplished at a much lower figure, although Mr. Fuller is not prepared to give any cost data at present. Within the past few months he has had opportunity to investigate, in behalf of New York bankers, a test plant built in Brooklyn under the eastern end of the Williamsburg bridge for treating about 500,000 gal. of sewage per 24 hours according to the Dickson process which was originally installed at Dublin, Ireland. The sewage is subjected to plain sedimentation in hopper-bottom tanks from which the sludge is removed at intervals and a portion of the water removed by further sedimentation. This sludge, with 92 to 96 per cent of water, is mixed with about ½ per cent of brewers' yeast and allowed to ferment for about 24 hours in long, narrow round-bottom, sloping tanks, which are jacketed and kept heated to about 90 deg. Fahr. Anaërobic bacteria decompose the yeast cells and cause the sludge to become so mixed with entrained gases that the solid matters rise to the top in a manner similar to that noted with Imhoff tank sludge, and a fairly clear subnatant water is removed through a perforated pipe at the bottom of the tank. The water content of the remaining sludge averaged about 80 per cent, according to analyses made by Hill and Ferguson, but some samples showed 75 per cent, which, with improved devices, could probably be obtained regularly.

No activated sludge has been treated at this plant, which has been shut down for several weeks pending changes. It is proposed to treat activated sludge as soon as material is obtained from the Brooklyn testing station. So far as known there appears to be no reason why activated sludge cannot be dewatered by the yeast-fermentation process in a manner similar to that experienced with the sludge of plain sedimentation tanks, as is being installed on a large scale by Mr. Watson at Birmingham, England.

Sludge Drying

Mr. Copeland refers to both indirect-steam driers and direct-heat driers, with results which promise practical success for reducing the water content from about 75 to 10 per cent. Much weight should be attached to the fact that success has attended the drying of wet products in other industries, such as garbage tankage and refuse from stock yards, packing plants, etc. To drive off 4 to 6 lb. of water with 1 lb. of coal seems to be attainable with the devices now on the market. Some manufacturers seem willing to guarantee a removal of 10 lb. of water for 1 lb. of coal. A test guarantee of 8 lb. evaporation seems reasonable, according to the conclusions arrived at in the office of Mr. Fuller, but in practice it would probably be wise to make some allowance for waste heat, which is characteristic of all plants of this general character.

Whether or not it would be worth while to use an indirect steam drier for removing a portion of the water and then finish the drying in a direct-heat type of machine is a point perhaps worthy of discussion and upon which Mr. Fuller has reached no final conclusion.

Drier at Williamsburg Unsuccessful

The drier of the Dublin type as operated at the Williamsburg test plant did not prove very satisfactory in several respects. One of the principal difficulties was that the sludge contained more or less fibrous material, which formed lumps or balls which were not crushed by the stirring arrangements in this drier, with the result that they passed out through the outlet into the disintegrator. The water was not removed from the interior of these lumps as they left the drier, but they were fairly well dried in the disintegrator. In the effort to dry out these lumps there were occasions when the sludge caught on fire, so that it would burn, and have its fertilizing value lessened if the fires were put out with water, which of course increases the amount of coal used for dewatering.

The foregoing comments are made, not with a view to intimating that sludge-drying is commercially impracticable, but to suggest that there are mechanical details yet to be carefully studied as the process is not so simple as one would gather from reading Mr. Ruggle's article in the Engineering Record of Jan. 21, 1911, page 79, describing experiences at Bradford, England.

Canopies at Denver Station Are of Precast Units

One Locomotive Crane Places Concrete in Slabs and Columns, Stacks Units in Yard and Erects Them at Station

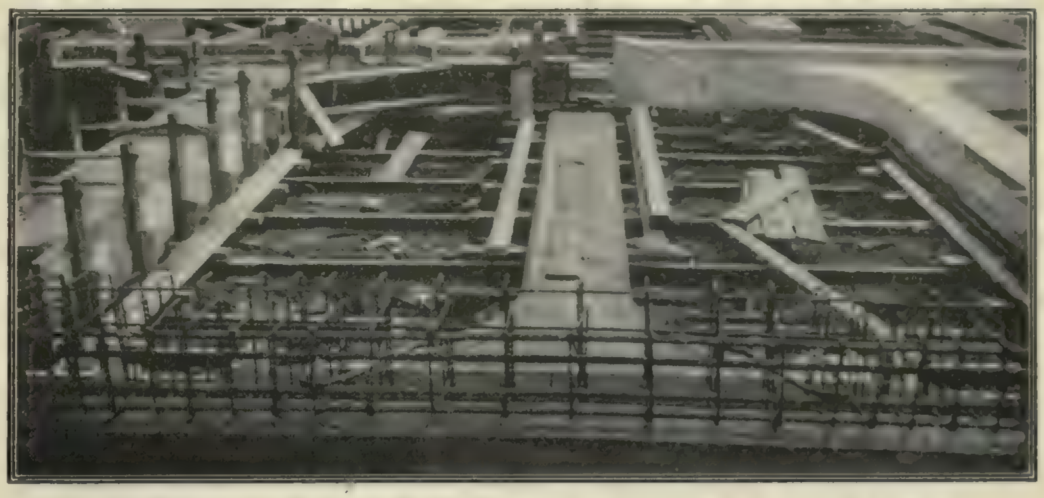
TWO SETS of units—one column unit supporting one end of each of four similar slab units—make up the canopies of the remodeled union station at Denver. The members are cast in place in a yard about ¼ mile from the station, one locomotive crane traveling up and down the yard placing the concrete, transferring the units from the forms to the curing stacks, moving them from there to flat cars and finally erecting them in the canopies.

There are 7000 lin. ft. of canopies. The photographs make it unnecessary to describe them in detail. The columns are 16 x 12 in. and 16 ft. 4 in. high, including 3 ft. bedded in the platforms and footings. The top beams are 11 ft. long. The slabs, each of which forms a half section of the canopy, are 9 ft. 9 in. by 20 ft., and 3 in. thick, ribbed as the illustrations show. The slopes of the two roof surfaces are respectively ½ in 12 and 3 in 12. The canopies are 19 ft. 6 in. wide, the platforms 17 ft. 6 in., and the clearance from top of rail to edge of shed is 16 ft.

In the casting yard care has been taken to make the foundation perfectly rigid, so that the members will be true and interchangeable. The forms are laid on steel rails carried on ties. For the slabs there are three rails longitudinal with the slab, one under each beam and one under the outer edge. Under the columns a large number of rails are laid transversely. The column forms are dovetailed to save space.

In the yard are sixty-five slab bottoms and twenty-five column bottoms. There are about one-third as many side forms of each type, so that the fresh concrete remains on the bottom forms while two more sets of units are being cast, after which the members are stacked for curing, the bottoms being released for further use. Slabs are cast every other day and moved to the stacks in six days. Columns are poured once a week and left on the bottom form for a period of three weeks.

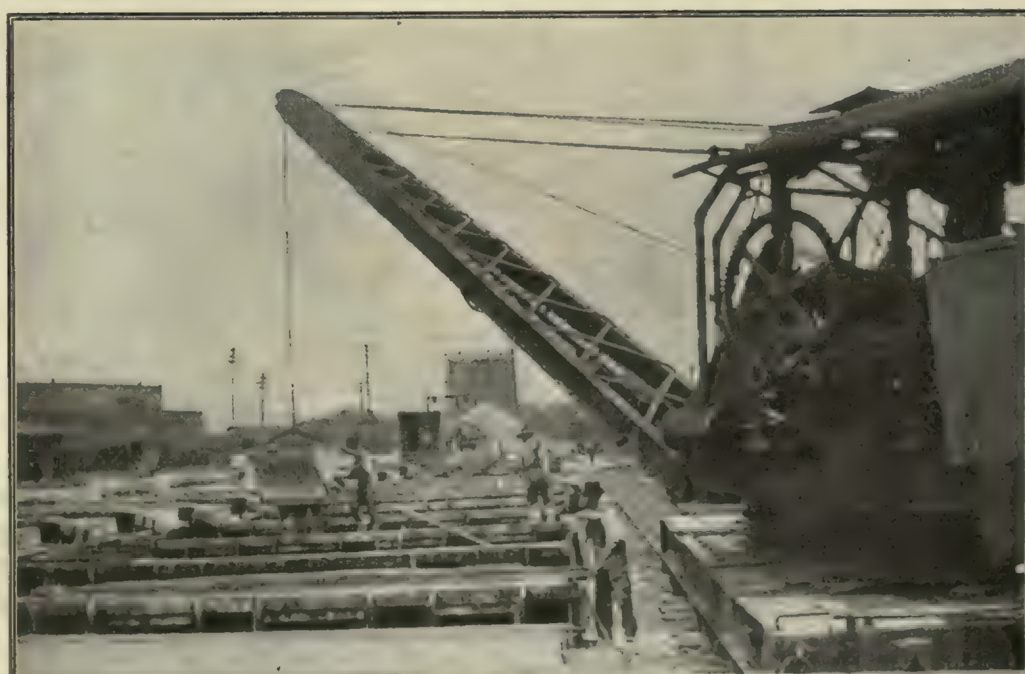
All forms are of wood covered with galvanized iron. Two carpenters can set up a side form for a slab in 20 minutes.



COLUMN FORMS ON RAILS IN DOVETAILED ARRANGEMENT TO ECONOMIZE SPACE

LOCOMOTIVE CRANE LIFTS SLAB FROM CAR AND PLACES IT IN CANOPY

SLABS ARE SPRINKLED DAILY FOR TEN DAYS—STACKED SIX DEEP



CRANE MOVING UP AND DOWN YARD FILLS FORMS FROM BOTTOM-DUMP BUCKET

The reinforcing for the column beams is built up outside. That for the slabs is laid in place. Along with the reinforcement are placed inverted U-rods for picking up the units with the crane.

The concrete, which is made 1:6, is mixed in a Cube mixer feeding into a ½-yd. bottom-dump bucket. The Industrial locomotive crane traveling along the yard picks up the bucket and delivers it as required. Thus a slab, which contains 3 yd., can be poured in 15 minutes.

The units are sprinkled every day for ten days. When the slabs have set sufficiently they are removed from the bottom forms by the crane and stacked six high, strips of lath being placed between them to prevent center-binding. When properly seasoned they are loaded on flat cars and set in place in the canopies, as shown in one of the photographs.

The canopies are being built by the Van Sant-Houghton Company of San Francisco, under the direction of J. G. Gwyn, chief engineer of the Denver & Rio Grande Railroad.

Aëration Suggested for Disposal of Sludge

George T. Hammond Discusses Problems of Activated Process of Sewage Treatment Before American Chemical Society

"IF we treat sewage by 'activation,' why may we not also find such a means of treating the sludge?" This is the line of thought suggested by George T. Hammond of the Bureau of Sewers, Borough of Brooklyn, New York City, in a paper presented last week before the division of water, sewage and sanitation of the American Chemical Society, which held its annual convention in New York, Sept. 25 to 30. The amount of sludge which must be disposed of, Mr. Hammond pointed out, easily stands first among the problems of the activated-sludge process of sewage treatment. This amount varies from 2000 to 4000 gal., or more, per million gallons of sewage, and the material has a water content of from 99 to 96 per cent. To minimize this surplus sludge Mr. Hammond sees possibilities in the use of fine screens and in some scheme of prolonged aëration. Extracts from his address are given below.

Dewatering Experiments

Sludge from the activated method of sewage treatment is highly putrescible unless dewatered, which is an expensive operation. Success in dealing with this problem is reported by T. Chalkley Hatton of Milwaukee, but the details and cost data are not yet available. At the Armour & Company plant at the Chicago Stock Yards experiments are still under way with dewatering methods, but their conclusions are reported as not final. It seems to them, however, that a battery of vertical-flow settling tanks, which decrease moisture to 97 per cent, followed by a Worthington or similar press, is the best method up to the present. The sludge, after pressing, is dried by a direct or an indirect-heat drier to 10 per cent moisture, which is necessary in order that the material may be used in making fertilizer. The cost of this method, according to Mr. Hammond, is such that the commercial value of the product must be considerable in order to make the treatment available. If means of transporting the dried product to market are costly, or fail at a critical moment, serious trouble may arise.

"Our further analyses of the sludge for fertilizer value," writes Mr. Noble of Armour & Company, "show it will run between 4½ and 5 units of ammonia, the value of it being therefore about what we have previously estimated—$9 to $10 per ton in the dried state." These figures, Mr. Hammond explained, refer to the sludge derived from the stock-yard sewage, and will probably not be equaled with ordinary domestic sewage.

Removal of Suspended Matter

It is quite probable, Mr. Hammond believes, that this difficulty can be overcome to a considerable extent by means directed to the removal of sludge-producing material from sewage previous to the treatment—for instance, by screens or tanks. So far no complete data are obtainable on this point, but experiments seem to justify the expectation of success. Experiments are needed to show how fine such a screen should be, for if it removes too much suspended matter the process may be seriously interfered with. So far as Mr. Hammond's experience goes the Imhoff tank is not likely to prove as successful as the screen in this preliminary treatment, as the tank takes out too much of the best size material in suspension for the activation process. But this is not stated as having been proved conclusively. If an Imhoff tank is used, the surplus activated sludge might be reduced to the condition of Imhoff sludge by being introduced into the digestion chamber, as suggested by Leslie C. Frank.

While the conditions at Milwaukee are rather unique, and favorable to the activated-sludge method, as well as to the transportation of the dewatered sludge, it is doubtful, in Mr. Hammond's opinion, if other cities less favorably situated will feel justified in going to the expense of installing extensive plants for dewatering sludge. The combination of a commercial venture with sewage disposal need not necessarily prove a failure, but the chances against its success do not make the project seem attractive.

Reduction of Moisture

A recent communication from Mr. Hatton states: "After elaborate experiments on the dewatering of sludge and sludge drying we find that there is little of the problem connected therewith that has not already been solved in industrial establishments where material of like character must be treated. Either of two kinds of presses will reduce the moisture from 99 to 75 per cent, and there is no difficulty by either the direct or indirect drier to reduce this moisture from 75 to 10 per cent or lower."

This statement is of great interest and seems very promising. It seems to Mr. Hammond, however, that in most places the problem will always be how to minimize the formation of surplus sludge and how to get rid of what does form without dewatering it in a plant especially provided for this purpose. If it costs more per ton to dewater than the sludge will sell for, or the net value obtainable therefor, then even though the value figures at $9 to $10 per ton, few will care to undertake such a venture, or at least go farther than what would be the fair cost of sludge disposal by other means.

Dewatering sludge is a matter of difficulty and expense and cannot but add a burden to the maintenance of a plant. This may be provided for in large plants, if the value of the sludge recovered warrants, but in small plants it would probably lead to a nuisance and would not be usually undertaken where the sewage amounts to less than 10,000,000 gal. per day.

Sludge-Drying Progress

The Schaefer-ter-Meer centrifugal sludge drier, used on a large scale at Frankfort-on-the-Main, and at Hanover, in Germany, has been thoroughly developed as a sludge-drying machine, which can handle with success large volumes of sludge and dry it sufficiently to burn readily in an incinerator plant. This machine was experimented with at the Jamaica sewage-disposal plant on Long Island, N. Y., and tests show that operating on sludge containing 91.5 per cent of moisture, from a lime-precipitation tank, it effected a removal to 64.2 per cent moisture, and operated continuously while effecting this removal. The cost of this method, as shown by the tests, was rather high, but the tests were really not a fair exhibition of what these machines can do, as the sludge treated was limed sludge and entered the machine in a sticky state, not favorable for economical operation.

The Dickson method of sludge dewatering, which employs brewers' yeast to effect a separation of water and sludge, also offers a possible means of success, and has the advantage of a fully developed system by means of which the dewatering and drying can be carried from the commencement to the completion of the process, without extra handling between the various steps. The dried sludge leaves the apparatus in bags ready for shipment to the fertilizer factory, or may even be made a complete fertilizer ready for market as it leaves the plant.

So far the cost of these methods has not been determined for activated sludge, but Mr. Hammond believes it will be lower than the cost for drying ordinary sludge. It is quite possible that the sludge may be destroyed by a septic process where the amount of it is not great enough to make dewatering an attractive measure. But little study has been done in this direction and much is desirable.

Suggests Sludge Aëration

As the sludge tends to break up and dissolve with over-aëration, and in doing so diminishes in volume, this gives promise of still another method that so far has received but little study. It has been found that by means of long-continued aëration activated sludge may be broken up and reduced to 10 per cent or less of its original volume. The problem is to get rid of the water during this reduction, so as to decrease the volume to be aërated. That this may be done seems fairly possible.

"Taking the surplus activated sludge as a special problem, it would seem," states Mr. Hammond, "that we should be able to design a plant to reduce its putrescible contents by means of biological agencies. If we may treat the sewage by 'activation,' why may we not, also, find such a means of treating the sludge? Since we have found that long-continued aëration will reduce it to a very small volume, can we not find means of doing this without excessive cost for air?

"We observe that after a short aëration period with activated sludge clarification of the sewage takes place, and that out of 1,000,000 gal. we have a net amount of

2000 to 4000 gal. of sludge, which we must dispose of separately, and this is about 99 per cent water. Clearly we can afford to aërate this small volume for a long time, if necessary, to effect its reduction to a form which will not cause a nuisance. Experiment shows that about half of this volume is free water which can be removed by an hour's tankage, and that 24 hours' aëration of the sludge will separate a large part of its remaining water, and the bacteria will keep on working for us. Thus we are continually treating a diminishing quantity of sludge, and the problem of design seems the principal problem."

Dikes and Tide Gates Help Control Mosquitoes

Problem of Salt-Marsh Breeding Solved by New Jersey Commission — Costs $437 per Square Mile

THE CAMPAIGN of mosquito control in New Jersey was begun in 1903, when the late Prof. John B. Smith, state entomologist, caused a section of the Newark salt marshes to be ditched. That experi-

NEWARK MEADOWS BREEDING PLACES CONTROLLED BY DIKES AND GATES

ment proved successful, and for several years the legislature appropriated sums of money to be used to demonstrate that class of drainage for mosquito-breeding elimination. The insufficiency of the method was due to the fact that in no one county could a large enough unit be drained to appreciably reduce mosquitoes, whose range of flight is several miles from the places where they breed. The result of this effort, says the commission, has proved that if the work could be extended on a larger scale much relief from mosquito nuisance would follow.

The Essex County Mosquito Extermination Commission began work early in the summer of 1912 with an appropriation of $65,000, which represented a per-capita cost of 12½ cents. Prior to beginning work the state and city of Newark had cut 695,000 lin. ft. of ditches, which the mosquito commission took over as an asset. To this the commission added 450,000 ft. In 1913 the 350,000 ft. of new ditches cut completed the draining of the salt marshes under the commission's jurisdiction so far as it was possible to do so by open ditching. Observation of this style of drainage for mosquito control showed that while open ditches proved successful under ordinary weather conditions, in periods of continued rains coupled with high tides, egg development would begin, and frequently mosquitoes reached the adult stage before the water could be drawn into the ditches.

Dikes Shut Out Tidewater

These abnormal weather conditions were overcome by shutting out the tidewater from the meadows with a system of dikes and tide gates. The work of diking the salt meadows in Essex County has been completed at a cost of $5,110.51, and the effectiveness of this style of drainage for mosquito control during the breeding season of 1916 has been carefully observed. The commission is of the opinion that it has solved the problem of controlling salt-marsh-mosquito breeding through its system of dikes and tide gates. It has also decided to go a step farther in some of the low-lying meadows by connecting them with the Newark pumping station by a series of ditches. The water can then be pumped from the meadows whenever necessary.

While much of the effort of the commission has been devoted to the large salt-marsh areas of the county, the control of mosquitoes which breed in fresh water has not been neglected. Many large swamps have been drained, miles of brooks cleaned, and a general backyard inspection has been maintained each year. Practically no complaints of mosquitoes indoors were received during the past summer.

During 1915, 500,000 ft. of ditch were cleaned and 11 tide gates installed. The previous year witnessed the installation of 28 tide gates and the construction of 27,195 ft. of dikes, as well as the cleaning of 500,000 ft. of ditch.

Crushed-Stone Roads Cost $3,500 to $4,500 Per Mile

Small First Cost and Maintenance Expense Necessary in Indiana — Highways Have Life of 15 or 20 Years

By R. L. LONGSHORE
Deputy Surveyor, Adams County, Indiana

INDIANA'S present laws provide for the construction of good roads by means of bond issues based on the total assessed valuation of the township. As the total bonded debt of the township must not exceed 4 per cent of the total assessed valuation, the cost of unit miles must be kept low in order to construct roads over the entire township in a reasonable length of time.

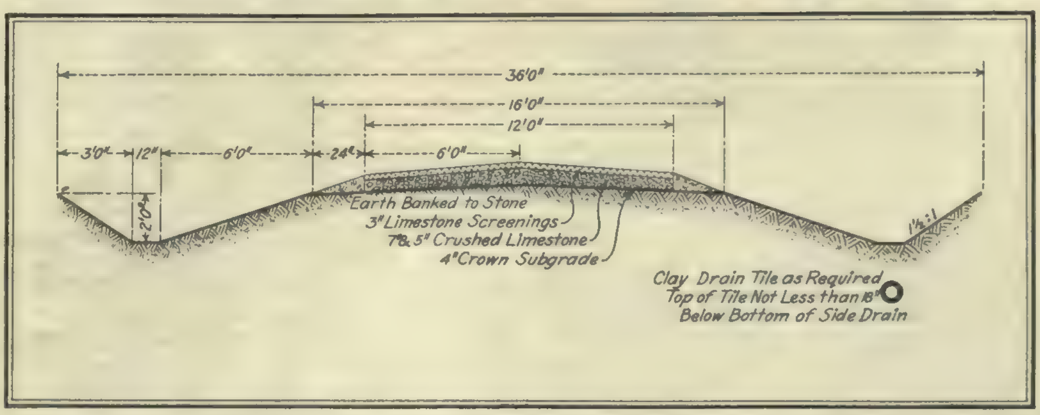
After construction the roads are maintained by the county under the supervision of a highway superintendent. The maintenance fund is raised by a levy on the entire county. Including state aid from automobile license, the fund amounts to only $100 per mile per year. This takes care of all repair work, including material for the grading, sewer and culvert repair, and weed cutting. Because this fund is low it is necessary that a type of road be used on which not only the first cost but that of annual maintenance is a minimum.

SECTION OF ROAD BUILT ON FILL

Double-Track Road Tried First

The first road tried in Adams County was a 24-ft. highway providing a 10-ft. crushed-stone pavement on the right side in the direction of the heaviest traffic and a 10-ft. earth side road. This type proved a failure, as it has been found impossible to maintain two radically different types of road on a 24-ft. subgrade. During wet or freezing weather the wheels of passing vehicles drag up mud from the earth-side road onto the stone, causing holes to "burn" through the metal. While the double track appealed to the public and is correct in theory, it has, in Indiana, proved impracticable, and in most cases the earth track is little traveled.

During the last two years the type here illustrated has been adopted. The subgrade, as shown in the drawing, can be built with the ordinary road grader pulled either by teams or farm tractor. Drainage is provided by clay drain tile laid in the center of the side drains. All tile drains crossing the road are replaced with cast-iron sewers, with brick receivers in the side drains. These receivers are laid up in cement mortar and equipped with removable cast-iron grates. Overflow sewers are of cast iron equipped with concrete bulkheads. All bridges and larger culverts are of reinforced concrete, and standard designs for those structures have been developed in the county engineer's office. After



COST OF ROAD OF THIS TYPE AVERAGES LESS THAN $4,500 A MILE

the completion of the subgrade the surface is thoroughly rolled with a 10-ton roller until all settlement ceases.

ROAD REPAIRED WITHOUT USING NEW MATERIAL

Upon this subgrade a course of ¾ to 2¼-in. crushed limestone, 5 in. thick at the sides and 7 in. thick at the center, is placed to a width of 12 ft. Limestone screenings (¼ to ¾ in.) are then placed to a uniform depth of 3 in. and the metal thoroughly rolled. Ledger boards are used at the sides to hold the stone in place. Before they are removed earth is taken from the side drains and placed against them to hold the stone in place.

Under traffic the 12-ft. road spreads to 14 ft., and owing to shape of the finished road surface may be graded in and repaired without the use of new material.

Adams County has 25 miles of this type, including roads under construction, as a part of the county system of 500 miles of stone roads. Under ordinary conditions of traffic these roads will have a life of 15 to 20 years, with nominal maintenance charges.

The road shown in the photograph was built this year at a contract price of $2,629.45. The estimates were as follows: 1321 yd. of stone complete in place, $2,443.85; grading, $350; sewers and headwalls, $115; receivers and subdrainage sewers, $42; tiling, $15; concrete culvert (8 ft. span and 26 ft. long), $322.50.

The total length of the road was 3800 ft., or 0.72 mile. Therefore the cost per mile would be from $3,500 to $4,500, depending on local conditions. All material was near at hand, and the longest haul was 2 miles. Common labor cost $2 per 10-hour day and a team with driver $4.50 per day.

Test 9-Foot Masonry Conduit for Carrying Capacity

Results of Readings Continued for 48 Hours at St. Louis Tabulated in Annual Report to Water Commissioner

DURING February and March, 1916, tests were run on the 9-ft. masonry conduit between Baden and Bissell's Point, St. Louis, to determine its carrying capacity. This conduit, built in 1889, is horseshoe in shape, 7 ft. 9 in. high and 9 ft. wide, with a granitoid finished invert and brick sides and arch. It was built with a uniform slope of 1 in 10,000 and discharges into the north, or No. 4, of the Bissell's Point storage basins. The following information is given in the annual report of Gordon G. Black, engineer in charge of the supply and purifying section, to E. E. Wall, water commissioner.

In testing, the discharge point, basin 4, was kept at a practically constant elevation, and hourly gage readings were taken at the Baden gate chamber, three gaging points between Baden and Bissell's Point, the terminal chamber and basin 4, all except that at the terminal chamber being by hook gage. In maintaining basin 4 constant, the Bissell's Point pumps drew from that basin and the surplus passed over a weir of adjustable height into basins 3, 2 and 1, being measured there. Counter readings on the pumps (all triple expansion) and gage readings in the basins were taken hourly. Care was used to keep the amount of water filtered and sent through the large conduit at Baden as nearly equal to the quantity pumped at Baden during the hour, plus the quantity for which the 9-ft. conduit was to be tested, as could be. At the 80,000,000-gal. per day rate, readings were continued through 48 hours, and at the 90,000,000-gal. rate through 36 hours, the first hours in each test during which readings were erratic being discarded in the final computations. The results are indicated in the table.

In computing C for the full section, the dimensions of the conduit as it was built were used; for the actual section the dimensions at present were used, these varying from the original dimensions because of the coating of lime carbonate on the sides. Near the bottom this is approximately 1½ in. thick, reducing to nothing at the water line.

DATA DETERMINED BY TESTS

Nominal rate, million gallons daily	80	90
Average rate	82.58	91.31
Number of hours averaged	9	8
Gage 1 at Baden gate chamber	110.60	110.93
Gage 2 at terminal chamber	107.32	106.48
Gage 3 at Basin 4	106.99	106.00
Distance between gages 1 and 2, ft.	17,044	
C in Chezy formula (full section)	119.8	118.5
C in Chezy formula (actual section)	121.4	119.8
Velocity, average at Baden, feet per second	2.42	2.60
Velocity, average, at outlet	3.07	4.27

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Information on Concrete Log Decks Desired

SIR: Can you through your columns give us any data concerning, or examples where, a concrete log deck has been used for unloading logs from cars into a mill pond? It is a question whether a concrete deck is flexible enough to withstand the impact imposed by falling logs, and any information concerning a concrete deck now in use will be appreciated.

G. L. COYLE,
Engineer with Babcock Lumber & Land Company.
Maryville, Tenn.

Some Aspects of the Railroad Wage Controversy

SIR: I thank you for your editorial of Sept. 9, page 308, under the caption "Some Aspects of the Railroad Wage Controversy." I have been able, during the past four or five years, to talk with a few of the captains of industry and with more of the lieutenants. My interest in the question you discuss was first aroused because of the attitude of these men toward employees. They face a danger that they do not seem to recognize. They must discover some time that the balance of power lies in the hands of the men they employ and that sooner or later these men are to break away from party lines and support principles that will protect them. Compromise now might bring results that would be satisfactory to both employer and employee. A victory won at the polls by the laboring class may result in industrial revolution, and the employer will then discover, when too late, that he has been shortsighted.

If there is any profession, or any class of men, who should see the handwriting on the wall, it should be that of engineering. Our early training was, perhaps, unfortunate. We have lived in an age of special privilege. Our law-making bodies and, even more, our tribunals of justice have largely lost sight of the real interests of society in their haste to favor and protect private property. If the history of the labor party in other countries is to be repeated here, we have nothing to fear. Australia affords us an illuminating example. In that commonwealth the technicalities of law have largely been replaced by statutes based on live principles that all can understand and appreciate. Australia affords the best model in government thus far produced. The engineers of the United States can perform no greater service for their country and for their profession than to accept the sentiments expressed in your editorial.

CLARENCE T. JOHNSTON.
Ann Arbor, Mich.

Final Report of Construction of Los Angeles Aqueduct

SIR: By a change in plan, the Board of Public Service Commissioners of the city of Los Angeles has made possible the acquirement of a copy of "The Final Report on the Construction of the Los Angeles Aqueduct" by those who failed to send a paid order for the volume previous to July 15. The board originally intended to print only the number of copies for which paid subscriptions were received to that date. Orders came in such volume, however, from all over the civilized world, that it was felt that when the book was published and in the hands of readers even a greater demand would be created. A new contract was therefore entered into for an additional 3000 copies, and so long as these last the volume will be delivered post paid in the United States or Canada for the regular subscription price of $1.95. Subscriptions should be addressed to the Los Angeles Department of Public Service, 645 South Olive Street, Los Angeles, Cal.

Delivery of subscribers' orders has been delayed by the unexpected volume received and the changes necessitated in printing; but the copies should be in the hands of purchasers soon after this appears.

As now coming from the press, the book is a handsomely bound volume in green cloth library binding, 8½ x 11 in. in size comprising 336 pages, 110,000 words, and 62 full-page and 30 half-page engravings, besides 40 plates showing full engineering details of all features of this great work.

The city of Los Angeles realizes no profit on sales, the rather unique plan of selling a municipal report having been devised in order that the valuable volume, which is sold at less than cost, might be placed within reach of the many who could not hope to obtain a copy under the usual procedure of issuing reports of such character.

R. F. DEL VALLE,
President, Board of Public Service Commissioners.
Los Angeles.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Rock Ballast for Industrial Track Pays on Road Work

By HARLAN H. EDWARDS
Urbana, Illinois

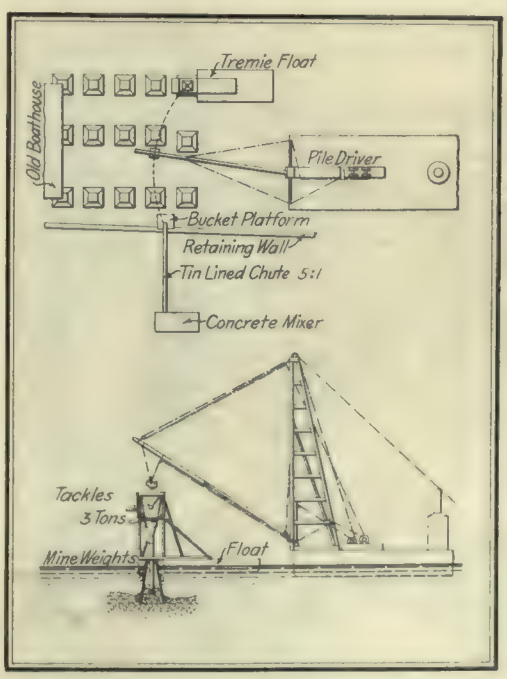
USING SOME of the macadam stone for ballasting the 2-ft. gage industrial track employed on the road work near Hoopeston, Ill., described on page 400 of the Engineering Record for Sept. 30, 1916, was found to be well worth while. At first the track had been laid along the earth shoulders of the road, but after every rain it settled in spots, while on hot days the rails expanded and twisted the track over the entire roadway. Much expense for maintenance was occasioned, and there was frequent danger of derailment. The accompanying photographs show clearly the way in which the track behaved when laid directly on the shoulder and the improvement made by using the ballast.

RAINS AND HOT WEATHER WASHED OUT AND TWISTED INDUSTRIAL TRACK ON ROAD WORK TILL TROUBLE WAS OVERCOME BY USING BALLAST

Unique Tremie Float and Driver Rigged as Derrick Used by Navy

PLANT ALREADY on hand was converted through the ingenuity of civil engineers of the United States Navy to construct fourteen concrete piers under water for an extension to the boathouse at the Newport, R. I., naval training station. Concrete for these footings was conveyed from the mixer by chute to a bucket at the water's edge, handled by an improvised boom mounted on a floating pile driver to a hopper supported on a small barge, and deposited through a tremie in wooden forms weighted down in place in the dredged excavations made for each pier. The work, including the superstructure, was done in this way for $6,450, a little less than the appropriation available and more than $4,000 less than the lowest bid received for the work. The method was developed after cofferdam work had been found to entail the use of expensive plant which could not be provided within the appropriation. The work is described by Civil Engineer Kirby Smith in a recent issue of *Public Works of the Navy.*

The twelve piers ranged in height from 8 to 14 ft., the concrete portion extending to El. —0.5 and the remainder of the piers being constructed of granite. The excavation for each pier was made with a ½-yd. grab bucket handled by a small power derrick. The forms set in these excavated pockets were made of 2 x 6-in. tongue-and-groove plank with 4 x 4-in. corner braces, which extended about 6 in. below the form proper. After placing, dredged material was filled around the lower part of each form to hold it in place and seal the bottom. Also eight 90-lb. lead mine weights were hung outside the forms to overcome buoyancy. A fixed hopper and a frame for handling the tremie were carried on one end of a 15 x 30-ft. steel float. A 15-in. pipe was used, suspended from the frame by two 3-ton differential hand tackles, by which it could be easily and rapidly raised when full of concrete. The fixed hopper, which was above the small circular hopper secured to the top of the tremie pipe, had a capacity in excess of the entire pipe. In this way sufficient concrete completely to fill the tremie pipe could be placed in the large hopper before opening the gate under it when starting to concrete a pier. This was necessary, as the bucket handled by the boom on the pile driver carried only 9 cu. ft. The bottom of the pipe was kept embedded 12 in. in the concrete, and only once was the concrete in the pipe lost. The tremie had to be watched closely, however, as with the release of weight in discharging concrete from the upper hopper the small float would rise rapidly, carrying the tremie with it.



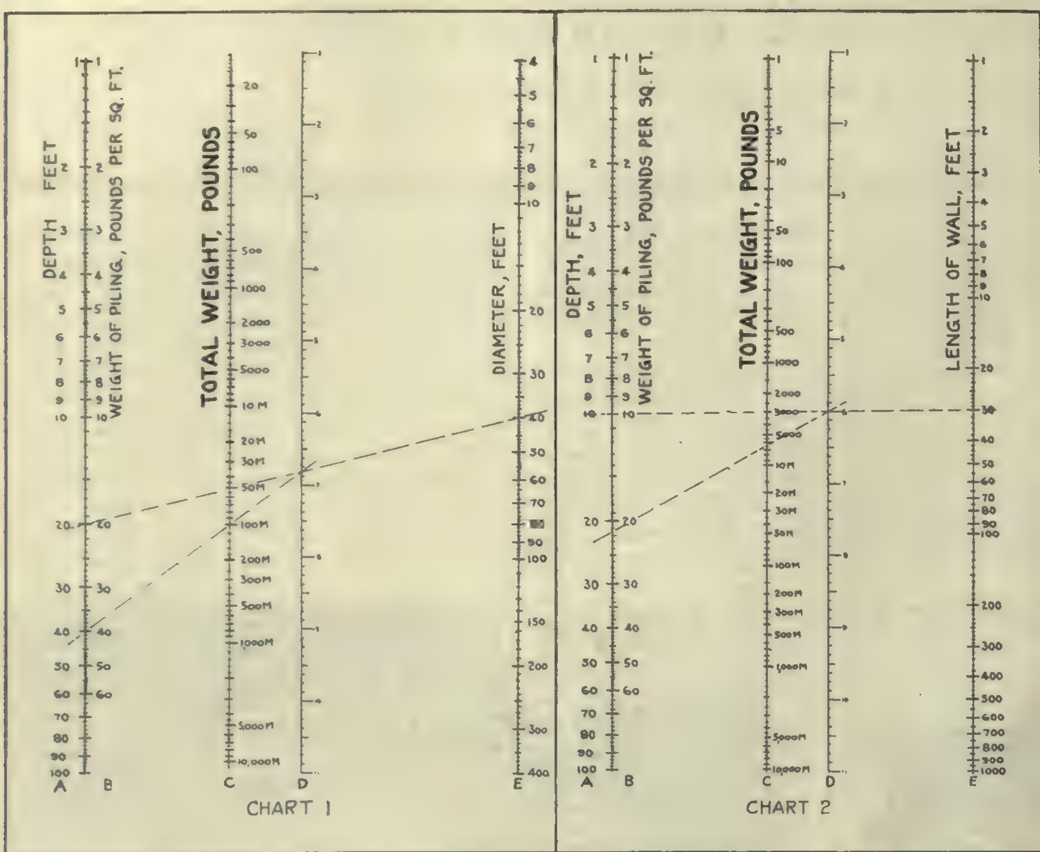
CLEVERLY CONVERTED PLANT ENABLED NAVAL ENGINEERS TO BUILD UNDERWATER FOOTINGS WITHIN APPROPRIATION

The concrete was conveyed from the ½-yd. gasoline-driven Austin mixer on the bank to the bucket on the lower platform through a tin-lined wood chute. Although the flow was regulated at the mixer, the lower end of the chute was fitted with a sliding gate and the sides increased in height to 24 in. to prevent loss of concrete. As the work could only be prosecuted at favorable stages of the tide, a progress of two piers a day was considered good. The 109 yd. of concrete placed in this way cost $9.91 per cubic yard and the entire footing work, including the excavation, forms, concrete and granite, cost $2,142.81.

Charts Tell Weight of Sheeting for Round or Box Cofferdams

By N. G. NEAR
New York City

THE NOMOGRAPHIC charts reproduced herewith have been found to save considerable time in calculating the quantity of steel sheeting required for a given wall or cofferdam, especially in the case of a circular structure. Chart No. 1 is for computing the weight of such cofferdams, and its use may be illustrated by supposing that it is desired to find the weight of steel



TWO MOTIONS WITH A STRAIGHT EDGE DETERMINE WEIGHT OF SHEETING FOR COFFERDAM

sheet piling required to construct a cofferdam 40 ft. in diameter and 20 ft. deep, assuming that a section weighing 40 lb. to the square foot is used. To solve this problem, connect 20 on scale *A* with 40 on scale *E* and locate the intersection with scale *D*. Connect the point thus found with 40 on column *B*. The weight, 100,000 lb., is then read at the intersection of this last line with column *C*.

The second chart, which is for straight-wall or irregular structures where the total length is known, is used in a similar manner. For example, to find the weight of steel sheeting required to build a wall 30 ft. long and 10 ft. deep, using a section which weighs 21.5 lb. per square foot, connect 10 on scale *A* with 30 on scale *E*, locate the intersection with scale *D* and connect this point with 21.5 on scale *B*. The total weight, about 6500 lb., is read at the intersection of this line with scale *C*.

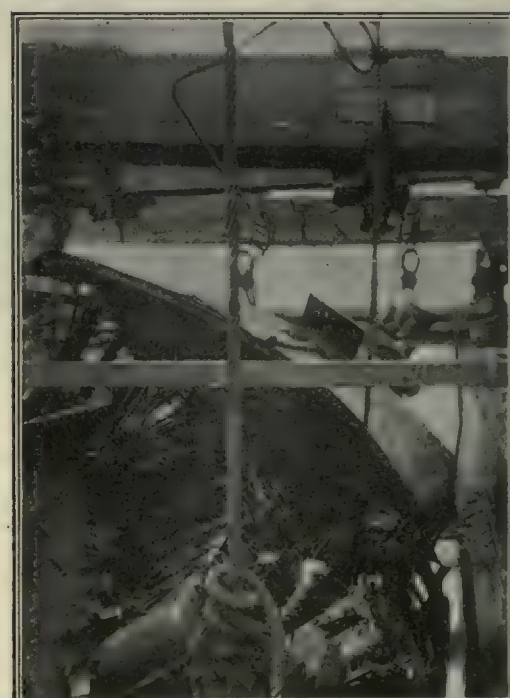
The range of these charts is wide enough to cover almost any sheet-pile structure. The weight per square foot of the type sheeting which is to be used can, of course, be taken from the handbooks of the steel companies which make piling.

Locomotive Raised from Harbor by Jacks Mounted on Scows

By VICTOR W. KILLICK
Glendale, Cal.

A RAILROAD locomotive was recently raised from the bottom of the harbor at San Pedro, Cal., by being jacked up between two barges, floated at high tide over a temporary track built on a nearby mud flat and lowered once more to the rails. The jacks were set under the ends of built-up timber girders which spanned between the barges and from which the locomotive was slung. Three lifts were necessary to bring it to the surface.

The engine, which had been handling a large pile driver used in repairing a railroad trestle in the harbor, reached the bottom of the bay through the collapse of the portion of the old trestle on which it had been standing. It turned over in falling and landed in soft mud about 30 ft. below the surface. It was not desirable to attempt raising the locomotive to the trestle with a wrecking crane, and no floating cranes of sufficient size were available in the harbor. Two 200-ton barges were therefore secured and placed side by side over the wreck 12 ft. apart. They were fastened together at each end with two girders made up of three 20-ft. piles each, lashed together with heavy manila rope, each turn of which was drawn tight with a hoisting engine. For raising the locomotive three heavy clusters of timbers, one at each end



LOCOMOTIVE WAS CARRIED OVER TRACK ON MUD FLATS AT HIGH TIDE

and one in the center, were placed across the gap between the barges. Under each end of each of these girders was placed a 50-ton hydraulic jack, and 1¼-in. steel cables were used to suspend the locomotive. After the engine and tender were turned right side up, hoisting was begun, using the usual method of supporting the timber girders on cribwork while the jacks were reset. When the locomotive had been raised about 10 ft. in this way it was slung from the barges by a second set of cables, while the timber girders were lowered again to the deck. After this operation had been repeated three times, the locomotive had been raised high enough to permit its being towed to the mud flats mentioned, half a mile above the trestle, and replaced on the temporary track, which had been built at low tide.

The services of a diver were required during the operations to remove several broken piles at the site and to fasten the cables to the locomotive.

HEAVY TIMBER GIRDERS FROM WHICH LOCOMOTIVE WAS SLUNG WERE JACKED UP TO SURFACE ON CRIBWORK, THREE OPERATIONS BEING REQUIRED

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Fire Wrecks Bridge Over Missouri River

$500,000 Structure May Be Total Loss—Eastern Approach Demolished — Spark from Locomotive Starts Blaze

Most of the timber floor and all of the timber trestle of the eastern approach to the St. Charles (Mo.) highway bridge across the Missouri River was destroyed by fire Sept. 26. The steel work of the bridge, which consists of four through-truss spans—three of which are 460 ft. and one 360 ft. long—and one deck-truss span about 250 ft. long, was badly damaged.

The entire floor system appears to be ruined. Numerous panels of eyebars in the bottom chords of the through trusses have been lengthened by the intense heat and several vertical and diagonal members of the trusses are practically sheared in two. The deck-truss span is so badly warped and twisted that it is doubtful whether any parts of it can be used in reconstruction. The floorbeam at the west, or expansion, end of this span buckled so badly that the connection of the south truss to its shoe was severed and the truss pulled about 2 ft. out of line. This action also drew the shoes at the east end of the span about 5 or 6 in. out of position and chipped several large blocks of concrete off the top of the pier. The laterals and swaybracing of this span are also badly distorted.

Eastern Approach Total Loss

The entire eastern approach, a timber trestle about 500 ft. long resting on concrete footings, is a total loss. The floor of the bridge, which carried one street-railway track and a roadway, was of timber construction, with stringers resting on the steel floorbeams. It was covered with a two-ply floor of 3-in. material, the first ply of which was creosoted pine and the top of oak. The fire, which started about midway of the west span, is supposed to have been caused by a spark from a locomotive which was doing some switching about 200 ft. west of the point of origin. When first brought to the watchman's attention a very small area of the under side of the floor was ' urning. The local fire department was immediately notified, but by the time they had arrived a high wind had whipped the fire into a roaring conflagration. Fire-fighting apparatus sent from St. Louis in an attempt to save the eastern approach and several small residences was unable to stay the flames.

Original Cost $500,000

The bridge was designed by and built under the supervision of Waddell & Hedrick, consulting engineers, of Kansas City. The Missouri Valley Bridge & Iron Company was the contractor for the substructure and the Midland Bridge Company for the superstructure. Mr. Hedrick has been retained by the owners to make a thorough examination as the structure now stands and an estimate of the necessary expenditure to reconstruct it. The original cost was about $500,000. W. V. Delahunt, secretary of the Commonwealth Trust Company, owner of the bridge, stated that it had not yet been decided whether the structure would be rebuilt.

This information was furnished by A. R. Ross, engineer in charge of the St. Louis Municipal Bridge.

Prices of Materials This Week

See Page 149

Will Build About 1000 Miles of Railroad in China

American Capital Finances Work—Probable Cost Will Run Into Millions—$500,000 for Preliminary Survey

A contract for the location and construction of about 1000 miles of railroad in China was signed Sept. 30 by the Chinese government with the Siems-Carey Railway & Canal Company, in which firm the American International Corporation is financially interested. According to the first announcement on Oct. 3 the necessary funds will be raised by a Chinese bond issue to be marketed by the American International Corporation. Reports that the probable cost will be $50,000,000 or more are unconfirmed by the corporation, as nothing like a definite figure can be agreed upon until the lines are located and the nature of the construction determined.

American Engineer to Have Charge

According to a statement by Willard Straight, vice-president of the American International Corporation, the lines will be located by an American chief engineer who will later, on behalf of the Chinese government, superintend the construction. He will, upon the road's completion, act as its chief engineer. An American auditor and a traffic manager will also be appointed. No routes have yet been selected, although $500,000 has already been advanced to cover the cost of investigations and surveys. At present there are only about 6000 miles of railroad in China. The construction of the new lines, on which actual work will start in about a year, will therefore almost triple that country's railroad mileage.

May Build Canals

Siems and Carey are railway contractors of St. Paul. Last May they signed a preliminary agreement with the Chinese government for the construction of railroads in China. About the same time preliminary contracts for dredging the Grand Canal were concluded and the American International Corporation, together with the Siems-Carey Company, organized the Siems-Carey Railway & Canal Company, to undertake the construction of railroads and the dredging of the canal. Final agreements for the canal work are now under negotiation. The announcement in the Engineering Record of Aug. 12 of the appointment of F. C. Hitchcock, formerly vice-president of the MacArthur Brothers Company, to a similar position with the Siems-Carey organization in China indicates that possibly he is the American engineer who will have charge of the work. The new contract will be handled on a percentage basis.

City Managers Will Meet at Springfield, Mass.

The annual convention of the City Managers' Association will be held Nov. 21 to 23 at Springfield, Mass. Although the tentative arrangements include no presentation of papers, the program provides for discussion by each member of the topics which have been selected. The convention will really be opened at Springfield, but those who desire to inspect New York City's municipal activities will meet in that city Nov. 20, leaving for Massachusetts that night. The following three days will be devoted to three or five-minute discussions by each member on topics relating to the duties of the city manager and matters bearing on the improvement of that form of government.

Discuss Civic Organization of Engineers and Chemists

Proposal Made That Naval Consulting Board's Industrial Preparedness Committee Be Made the Nucleus

Shall the engineers and chemists of the country form an organization for the consideration of, and action on, public questions of an engineering nature?

This was the question put before a gathering of engineers called together at luncheon at New York on Sept. 28 by W. L. Saunders, past president of the American Institute of Mining Engineers and a member of the Naval Consulting Board. The governing thought, Mr. Saunders explained, was whether, since an organization of engineers for civic work had been created by the Naval Consulting Board through its committee on industrial preparedness, it is not wise to hold the organization together and to make it permanent. Such problems as the conservation of our natural resources, mining laws, railroad regulation, and river and harbor appropriations might be considered. Mr. Saunders proposed that the new organization be independent of the national engineering and chemical societies, but that the qualification for membership in the new body would be membership in the existing national professional organizations.

Vote to Appoint Committee

A general discussion followed Mr. Saunders' statement. Most of the speakers believed that the national engineering and chemical societies would not be inclined to take suitable action on civic questions, and therefore favored the perpetuation of the Naval Consulting Board's organization. It was pointed out, however, that the existing bodies are well organized and have the necessary machinery for effective action. On one point there was unanimity—that there should be some agency by which the engineers and chemists could exercise an influence in public life. There was a difference of opinion only on what the agency should be.

As a result of the discussion it was voted that the chairman should appoint a committee of five to consider the question from the various angles brought out in the discussion and to report conclusions at a later meeting. Mr. Saunders is to be an ex officio member of the committee.

Personnel of Committee

The committee, as appointed by the chairman, is as follows: J. J. Carty, past president of the American Institute of Electrical Engineers; Charles Warren Hunt, secretary, American Society of Civil Engineers; Calvin W. Rice, secretary, American Society of Mechanical Engineers; Thomas Robins, member of the Institute of Mining Engineers; Benjamin B. Thayer, director, the Engineering Foundation.

Among those present were Clemens Herschel, president, American Society of Civil Engineers; H. W. Buck, president, American Institute of Electrical Engineers; D. S. Jacobus, president, American Society of Mechanical Engineers; Dr. Charles H. Herty, president, American Chemical Society; Gano Dunn, chairman, the Engineering Foundation; Frank J. Sprague, past president, American Institute of Electrical Engineers; Dr. L. H. Baekeland, past president, American Electrochemical Society, and E. J. Mehren, editor, Engineering Record.

Information has just been received that on Aug. 25 a resolution was adopted by the Affiliated Technical Societies of the City of Atlanta urging similar co-operation in civic activities.

Four-Day Smoke Convention at St. Louis

Standards Presented and Every Phase of Combustion Discussed—Firing of Locomotives Demonstrated

The Smoke Prevention Association held its annual convention at the Planters Hotel, St. Louis, Sept. 26 to 29, with an attendance of 86. The first session was opened Tuesday morning by President W. A. Hoffman. C. H. Daues, city counselor, gave the address of welcome and W. M. Chauvenet spoke in behalf of the Joint Smoke Prevention Committees of St. Louis.

An important feature of the morning session was the report of the standardization committee. The composite report by each of the twelve members covered practically the entire field of the smoke inspector. In the first of the individual reports a violation was defined and standard permit and certificate of operation clauses were suggested. Other standards were presented, but their use discouraged.

A report on front-feed stokers showed standard methods of setting this furnace with different types of boilers. Another section dealt with standard methods of applying chain grates to different types of water-tube boilers. A report on locomotive practice suggested standard methods of firing in service, of building up the fire, and of applying brick arches and steam jets. These various standards will be given a year's trial before they are officially adopted.

Heating Plants Deserve Study

In the first paper of the afternoon session, by O. Monnett of Chicago, it was pointed out that smoke from heating boilers was much more detrimental than that from high-pressure plants, due to the presence of tarry matter and unignited distilled creosote passing off at relatively low temperatures. Besides damaging buildings and vegetation these products often cause acute lung diseases, so that it is of the greatest importance to give more attention to the study and regulation of heating plants. W. A. Pittsford of Chicago traced the evolution of arch buildings over chain grates during the last 12 years and suggested a standard setting.

Wednesday morning J. W. Henderson, chief of the Bureau of Smoke Prevention in Pittsburgh, told of the progress made in that city, where publicity had proved most effective in securing public interest and co-operation. "Chimney Draft and Its Relation to Boiler and Furnace Efficiency" was the title of the next paper, by E. R. Fish of the Heine Safety Boiler Company. The speaker outlined the advantages of natural draft and the use of forced and induced draft for high rates of combustion.

Thursday Was Railroad Day

At a short afternoon session Joseph G. Worker pointed out that all large central stations now operate with very little smoke and that the proper use of instruments has been a great factor in obtaining present-day economy. He said that high efficiency at normal rating with a wide range of operation and large reserve capacity was the prime factor of the under-feed stoker rather than large steaming capacity.

Wednesday evening's entertainment was supplied by the Engineers' Club and the Associated Engineering Societies of St. Louis, as noted in last week's issue. Thursday was railroad day. The entire morning was devoted to papers on problems met in locomotive operation. Practical demonstrations of firing up engines were given in the afternoon.

The principles of combustion and the cause of smoke formation were discussed Friday, as was the importance of fineness and intermingling of the coal with the air supply. This was followed by an outline of the Bruden method of burning powdered coal.

Officers elected for the ensuing year were: W. H. Reid, president; Martin Rooney, first vice-president; W. L. Robinson, second vice-president, and A. A. Chambers, secretary-treasurer. Columbus, Ohio, was chosen as the place for the next convention.

Two Killed, Thirty Hurt in Cleveland Bridge Failure

Two cars crashing together the night of Oct. 3 on the Third Street bridge, Cleveland, caused that steel structure to collapse and precipitate its load upon the tracks of the Baltimore & Ohio Railroad 30 ft. below. The cars almost rolled into the Cuyahoga River. Of the approximately sixty occupants of the two cars, two are reported killed and thirty injured.

The motorman lost control of his heavily loaded car on a hill. The runaway conveyance reached the north approach to the bridge at the same time as a car coming from the opposite direction. The two cars crashed together, and their combined weight, together with the shock of the collision, caused the old structure to sag and then give way.

The portion of the bridge which fell is just north of the river. The structure was erected in 1888 and has a span of about 105 ft. The opinion has been advanced that while the structure is about 28 years old a newer bridge could not have withstood the impact such as the two posts received.

Propose Law to Prevent Public Bidding on Municipal Work at Los Angeles

An organization intended for civic betterment, known as the United Improvement Federation, has drafted a drastic measure in an attempt to eliminate public contracting from the field of local municipal improvements at Los Angeles. The proposed amendment to the city charter makes unlawful the calling for any bids for street, sewer, water and similar city improvements and extensions. It proposes that such work be handled at actual cost by a municipal department organized and operated particularly for such purpose. Arranged in the form of a petition for property owners' approval for formal presentation to the city council and submission at a special election this month for the ratification of voters, the amendment reads as follows:

"No contract for the grading, regrading, paving, repaving, macadamizing, remacadamizing, construction of sewers or construction of sidewalks shall be entered into by the City of Los Angeles.

"This charter amendment to provide for the improvement by the direct employment of labor, purchase of material, of the streets, avenues, alleys, or other public places of the city, or for the construction or reconstruction in any public street, avenue, alley or other public place in the city, or in any right-of-way owned by the city, of sewers, drains, water and gas mains, lines and conduits for transmitting electric energy or telephone communication, and to make the cost thereof a lien and charge upon abutting property or upon property in the districts according to benefits.

"The foregoing charter provision and all ordinances, acts and procedure enacted, done or taken in pursuance thereof shall be valid and binding, anything in any law of the state heretofore or hereafter to the contrary notwithstanding."

Brooklyn-Brighton Bridge Opened September 30

The official opening of the Brooklyn-Brighton bridge at Cleveland was celebrated Sept. 30. As described in the Engineering Record of June 24, page 832, the structure has many features of unusual interest, among which are the use of unsymmetrical arch spans, necessitating unequal levels of springing lines. The total length of the bridge is about 1726 ft. It is made up of eighteen arch spans, six of which are of 139-ft. span.

Fellowship Established for Asphaltic Research

With the co-operation of Harvard University and the Massachusetts Institute of Technology, the Barber Asphalt Paving Company has established at these institutions a fellowship for research in asphaltic materials and their uses. The fellowship is to be known as "The Clifford Richardson Fellowship." Mr. Richardson, an alumnus of Harvard, has made many contributions to asphaltic highway construction and to the chemistry of bitumens.

The appointment of the incumbent of the fellowship and the choice of subjects for investigation, as well as the disposition to be made of the results of such investigations as may be undertaken, are to be decided by the institute faculty or the joint committees of the university and the institute having control of engineering work.

Hearing on Official Plan of Miami Conservancy District Last Tuesday

A hearing before the conservancy court at Dayton on the official plan of the Miami Conservancy District began last Tuesday. The program is that submitted to the district by Arthur E. Morgan, president of the Morgan Engineering Companies, and adopted by the board of directors May 10, 1916.

The hearing is of considerable interest and importance in that it deals with a flood-control project, the plans for which are to be tested before a court of nine judges acting under a new law, and by the examination of a number of consulting engineers.

It is expected that the close examination of this plan before the court will bring out the most complete and comprehensive compilation of data and discussion relating to a single flood-control project that has ever been developed.

Street-Cleaning and Refuse-Disposal Society Meets October 13

The second annual convention of the Society for Street Cleaning and Refuse Disposal of the United States and Canada will be held Oct. 13 and 14 in New York City. As announced in the Sept. 2 issue, the sessions will be held in the offices of the New York Department of Street Cleaning. The program includes papers on all methods of collecting dirt. An appropriate motion picture entitled "The Day's Work," will be shown by the Gaumont Film Company.

Prizes for Photographs Showing Merits of Concrete

Cash prizes for photographs illustrating the uses of concrete will soon be offered by the editorial bureau of the Portland Cement Association. In addition, all prints having a distinct value for advertising purposes will be purchased. Arrangements for the competition, which is open to all, are now under way. Further particulars may be obtained from the Portland Cement Association, 111 Washington Street, Chicago.

Would Build Transcontinental Highway in Canada

The Military Hospitals Commission, at its recent meeting in Toronto, passed resolutions to be forwarded to the government calling for the construction of a transcontinental road which would be modeled after the Lincoln Highway. The resolution calling for the construction of a national highway points out that work would be provided for thousands of unskilled men and for ex-soldiers returning after the war who could not otherwise find work at once.

Sanitarians Visit Electrolytic-Lime Sewage Plant

Nearly 100 men, including stockyard and industrial chemists, city officials, capitalists and sanitary engineers, on Sept. 30, at the invitation of the Electrolytic Sanitation Company, visited the 1,000,000-gal. experimental electrolytic-lime sewage-treatment plant at Decatur, Ill. The plant, which is similar to the one at Elmhurst, L. I. (see Engineering Record Sept. 12, 1914, page 292; Sept. 19, page 315 and Oct. 17, page 429), consists of an electrolytic machine in which the sewage remains one minute, a lime-charging outfit, a hopper-bottom settling basin of ½-hour capacity, and a Johnson sludge press. The machine contains twenty-two banks of electrodes consisting of forty-eight 10 x 16-in. iron plates 3/16 in. thick. The plates are ⅝ in. apart, and between each plate are two revolving paddles which agitate the sewage and keep the surfaces of the plates clean without touching them.

Current is supplied at a constant rate of 40 volts and 70 amperes. To turn the paddles requires 1200 watts. The average lime applied for the official test period of one month was 2846 lb. per 1,000,000 gal. The resulting sludge amounted to 4½ tons dry, in which it is claimed there are from $5 to $8.79 worth of fertilizer values per ton. The 4,000,000 gal. of sewage from the city of 45,000 people contains 750,000 gal. per day of waste from a starch factory, which has in it a large amount of sulphurous acid. The average suspended matter was 467 parts per 1,000,000.

The Effluent

The effluent, as described in a leaflet furnished by the company, "has a yellow color and a slight odor peculiar to the waste and to lime, but it is not disagreeable. The color is due to the action of the excess of lime on the protein content of the waste. The effluent containing this starch waste is not stable in the ordinary accepted terms, but when exposed to the air it does not become offensive or putrid, and loses its odor in a few days. When the starch waste is absent, or is highly diluted, the stability test by methylene blue shows a stability of 100."

After settling for one hour the bacterial and suspended matter removal was reported to be slightly more than 95 per cent in both cases. Comparative results on one-half and one-hour periods of sedimentation in the nitrogen content are shown in the table:

COMPARATIVE RESULTS

	½-hour period	
	P.P.M.	Per cent of raw sewage
Free ammonia	9.28	51 reduction
Nitrates	0.188	269 increase
Nitrates	0.999	97 increase
Total organic	65.4	14 reduction
Oxygen consumed	331.8	16 reduction

	1-hour period	
	P.P.M.	Per cent of raw sewage
Free ammonia	11.3	43 reduction
Nitrates	0.234	333 increase
Nitrates	1.06	63 increase
Total organic	62	23 reduction
Oxygen consumed	383.8	19 reduction

No results of stability were reported by the biochemical method and no results were given showing what the plant would do were the same amount of lime whipped into the sewage without the electric current.

Waterworks Men Will Open Joint Convention Next Week

The joint meeting of the Iowa and Illinois sections of the American Waterworks Association Oct. 11 will be preceded by a one-day convention of the Iowa division in the Hotel Blackhawk, Davenport, Iowa. The morning of Oct. 10 will be devoted to a round-table discussion by the Iowa members of problems relating to satisfaction of water consumers, leaks in river crossings, cleaning of water mains and pumping economy in small plants.

A paper on an inverted siphon in a suction line, by Karl C. Kastberg, city engineer of Des Moines, will be presented at the afternoon session. J. H. Dunlap, professor of hydraulics and sanitary engineering at the State University of Iowa, will speak on "The Sanitary Drinking Fountain." J. M. Lewis, commissioner of waterworks and parks, will speak about the Sioux City booster station, and Earl T. Kirkpatrick, of the Des Moines Water Company, will tell of his company's experience in handling bad-water complaints. The purification of the Missouri River water is the subject on which J. B. Thornell, of the Council Bluffs waterworks, will address the meeting. Papers on swimming-pool operations and the Tri-City water plant are scheduled for presentation in the evening.

The Iowa men will join the Illinois section Wednesday at the filter plant of the Rock Island arsenal, following which an inspection will be made of pumping stations and filter plants in the vicinity. At the dinner to be held that evening in Moline Leonard Metcalf, president of the American Waterworks Association, and Mayor Martin R. Carlson will address the convention.

St. Louis Municipal Bridge Nears Completion

THE popular joke that St. Louis has the longest bridge in the world—"one without an end"—ceased to be a fact Friday, Sept. 22, when the last panel of girders connecting the eastern railway approach to the channel spans of the municipal bridge was set in place. There remain to be erected the highway portion of the eastern combined approach and approximately 1⅓ miles of the eastern railway approach, including one 184½-ft. and one 227 ft. 3-in. span. It is expected to have all foundation work finished before cold weather. The concrete base for the roadway paving is complete on the west approach and the channel spans. Also, on the west approach, the sidewalks are in place and the wood block paving is well under way. The concrete base for the paving of the roadway on the east approach is progressing rapidly.

The work is being done by the city of St. Louis under the direction of Clinton H. Fisk, chief engineer of construction, Board of Public Service, and William F. Collar, general superintendent. Boller, Hodge & Baird of New York City are the consulting engineers, and Brenneke & Fay of St. Louis are resident engineers. A. R. Ross, engineer in charge, furnished the information and photographs. A description of the job appeared in the Engineering Record of June 10, 1916, page 760.

$100 for Best Letter on Use of Hydrated Lime

For the best letter on the use of hydrated lime in concrete construction $100 will be paid; for the two next best letters, prizes of $50 and $25 are offered by the National Lime Manufacturers' Association. All letters not returned to their authors will be paid for at the rate of $5.

The problem consists of writing a 500-word (or less) letter on the use of hydrated lime in some specific concrete operation. Photographs are desirable, but not necessary. All letters are to be signed and mailed to reach E. J. Mehren, editor of the Engineering Record, by Dec. 6. Further details can be obtained from the hydrated-lime bureau of the National Lime Manufacturers' Association, Arrott Building, Pittsburgh.

Tentative Program for Irrigation Congress Arranged

A tentative program has been arranged for the twenty-third International Irrigation Congress, to be held Oct. 14 to 19 at El Paso, Tex. The first day will witness the formal dedication of the Elephant Butte dam. The following Monday, which will be devoted to the appointment of committees, has been set aside as a special day in honor of governors of states and representatives of foreign countries. The irrigation-districts section will meet on the third day under the direction of A. L. Cowell, past secretary of the California Association of Irrigation Districts. Dr. John A. Widtsoe, president of the University of Utah, will preside at the session of the irrigation-practice section. That afternoon and evening will be devoted to "rural credits and land settlement" and a conference between water users and representatives of the U. S. Reclamation Service.

The sessions of the members interested in irrigation legislation and drainage and irrigation engineering will be held Wednesday.

Chicago Cement Show Will Be Held February 7 to 15, 1917

Feb. 7, 1917, has been selected as the opening date of the tenth Chicago cement show, which will be housed in the Coliseum and annex. Several conventions to be held in Chicago at approximately the time of the cement show give promise of that city being the center of activity of the building industry in February. As only the Coliseum and annex will be used, the exhibits will be more concentrated. Exhibitors are asked to apply early for the smallest space in which they can display their materials.

The National Builders' Supply Association, Illinois Lumber & Builders' Supply Dealers' Association, American Pipe & Tile Association, American Concrete Institute and American Association of Engineers are among those that will probably convene in Chicago early in February.

Engineering Society Activities

At the American Society of Civil Engineers' Oct. 18 meeting, a paper by J. B. Lippincott, consulting hydraulic engineer, of Los Angeles, on "A Method of Determining a Reasonable Service Rate for Municipally Owned Public Utilities" will be presented for discussion.

The Detroit Engineering Society will hold a meeting Oct. 20, at which Frank B. Gilbreth, expert on management and time-study work, will give an illustrated lecture on those subjects. Last evening the society heard C. W. Hubbel discuss sewage disposal and contamination of the Detroit River.

The Oregon Society of Engineers recently entertained as its guest A. N. Johnson, formerly of the Illinois State Highway Commission and now chairman of the New York Municipal Bureau of Research. Mr. Johnson addressed the club on road work and legislation.

The Committee on Engineering Co-operation at the second annual conference held in Chicago last April adopted a resolution providing for a sub-committee composed of four men selected by the chairman to act with him in the preparation of a plan to be submitted for consideration at a third conference called for the purpose. Conforming to the instructions in this resolution, F. H. Newell, chairman of the committee, has named Hunter McDonald, Isham Randolph, M. L. Cooke and C. E. Drayer as members. A first draft of a plan is in the hands of the sub-committee, which will probably meet during the next month for further consideration of it.

The Colorado Association of Members of the American Society of Civil Engineers will hold a joint meeting this evening with local sections of the American electrical and mechanical engineering societies. Westinghouse steam railroad electrifications of several large railroads will be described and illustrated by motion pictures. S. G. Porter, secretary of the Calgary branch of the Canadian Society of Civil Engineers, will discuss irrigaton development in Western Canada.

What Engineers and Contractors Are Doing

J. W. EVANS, who for the last three years has been employed by the bureau of lands of the Philippine government, was recently appointed instructor in the civil-engineering department of the Oklahoma Agricultural and Mechanical College. That institution is broadening the scope of its engineering courses and increased attendance has necessitated additions to the faculty. Mr. Evans' work in the Philippines was in the execution of cadastral surveys in the province of Occidental Negros.

ALBERT L. UPHAM has resigned from the employ of the Dunn-McCarthy Company, contractors, of Chicago, to become inspector for the Indiana Concrete Roads Association, with office at Bloomington, Ind. Previous to his employment by the Dunn-McCarthy Company Mr. Upham was with the Cuban Portland Cement Company.

G. W. STICKNEY, formerly in charge of designs in the paving department of the bureau of engineering of Syracuse, N. Y., has been appointed chief engineer for the Rivers and Lakes Commission of Illinois, with headquarters at Chicago. After graduation from the University of Maine in 1900 he was employed by the J. W. Bishop Company for about a year, following which he entered the employ of the Metropolitan Water and Sewage Board of Boston. During his service with the board Mr. Stickney took part in the work of constructing the Wachusett dam at Clinton, Mass. From 1904 to 1915 he was engaged on New York State Barge Canal work as leveler, assistant engineer and resident engineer. He resigned in 1915 to enter the bureau of engineering of Syracuse, N. Y.

IRA B. LANPHIER has left the employ of the maintenance-of-way department of the Illinois Central Railroad to become assistant in the civil-engineering department of the University of New Mexico. Mr. Lanphier was graduated from South Dakota State College in 1915 and received his C.E. degree this year. He has spent his time since then in the employ of the Illinois Central. Several buildings are now under construction at the university, he says, whose architectural design has, for the sake of economy and general artistic effect, been based on that of the Pueblo Indians.

PROF. A. B. MCDANIEL, whose resignation as assistant professor of civil engineering at the University of Illinois was briefly announced in the June 24 issue, has assumed his duties as assistant professor of civil engineering at Union College. Professor McDaniel was graduated from Massachusetts Institute of Technology in 1901, following which he was employed by the American Bridge Company. After about two years' experience as draftsman for several engineering companies he was in 1903 made structural engineer for the Fort Pitt Bridge Works. That was followed the next year by his appointment as assistant engineer on the East River division of the Pennsylvania Railroad tunnels at New York City. Two years later he first turned his attention to educational work as instructor in civil engineering at the Case School of Applied Science. He resigned the following year to become professor of civil engineering at the University of South Dakota, in which position he served for one year. During his residence in South Dakota Mr. McDaniel established the Missouri Valley Engineering Company, of which he was president from 1907 to 1912. From 1909 until last June he was a member of the faculty of the University of Illinois. He is the author of a book on "Excavating Machinery" and has contributed a number of articles to the engineering press.

JOHN S. CARPENTER, who has been with the Pelton Water Wheel Company as hydraulic engineer for the last eight years, is now designer of hydroelectric power plants for the Fargo Engineering Company, of Jackson, Mich.

HOWARD E. STEVENS, whose promotion from bridge engineer to chief engineer of the Northern Pacific Railway was noted in last week's issue, was graduated from the University of Maine in 1897. For two years thereafter he was employed by different bridge companies, becoming associated with Ralph Modjeski, consulting engineer, of Chicago, in 1899. After four years with Mr. Modjeski, Mr. Stevens entered the employ of the bridge department of the Northern Pacific, and four years later he became bridge engineer.

W. L. DARLING, whose resignation as chief engineer of the Northern Pacific Railway was noted in last week's issue, will in the near future open consulting offices in St. Paul for the practice of general railway engineering and construction. Mr. Darling's experience in his field covers a period of thirty-seven years. His first employment was in 1879 with the railroad from the head of whose engineering department he has just resigned. Three years later he went to the St. Paul & Northern Pacific Railway as resident engineer, from there to the Chicago, Burlington & Quincy and then to the Florida Railway as locating engineer. Mr. Darling turned his attention to the solution of terminal problems in 1885 and for the next two years was in charge of the Chicago terminals of the Chicago, Burlington & Northern. A brief experience as chief engineer of the Duluth, Watertown & Pacific preceded his appointment with the St. Paul, Minneapolis & Manitoba in 1887, which he left two years later to return to the Northern Pacific as assistant engineer. He was soon promoted to principal assistant and later to assistant chief engineer and in June, 1901, was made chief engineer of that road. Three years —1902 to 1905—were spent as chief engineer of the Rock Island system and a few months of 1905 as chief engineer of the Pacific Railway. Early in 1906 Mr. Darling returned to the Northern Pacific as chief engineer.

CARL H. REEVES, consulting civil engineer, of Seattle, has been retained by the city of Bothell, Wash., to handle matters pertaining to municipal improvements, particularly paving, which is now before the council of Bothell.

A. B. CLARK, assistant engineer maintenance of way of the Pennsylvania Railroad at Philadelphia, has been promoted to succeed J. M. James as superintendent of the Renova division. Mr. Clark's promotion comes after twenty-seven years of continuous service with the Pennsylvania, whose employ he entered in 1889.

C. H. NIEMEYER, formerly division engineer at Pittsburgh, has been made assistant engineer maintenance of way of the Pennsylvania Railroad at Philadelphia, to succeed A. B. Clark, promoted.

HERMANN A. PHILIPPI, formerly superintendent of construction in the U. S. engineer's office at Vicksburg, Miss., has been made superintendent of the Miller Engineering Company of Little Rock, Ark. He will have charge of the construction of dam 2 on the Ouachita River, Louisiana. Mr. Philippi previously had charge of construction on the Big Sunflower River, Mississippi.

AUSTIN H. REEVES, of the New York office of the Southern Power Company, has been promoted to fill the position made vacant by the transfer of E. A. Van Deusen, noted elsewhere in this issue.

C. N. PHILLIPS, formerly assistant engineer to T. W. Jaycox, consulting engineer, of Denver, has joined the forces of the Morgan Engineering Companies at Dayton, Ohio.

Obituary Notes

MAJOR WILLIAM G. RAMSAY, a vice-president and director of E. I. du Pont de Nemours & Company and chief engineer of its construction department, died Sept. 28, at Wilmington, Del. He was the principal factor in the physical development of the du Pont plants caused by the extraordinary demands put upon the company by the European war. Major Ramsay built many explosive factories throughout the country and recently was engaged in the construction of a plant in Montana which will be named in his memory. He was born in San Francisco in 1866 and was graduated from the civil engineering department of the University of Virginia in 1887. His first engineering work was as division engineer on the Chesapeake & Ohio Railway, which was followed by his appointment as resident engineer on the Baltimore & Ohio Railroad. His first connection with the powder business was when he became general agent for the Repauno Chemical Company, makers of high explosives. During the Spanish-American war he joined the engineering corps and rebuilt many bridges and roads in Porto Rico, for which he was promoted to captain and later to major.

JOHN CAMPBELL OLIPHANT, civil engineer, formerly of Trenton, N. J., died at his home in Toledo Sept. 29 at the age of 69. He was for many years employed by the Pennsylvania Railroad and was at one time resident engineer of the Pittsburgh division of the Baltimore & Ohio Railroad. He had also taken part in railway construction in Mexico. For the last few years Mr. Oliphant has been associated with the engineering department of Toledo.

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British Standards Committee

THOSE who are familiar with the organization and excellent work of the American Society for Testing Materials will read with interest the article elsewhere in this issue on the plan, scope and accomplishments of the British Engineering Standards Committee, which does for the United Kingdom and the British Empire what our American Society for Testing Materials does for us. While it is gratifying to note the wide scope of the British organization, it is equally a cause of satisfaction to observe that our own society is still in the lead. Wherever a good direction is indicated in the British work, there too have we been working. It is interesting, in view of recent movements in this country, to know how keenly British engineers realize the relation which their work bears to the industrial progress of their country. Industry, fundamentally, is engineering and chemistry—the technical arts—and our British brethren are keeping this fact clearly in mind. Possibly this realization was not so clear-cut before the war as it is now. At any rate, the relation is now thoroughly understood.

Motor Trucks in Mexico

WHEN the punitive expedition under General Pershing was sent over the Mexican border last spring and the use of the Mexican railroad for United States' troops was denied, it became necessary to supply the entire force by means of motor transportation. The experience gained in the south foreshadows the passing of the army mule as the mainstay of military traffic. What motor trucks have done in Mexico was touched upon briefly by Captain Arthur P. S. Hyde, U. S. A., in a paper presented at the recent annual meeting of the Washington State Association of County Engineers in Tacoma. Until the War Department purchased hundreds of motor trucks for use in Texas and Mexico there was, Captain Hyde reports, considerable difference of opinion as to the relative value of mule-drawn wagons and motor-propelled trucks. The Mexican experience, however, has demonstrated conclusively the value of the motor truck for army service. Captain Hyde says: "It is unquestionably true that the motor truck as a means of military transportation has come to stay. While there will still be mule-drawn wagons accompanying troops and used for the distribution of supplies between various units, yet the connecting link between the army in campaign and the base of supplies at the rail-head will unquestionably be largely by motor trucks." He cites also an interesting experiment tried recently in the use of motor transportation for the handling of troops. The Second Kansas Infantry on duty at Eagle Pass, Tex., was transported in one day by motor trucks to San Antonio, a distance of 150 miles. Had this regiment proceeded by marching, the distance could not have been covered in less than a week's time, and ten days would not have been unreasonable. The roads of Texas are not remarkable for their excellence either. This little sidelight on the Mexican campaign carries with it a lesson for contractors as well as for army men.

Belt Floats for Roads

SO thoroughly have methods of concrete road building been studied and standardized for several years past that there would appear to be no room for the development of new details. Nevertheless the use of an 8 or 10-in. belt, worked back and forth like a strike board, as described in the article on page 481, seems to be an innovation deserving of more than passing notice. After Mr. Bushnell's story was received the Engineering Record was informed that the same procedure had been used with success and profit in Wayne County, Michigan, and further that in California a thin, flexible redwood strip, ⅜ in. thick, has been employed for the same purpose. In Michigan finishers are still required to handle the surface at the joints. On the Illinois road there are no joints, so that the method is all the more applicable. We are not informed as to the California work, but many miles have, in the past, been laid without joints. Anything that saves the contractor the grief of keeping high-grade finishers on the job will be appreciated.

Meddling by City Fathers

PHILADELPHIA last week was treated to the spectacle of a joint special committee of City Councils passing judgment upon a proposed ordinance regulating the sale of water by meters. John C. Trautwine, Jr., was present at the meeting and characterized its deliberations in these words: "A score or so of men sat for an afternoon darkening counsel by words without knowledge and hearing pleas from self-seeking manufacturers who are getting their water far cheaper than in most other cities, but who are nevertheless panic-stricken when the city proposes to add a fraction to what must be a very small proportion of their outlay." Speaking for the Engineers' Club of Philadelphia, Mr. Trautwine contended, in effect, that the working out of the details of a new water schedule was none of the City Councils' business. With this statement of the case the Engineering Record is in hearty accord. Philadelphia, as well as most other cities, has a department of public works numbering in its personnel engineers of recognized ability. The formulation of a scale for water charges is a job for the department of public works and not City Councils. In fact, Mr. Trautwine contended that Councils, in considering the proposed water ordinance, were impertinently usurping powers placed elsewhere. In addressing the city fathers Mr. Trautwine did not mince words. "Whether or not your committee agrees with me that the charter does take these matters out of your hands, and does leave them in the hands of the department of public works, your committee must, I am sure, agree with me that it should do so. The salaries paid to your members by the city for their services are hardly sufficient to justify the city in expecting, at your hands, that expert knowledge which alone can entitle them to pass upon matters of this kind." It is high time that aldermen, councilmen and all the rest of the gentry whose names are bedecked with the prefix of "The Hon." should be prevented from dabbling in matters about which they know nothing.

Goethals and the Eight-Hour Law

RETURNING to the States last month, General Goethals told the newspaper men who inquired about his plans for the future that his mission here was "to look for a job." He was not long in finding one—and a pretty big one, too. His selection by President Wilson as a member of the commission to report upon the working of the newly enacted eight-hour-day railway legislation will insure a sound-minded, impartial judgment of the merits of the case. Whether or not the task is to General Goethals' liking it is impossible to say. "I am a soldier and can do nothing but obey the orders of my superior officer." This, the papers state, was the cryptic reply to questions regarding his opinion of the appointment. Nevertheless, it is well that a man of his caliber and training is on the commission. He enters upon his important duties not as a theorist but as an executive, who, at Panama, has had to deal with all phases of the labor problem at close range. Unlike some of our legislators at Washington, who, on all sorts of public questions, have exhibited a tendency to rush in where angels fear to tread, General Goethals is qualified to render an intelligent opinion. No man with his training could have any delusions as to what the "basic eight-hour day" really means. To engineers the appointment is particularly gratifying. Himself an engineer, the Panama Canal builder has demonstrated how problems of national importance may be efficiently handled by the right kind of technically trained man.

Paving Petitions—The Right Kind

UNDER the title, "Who Should Select the Pavements?" this journal on July 8 of this year scored the practice which allows citizens to determine what type of paving they shall have in front of their property. It condemned the practice, not only because property owners are not competent judges of types of pavements, but also because manufacturers and promoters of paving materials use the system for their own benefit, regardless of the suitability of their materials for the location in question. Engineers, generally, if they had their way, would put full control of this matter in the city's engineering department. There all the factors would be properly weighed. Political scheming and the influence, legitimate sometimes, illegitimate oftener, of the materials manufacturers prevent the general adoption of the plan. Some cities have already eliminated politics, and that means manufacturers' chicanery and promotion, from their pavement-extension work. One eastern city, which is under the commission form of government, has already adopted a rule that no petitions will be received or considered by the commission which name the type of pavement the citizens want. The petition may merely ask that a new pavement be laid. It is for the commission, advised by its engineering forces, the intelligent citizens of this community agree, to determine what pavement is best under the given conditions. This is a paving petition of the right kind. Its adoption deserves to become universal.

Water-Supply Prodigality

WHEN any town shows such an abnormally high water consumption as 665 gal. per capita daily it is clear that "something should be done." In the case of Tonawanda, N. Y., recently investigated by engineers of the National Board of Fire Underwriters, this "something" is nothing more than the well-known remedies of meters and tight pipe joints. The population of the town is only about 9000. In casting about for an explanation of the excessive amount of water used it would be natural to conclude that a very large commercial use of water is accountable, in part at least, for the high figure. This answer, however, is not satisfactory. It appears from the report of the fire underwriters that the excessively high per-capita rate is due largely to leakage, for during the night hours there is only a small decrease in pumpage as compared with day pumpage. The lack of action on the part of the city in reducing the enormous waste indicated by the high consumption has resulted in fire protection being seriously reduced, and will, according to the report, necessitate large expenditures that otherwise would be needless. In view of the fact that Tonawanda's water supply is not a gravity supply but is entirely delivered by pumping, it would appear, in the interest of economy, that a wholesale campaign of metering and leakage prevention should be undertaken at once. The present prodigality should not be tolerated.

Running History of an Engineering Design

RECENTLY a representative of this journal was shown a loose-leaf binder in which were kept records of the development of the design of an industrial plant—rough notes and sketches which recorded reasons for various decisions as to layout, details of construction, etc., and named the authority for each decision. Some structural engineers always take the time to keep such notes on each job. This is excellent practice, and to be heartily commended, even if not new. Memory is a treacherous resource when future difficulty or perhaps serious trouble arises. Wholly aside from the benefit of accuracy of record, it tends to insure that careful consideration of details which results in the best possible structure. The practice may be applied in every field of design and construction.

The notes have an additional valuable use—the preparation of reports and descriptive articles. The chief engineer of a large bridge company recently suggested that young engineers be urged by their superiors to write about their work, and even that some incentive be offered. He contended that it would not only develop facility in the use of technical English, but would give the young men an understanding of the broader aspects of their work and of its relation to other construction of a similar nature. Such an understanding should result in bringing new enthusiasm to tasks that threaten to become monotonous. As a basis for articles, a running history of the development of the design is invaluable.

It cannot be urged too strongly that every engineer keep such a record as outlined and use it as a basis for contributions to technical or society publications. Information on the reasons for the selection of types of structure, component parts and details leads, even though every problem is in a class by itself, to a more thorough understanding by designers of the principles upon which good design depends.

The day of individualism in the profession has long passed, and except within the limits of really new discoveries, no man should keep to himself improved methods or details. The profession as a whole can advance only as each member contributes to the fund of technical knowledge.

Straight Thinking on Reclamation Service Problems

WHEN the cost review boards were appointed by the U. S. Reclamation Service last year it was the opinion of this journal that the step was another move in the direction of repudiation, of a part at least, of the project costs. Certainly on the projects themselves this was the interpretation placed upon the creation of the boards.

The event fortunately has not realized the expectations. Engineers, of course, knew that with two such men as Brig.-Gen. William L. Marshall and Dr. Elwood Mead on the Central Board of Review the findings would be judicious. They have not been mistaken. Instead of the huge cost reductions hoped for by the agitating elements in the West, rumor has it that the central board has recommended reductions of only about 10 per cent. Reductions have been recommended only where warranted. Each proposal of reduction has had to bear the searching inquiry of two very able engineers.

The Engineering Record has already commented upon one of the reports of the central board—that reviewing the Carlsbad project. Now there appears the report on the Shoshone project. While, fortunately, the board was not forced into the caustic comments which were demanded in reviewing the findings of the local board at Carlsbad, the Shoshone review contains an equal amount of common sense bearing on the proposal of cost reductions. For example, the report says:

"We do not agree that the just or effective method of extending aid [to settlers who have faced unsurmountable difficulties] is through reducing project costs. Such action would be a donation of public money to water users already enriched by the enterprise, not in need of aid, and not entitled to it. It would be the repudiation of an obligation to the government without any adequate justification."

And further we read: "A reduction in project cost is simply a donation. It does not give to those in need of assistance the amount required or in the form required."

We have no doubt that the publication of these reports in the *Reclamation Record*, a medium through which they will receive wide distribution in the arid sections, will do much to squelch the speculators and the agitators—and they are one and the same crowd—and bring home to all water users a keen sense of their legal and moral obligations to the government.

Snubbing the Other Eighty Per Cent

A SIDELIGHT on the recent struggle between the railroads and the brotherhoods, resulting in the so-called eight-hour law, is set forth in a report just issued by Robert T. Frazier, Jr., originator of the petition of "the other 80 per cent." Those who read in the Engineering Record of Aug. 12, page 189, of the movement started by Mr. Frazier may have wondered that so little was heard of it when the controversy reached the acute stage late in August. According to Mr. Frazier's report the signatures, 105,000 of them, were obtained and during the entire conference period Mr. Frazier and an associate were at Washington patiently seeking a hearing of a few minutes to present their petition. The President denied them the hearing. As he put it in a letter to Mr. Frazier, it was "really impossible for him to have personal interviews."

This journal does not know how clear Mr. Frazier and his associate had previously made it to the President's outer guard that they were there not as individuals but as representatives of a large group of men. The letter concerning "personal inter-

views," however, was in response to one from Mr. Frazier setting forth his errand clearly, so the President must have understood by that time. It is interesting, too, to note that the letters were dated Aug. 30 and 31, while the dates of the President's special message to Congress and the passage of the Adamson law were Aug. 29 and Sept. 1 respectively.

As the Engineering Record suggested when it announced the 80-per cent movement two months ago, it is unfortunate that it was not inaugurated a month earlier. A petition with 500,000 or 1,000,000 signatures could hardly have been so easily ignored, especially if it had obtained a goodly amount of newspaper publicity, as this one did not. The failure of the movement to help in the crisis just passed does not mean, however, that the efforts were wasted or that the issue is dead. In his letter of Aug. 30 to the President Mr. Frazier suggests that "the 80 per cent must of necessity organize and present their demands for recognition and protection." Whatever form this organization may take—and this journal hopes and assumes that it will never emulate the peremptory demands of unionism—it can confidently be predicted that the other 80 per cent will be heard from further, and that the snubbing they received at Washington will quicken their action.

A New Relation Between Engineers and Pure Scientists

LAST week we took occasion to call attention to the very rapid strides being made toward professional unity and toward the co-operation of engineers with other classes of citizens in public projects. Now comes the very important announcement, detailed in the news section of this issue, that the Engineering Foundation is lending its financial support to the work of the National Research Council, appointed, at the request of President Wilson, by the National Academy of Science. The step holds tremendous possibilities for the welfare of our country. It spells a new era in the relation of the pure and the applied scientists and shows that for the present at least the course of the Engineering Foundation has been determined.

The purpose of the National Research Council is to mobilize the scientific work of the entire nation for peace no less than for war. Its scope is necessarily wide. The questions needing answer are many. What are our research agencies? What are their characteristics, their excellences, their limitations? What changes are needed? What new agencies must be provided? What new relations must be established? What shall be the machinery for exchanging information? What are the problems that need solution? How much has already been done? What gaps must be filled by new research? What agency is best fitted to carry on the work? What groups of pure or applied scientists can co-operate in and further the investigation? These are some of the problems that offer themselves to the council. That they must be answered if our nation is to be truly efficient, only those fully realize whose connection with research work has disclosed duplication, inefficiency and lack of data on essential phases of important problems.

That the body is qualified to handle big problems its personnel clearly shows. Not only are the members leaders in their specialties, but most of them represent powerful bodies of engineers and pure scientists. From every organization which can contribute to the success of this mobilization of the scientific brains of the country co-operation has been assured. The National Academy of Science, the American Medical Society, the American Association for the Advancement of Science, all the great chemical bodies, all the leading national engineering societies, and the industries which have led in research are represented by members or officers. At the same time these men represent particular specialties and will bring to the work of the council the varied experience which will guarantee for every problem the broad consideration necessary in order that its full bearings on the military and the industrial future of our countries may clearly be seen.

The significance of the council's foundation from a national point of view can hardly be overestimated. We have been a prodigal nation. We have wasted our natural resources. In the rush for profits we have skimmed the cream and thrown away millions in waste. Our standard of efficiency was set at an immediate gain, without regard for the future and for the scientific efficiency of the performance. And yet, as a nation, we prospered. We were living in a garden, or, as a German student of American conditions has expressed it, in a gold mine. The country was rich and was developing rapidly. The market was large. Initiative was the chief asset needed for success. Now the conditions are different. Our own market has, relatively, narrowed, for there is more competition, and that competition has forced economies and waste utilization never dreamed of twenty-five years ago. With narrowing home markets comes the temptation—in fact the need, if we are to have a stabilized industry—of getting foreign markets. There we have encountered a German competition—a competition based on scientific analysis of products, and even of foreign finance and selling methods. Engineering and scientific research have thus been forced upon us. But as yet we are working, in large part at least, as individuals or as groups. How much duplication there is, how large the gaps in our scientific researches, whether military or industrial, what opportunities for co-operation are lost, no one can know. Now we propose to find out—to mobilize our research activities, to bring individuals and groups into contact with others who are working on the same or allied problems, to the end that when figured on a national basis our efficiency rating will be high, our military resources and industrial organism second to none.

But these remarks refer to the origin and scope of the council itself. What of the co-operation which it establishes between the engineer on the one hand and the pure scientist on the other? Between the pursuits themselves—pure science and engineering—the relation is necessarily close. In fact, it is hard to tell where the one ends and the other begins. The one term, "scientific research," properly covers investigations whether along engineering lines or those of pure science. The scientists form the advanced guard of the industrial army. They do the pioneering work. They extend the bounds of human knowledge and leave to the engineers who follow the development, along practical lines, of the principles they discover.

As far as the intrinsic relationship between pure science and engineering is concerned, there is no need that a new bond be formed. The pursuits themselves are closely drawn together—not always so, however, the men themselves. The relationship established between the engineers and the pure scientists through the co-operation of the National Academy of Science and the Engineering Foundation will be as it was, "the outward sign of an inward grace," that will be to every engineer and to every scientist a keener appreciation of the closeness of the relations of their occupations. New vistas will thus be opened before each class of workers. The engineer will be the more ready to turn to his strictly scientific brethren for assistance; the scientist more eager even than now to direct his resources along lines that are most likely to turn over to the applied scientists material which will aid them in solving their practical problems.

Finally, the action of the Engineering Foundation in offering its financial support and the services of a secretary to the National Research Council indicates that the foundation has determined upon at least one of its lines of activity. It has been importuned to support particular researches of many different kinds. Many of the suggestions were admirable, but each looked to the solution of only one small problem that confronts the scientific and the engineering world. Rather than spend its substance on the solution of these individual problems, no matter how praiseworthy such activity might be, the foundation has chosen to promote research broadly.

In reaching this decision the Engineering Record believes that the Engineering Foundation has acted wisely. We can conceive of no better direction for its activities than the raising of the efficiency of all the scientific research of the country. If the National Research Council realizes the high hopes which we entertain for it, that end will be brought about. Fortunately, men of affairs, who have brought large enterprises to a successful conclusion, as well as those distinguished in scientific research, are interesting themselves in the work. Their participation is a guarantee that the council will accomplish what it is setting out to do. The very best wishes of the scientists and engineers of the entire country go with them in their endeavors and will undoubtedly be backed by all of the co-operation which the council will ask from them as individuals and through their societies.

SCENIC BEAUTY OF GORE CAÑON ROAD OFFSETS NARROWNESS

FORD FOR DRY ARROYOS CARRIES DÉBRIS OVER ITS TOP

Disintegrated Gravel, 1000-Mile Tour Shows, Is Best Natural Highway Material in Colorado

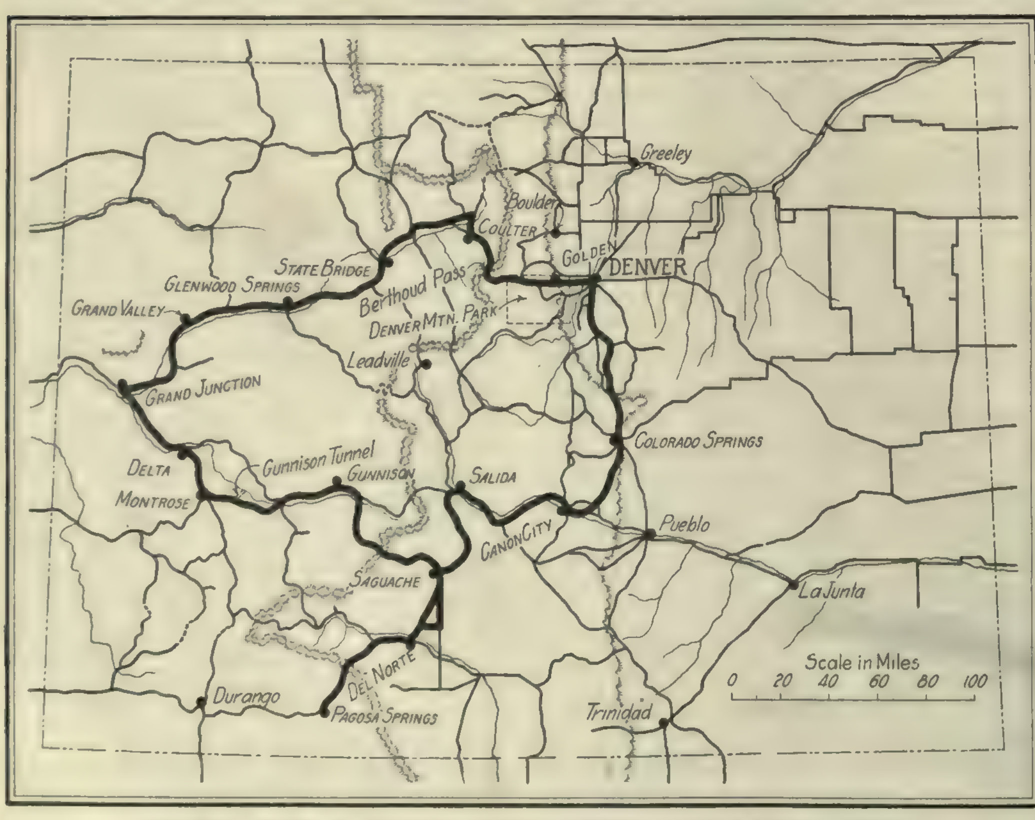
Large Mileage, Using Metal at Roadside, Is Like Boulevard—Most Important Elements in Maintenance Are Adequate Drainage and Sloping of Surface Downward Toward Uphill Side

By W. W. DE BERARD
Western Editor, Engineering Record

COLORADO has 6000 miles of state roads, and a trip over 1000 miles of them, mostly in the mountains, was made recently by the state highway engineer, J. E. Maloney, T. J. Patterson of the Hardesty Manufacturing Company, and the writer. With few exceptions no detailed studies were made, as the general impression on the ultimate user and conditions at points where this season's work has been prosecuted were desired. Furthermore, the trip was made in a week, involving night driving when visual inspection was limited. The itinerary covered the Rainbow Route, west of Colorado Springs, to Grand Junction, a side trip to Pagosa Springs from Saguache and a return by the Midland Trail up the Grand River and over Berthoud Pass.

The enormous mileage of roads in boulevard condition made from material found at the roadside was the most noticeable feature of the trip. Drainage and the sloping of the road toward the bank on side-hill work easily outweigh all other mountain-road precautions. Two or three experiences on a slippery side-hill road with 1000 ft. of sheer cañon wall below leave no doubt in the mind of the automobile driver as to the proper abode for the road builder who overlooks these vital points.

We started from Denver—and by the way, Denver has many miles of disintegrated-granite-and-slag-paved residential streets which continual watering and an occasional reshaping keep in excellent condition, although why oiling has not been resorted to in this dry climate where water is so expensive and evaporates so quickly is a pertinent question. Oil-company experts tried it once and made a mess of it, they tell you, so no one else has had the temerity to experiment again.



PRINCIPAL ROADS IN COLORADO—ROUTE COVERED IN TOUR SHOWN HEAVY

CLAY-GRAVEL ROADS

The itinerary carried us first to Colorado Springs over 75 miles of clay-gravel roads in almost perfect condition. In spots this road had recently been scarified, reshaped and redressed with 2 in. of pea gravel, a procedure costing approximately $800 per mile for an 18-ft. roadway. Over clay it is the practice to place 4 in. of gravel the first year, let the traffic work it in and then apply 2 in. the second year. By the third year the road is likely to require scarifying, reshaping and the addition of 2 in. of gravel. This road, which is part of the Great North and South Highway paralleling the eastern foothills through the state, is so much traveled (we encountered more than 110 machines in the 2¼ hours of running) that all three counties—Arapahoe, Douglas and El Paso—are making a special effort to keep it in shape. Two years ago most of it was regraded, and it is now dragged after every rain. Maintenance costs about $50 per mile per year.

Colorado Springs is entered over a stretch of Tarvia-covered, disintegrated granite in fair condition. One gallon was applied three years ago, ½ gal. last year and something will have to be done this season, for the pavement shows the patchy appearance seen in Denver, but it certainly is not impossible to repair.

CONCRETE FORDS

Ten miles from the Springs on the way to Cañon City the road starts up the mesa on 6-per cent ruling grades and minimum 30 ft.-radius curves. Twenty-eight miles of relocated road was built by convict labor

and opened in 1912, since which time much of the clay has been graveled. Constant maintenance has given it a smooth, compact surface, wet or dry. The natural material on the ascent is red disintegrated granite, which packs quickly under traffic, and requires dragging only to keep it in excellent condition. The road is 16 ft. wide and has inside longitudinal drainage on sidehills to culverts under the roadway.

Another 10 miles on the way to Cañon City we came to a concrete ford to carry water from a dry run over the roadway. This ford, like the one at the end of the convict work above Cañon City, shown in the photograph, has a small opening to pass the ordinary storm flow. Heavy downpours bring much débris, and in the higher altitudes winter snowslides are so destructive of bridges that the ford is the only feasible solution for a permanent structure. The precaution of ample protection from undercutting for the downstream side is usually attained by placing large rocks for the water to fall on.

Over the first auxiliary range the fertile irrigated Arkansas River valley spreads out in panorama. Very soon the difference in natural road materials is evident. The limestone-shale and marl whites appear. The stacks of the cement plant at Florence later on assure one of the nature of the material. The road is dusty. Maintenance by dragging helps materially in dry weather, but high crowning for quick drainage is the bane of the motorist's life in wet weather. Visions of Iowa and Illinois return. An average of $2,500 per mile has been spent on grading a 16-ft. road on the west side of the pass, and there are few heavy cuts. About $600 per mile is now being spent to haul and spread a 2-in. gravel layer. Travel will compact it.

Convicts Do Heavy Work

Heavy rock work has been done by convicts on 10 miles of the road along the Arkansas River toward Salida. It starts 12 miles out of Cañon City after descending a steep, narrow, winding natural road over a hill around the famous Royal Gorge. The beginning and end of the convict road is marked, and a monumental slab to the prisoners has been erected on one side of a rock cut. The two years' task was completed in 1915. This work was paid for by Tremont County and the State Highway Commission, but no accurate cost data are available.

THE ARKANSAS RIVER ROAD IS BUILT PARTLY IN THE BED OF THE RIVER

Convicts completed this highway in 1915. The slope to the longitudinal drainage ditch is flat and traffic has begun to depress surface at wheel tracks, showing need of maintenance.

The rock drilling was done mostly by hand, although two Sullivan air drills were used in the heaviest sections. The method in sheer walls over the Arkansas River where the height is not more than 40 to 50 ft. was as follows: Holes were put down along the line of the finished back wall 8 to 12 ft. in depth and the material dropped into the river bed. The grade at these points was chosen so that the blasted material was used partly for roadbed. This, of course, is not feasible where the road is any distance above the water level.

This road affords an excellent example of the necessity for continual maintenance and of keeping the tailings out of the longitudinal drainage ditch on the bank. When this road was completed these two most important essentials to mountain road construction were amply provided for. The ditches lead to corrugated Armco pipes, which are laid at least 12 in. under the roadway and deliver the water well beyond the outer bank. Although it is practically all made of crushed hard granite, the surface shows the need of a road grader to fill in the depressions and longitudinal ruts which are beginning to form. The straight-line slope toward the bank now has two sags at the wheel tracks, illustrating the reason for advocating a parabolic crown with the outside edge highest. Attainment of this refinement in Colorado is not likely until maintenance is in the hands of engineers instead of the 200 road overseers appointed by the county commissioners. To secure a sloped straight line from outside to inside with the tailings well removed from the inside longitudinal drainage ditch will have to be the ideal for many years to come.

Last winter a professor at the University of Illinois read a paper at a road conference complaining about the attention and publicity roads were getting to the exclusion of the small-town streets. Most of the small towns on this trip bore out the contention as to the fact that town streets are poor in comparison with the country roads.

Local apathy toward dragging or light grading coupled with the denser traffic accounts for the condition.

The Smoothest Road

Probably the smoothest road encountered was a 7-mile stretch of natural material, gravel and clay recently regraded south of Villa Grove at the head of the San Louis valley. As it was late at night, details of side drainage and culverts could not be observed. The heavy wide-blade grader outfit moving to a new scene of activity was encountered in the town. It consisted of an extra-wide-tired gasoline tractor, a wagon loaded with gasoline barrels, the grader and a portable bunk or cook house. When it was built any attainable speed was practical on this road, straight as an arrow, level as a floor. The upper end, where there is gravel, is still good, but constant dragging is essential. The light loam farther down the valley, so desirable from the irrigated farm standpoint, is not good road material by itself. In dry weather it powders to dust; in wet weather it is greasy. A strenuous effort is made to keep it in shape by dragging, but despite this, travel to Del Norte takes the natural winding two-track desert road to the west close enough to the foothills to have incor-

CONVICTS WIDEN NARROW GRAND RIVER ROAD NEAR SHOSHONE POWER PLANT

Where rock is sheer for hundreds of feet construction is heavy and chances must be taken with overhang

SOILS OF IRRIGATED COUNTRY NEED CONSTANT SPRINKLING

THE GRADER IS THE PRINCIPAL ROAD TOOL IN COLORADO

porated in the soil plenty of disintegrated granite. For miles this follows the main ditch of the Farmers' Union, but never does the desert road lie in tangents. Withal, it is easier and more pleasant to drive over than the straight road.

FOREST-SERVICE ROAD

The Forest Service allots a portion of its funds from foraging and other privileges to build roads into and through the forest reserves. The service co-operates with the state and county officials and is allotting these funds to assist in bridging the gaps over many of the mountain passes. Such an arrangement is under consideration for about 24 miles of the road over Engineer Mountain and Molas Lake Pass, south of Silverton, on the road to Durango. At present tourists ship their cars by rail between the two points. Our trip back took us over the recently completed Wolf Creek Pass to Pagosa Springs (see the Engineering Record of Sept. 23, page 378), then back to Saguache and over Cochetopa Pass, in which an excellent example of Forest Service road, 16 miles long, was observed. This 14-ft. road was completed in 1915 and has been well maintained by dragging. It is built according to the specifications of the State Highway Commission with 6-per cent ruling grades, proper slopes and well-defined longitudinal ditches on sidehill work leading to corrugated-iron culverts. The ditches are kept commendably clean of tailings. The surface, which for much of the mileage is volcanic rock or disintegrated granite, is easy to maintain. There are no heavy cuts, and the principal features are two switchbacks with turns of 30-ft. radius on the west side to gain elevation from the valley mesa. On this side, by the way, limestone and surfacing material are not so easily obtained.

The real criticism of this route, as of so many others, is the abominable road beyond its western end on the way to Gunnison. Two wheel tracks, with the soil washed off the sharp rocks below, describe it. A few hundred dollars would make the worst places passable. As the county and the state both paid a large share of the cost of the government road the officials of the county, who control the expenditure of moneys furnished by the state, might well have devoted a little to making the Forest Service boulevard more available. Again the iniquitous principle of county control of through roads is indicted.

CULVERTS NEED COVER

West of Gunnison my notes are full of complaints against sidehill road not being drained toward the bank. Then near Cimarron there is a dash, for only the quick wit of the driver saved us when he speeded up his cautious forward movement so that it exceeded the faster side slip toward a "yawning chasm."

Exposed culverts a-plenty were observed in this section as in many other places. To get effective service from these culverts they must be buried below any possible chance of wheel wear and deformation from the weight of traffic.

Leaving Sapinero, and before the ascent out of the famous Black Cañon of the Gunnison, the road is cut from solid rock, dumped into the river, as was the convicts' road near Salida. Up and up on 7-per cent grade the Blue Mesa road winds in and out of the rolling mesa hills for several thousand feet in elevation, while all the time the ribbon of the steeper Black Mesa road on the north side of the great slot is in view. The road is well graded and dragged with no unusual features except the magnificent scenery.

INTO IRRIGATED COUNTRY

Over the Cerro Pass into the Uncompagre valley the road has been graded and is dragged regularly. Dropping by a gradual slope into the valley, the winding mountain road soon gives way to the tangents of the fertile irrigated areas. The change comes opposite the abandoned black shacks of the Reclamation Service force which built the Gunnison Tunnel—and some considerate engineer has erected a tablet telling just how many hundred feet below the road the tunnel is.

OVERHANGS IN THE SANDSTONE ARE NOT CONSIDERED DANGEROUS

The roads in the irrigated districts are well maintained, for intensive farming means heavy trucking. Dragging follows every rain and sprinkling.

In Montrose, Delta and Grand Junction the sprinkling wagon is constantly in evidence. Out of Grand Junction the road is sprinkled all the way to Palisades, 14 miles. A man and team with a sprinkling tank (and a gasoline engine to pump water from a wayside irrigating ditch) are employed at $100 per month to sprinkle and drag a district of approximately 4 miles. By this means the light loam soils are made to bear up the heavy fruit-wagon traffic. Little dust was in evidence and the roads were hard and smooth. Probably they are heavy during the wetter season.

MATERIALS VARY WIDELY

A reddish sandstone encountered west of Glenwood Springs and east of New Castle makes excellent road material, while a few miles back at Silt the soil was true to name. Dry and dragged it was like the Grand Junction loam roads. Through the red rock some heavy cuts have been made along the Grand River, giving an excellent scenic road. The materials vary rapidly, for the strata are on end. Just before entering Glenwood Springs even gravel hills are encountered, giving plenty of available surfacing material.

East of Glenwood Springs convicts are building a new road along the river to replace the old stage road. New alignment to give 6-per cent ruling grades and a 16-ft. roadway will necessitate carving a road from solid rock for at least 15 miles. Only thirty-five men were in the camp, many of the "honor" men being used on the state farm. The supply of convicts has diminished by about twenty per month since Colorado went dry. The population of the penitentiary has decreased by 111 since Jan. 1, no mean factor that must be considered in future convict road work of the state.

A Marion 1-yd. steam shovel, manned by convicts, except for one paid operator, is used for earth and loose rock excavation. Steam drills manned entirely by convicts are used on the rock work. This road is closed to travel during working hours because of the danger when setting off blasts. The work will progress all winter, the men being housed in a very substantial, electric-lighted camp. Shoshone power house is just above camp, and the question arises as to

why electric tools are not utilized to a greater extent.

Out of Wolcott until the Gore Cañon is reached, the country is uninteresting. There is much clay and alkali road, greasy and treacherous when wet, but fairly well maintained as a whole, and therefore not so bad when dry. Only it never is all dry at once.

On the road was encountered what a road engineer of Wisconsin calls cubical clay—one that is friable and breaks up into cubes when only slightly moist. It makes a most excellent binder for a gravel road.

Scenery is worth noting along the Gore Cañon. The Moffat road is at the water's edge; the highway is up thousands of feet upon the side of the mountain. The road is extremely narrow and the turns sharp. Not much has been done to it since its construction by the Moffat railroad engineers, beyond keeping its natural surface in shape.

In Berthoud Pass

From Kremmling to the foot of Berthoud Pass the road follows the Grand River in general. However, it leaves the river from Parshall to Hot Sulphur Springs to avoid a closed cañon, necessitating a considerable rise over a minor pass. It was realigned and well graded two years ago and has been well maintained since. From Hot Sulphur Springs to the foot of the pass much of the road, newly constructed since the Moffat road was built, is through disintegrated granite country. Of all the road materials encountered disintegrated granite gives the best service with the least attention.

Both sides of the pass are being improved at present. The north side has been pretty well completed as to new alignment, grading and draining, although a few stretches of corduroy badly in need of repair reminded the writer vividly of the same spongy spots when ridden over with a bicycle 20 years ago. In heavy work of grading the realignment is still under way. The old road is being widened to 16 ft., exclusive of the drainage; the old grades are being reduced from 10 and 15 per cent to 6 and the curves to a minimum of 30-ft. radius. Snow is almost at one's hand nearly the whole year; in consequence moisture is the road's worst enemy. The pass was reached at 7 p. m., so that no photographs of the work, with the magnificent scenery as a background, were possible.

Thirty-Mile Scenic Highway

To Denver now seems but a few miles, but pause must be made to observe the wonderful 30-mile stretch of mountain-park scenic highway built west of Golden through the co-operation of the State Highway Commission, Jefferson County and the Mountain Park Commission of the City of Denver. It is 20 ft. wide, sloped properly to the hillside, surfaced with the natural disintegrated granite and maintained constantly with graders and drags. Rollers are not used; in fact, not a roller or evidence of one was seen on the trip. To allay the fears of the timid tourist a substantial guard fence of discarded ¾-in. wire cables and 8-ft. sandstone posts, buried 4 ft., lines the road wherever there is the least suspicion that a car might go over the bank. It has saved two unmanageable machines so far. And the fine thing about this road is that the way to it, from Denver to Golden, over the worst gumbo in the state, has now been graveled and a start made to build a concrete road between the two cities.

Some Settlers, Not All, Need Help on Shoshone Project

Indebtedness Varies—Strongly Oppose Reduction of Project Costs—Government Loans and Bureau to Assist Beginners Suggested

THAT all settlers on the Shoshone project in Wyoming are suffering from meager returns, lack of capital with which to improve their farms, and from inability to borrow money is not a fair presentation of conditions. As outlined in the report of the Central Board of Review, of which Elwood Mead is chairman, to Franklin K. Lane, Secretary of the Interior, the sorry plight of the settlers described in the report of the Local Board of Review conveys the impression that all of them are far from comfortable. The report of the central board scores the suggestion that the project costs should be reduced. "Such reduction," the report says, "is simply a donation. It does not give to those in need of assistance the amount required, or in the form required.

Few Losses to Some Water Users

"Some of the water users have not been subjected to any of these discomforts, anxieties, or losses. Some had ample capital, and have comfortable homes, and they have found on this project a far better opportunity than could have been obtained in irrigation development under private enterprise. But there are settlers who have had to suffer losses, and whose condition is now critical. We believe that it is a mistake to permit settlers to enter on lands and projects of this kind who have not capital enough to give them a reasonable chance of success, and we also believe that there should be an organization to direct the work of beginners and save them the waste and loss due to inexperience.

"Such settlers have the sympathetic consideration of all members of this board, and we believe that they are entitled to such assistance from the government as will enable every man of industry and thrift to keep his home and complete his payments for land and water. We do not, however, agree that the just or effective method of extending aid is through reducing project costs. Such action would be a donation of public money to water users already enriched by the enterprise, not in need of aid, and not entitled to it.

Initial Difficulties Only Temporary

"All the members of the local board concede that present financial embarrassments are temporary, and that so far as agriculture is concerned much better results may be anticipated in the future. The agricultural records of the Garland division support this. The average acreage return for 1915 was $16.51, an increase of $1.50 an acre over the previous year, and an increase of $5.55 an acre over the average of the first seven years quoted in the supplemental statements. It was the testimony of all the settlers talked to during the recent visit to the district by the members of the central board that the color of the soil is changing, showing that its humus content is increasing, and there is a distinct gain in production.

"Market facilities have been greatly improved by the recent completion of a railroad south to Denver; a sugar beet factory at Billings and another factory to be constructed still nearer the district are destined to furnish a market for one of the most valuable crops grown in this section, and one which fits in well with stock raising, for which the district is eminently suited. One reason why the acreage return of these settlers has been low is that they lack capital to buy live stock. Once that difficulty is overcome, agriculture will be much more profitable. In our inspection of the district the impression created was that it has passed through its most trying period. It has a gratifying aspect of solid prosperity with every condition favoring increased acreage returns and better social conditions.

Indebtedness of Settlers

"There is another aspect of the financial situation of settlers that must not be disregarded. While the reports speak of the average indebtedness of settlers as being $1,000, this is not the actual situation. The indebtedness of settlers varies greatly. Some do not owe anything; some owe $4,000 and possibly more. Some are so prosperous that a donation of any part of the actual cost would be an act of mischievous and unwarranted favoritism.

"Three members of the water users' association board of directors are bankers. Two are bank presidents. These men are not developing farms to secure a home. The land is cultivated by tenants. Further, on this new project of 500 farms under cultivation, 107 are cultivated by tenants. A considerable portion of this area has apparently been filed upon by speculators. The stocks of the local banks sell above par, and as most of their money is loaned to settlers on the project it shows that local bankers have confidence in these settlers' solvency and in their ultimate success.

"It has to be borne in mind that this government project is only a small part of the irrigated area of Wyoming; that the greater part of the acreage has been reclaimed by settlers who had to finance their own enterprises, and where money was borrowed had to pay high interest rates for the money spent on construction.

Offsets to Hazards and Expenses

"As against the hazard and expense they would have had to incur, the settlers on these projects have had the advantage of low railway freights on material and the best of engineering advice; no interest has been charged on the money invested by the government during the period of construction, and none will be charged during the remainder of the payment period. These things of themselves place the settlers on this project at a great advantage compared to settlers on lands developed by private enterprise, and to add to this a donation of part of the cost is only justified on the assumption that the building of this work was an engineering blunder, or that the people living under it are not held to the same obligations to the government that exist in ordinary commercial undertakings. There is nothing here to indicate that this was an engineering blunder. On the contrary, everything indicates that the benefits of irrigation on this area are ultimately to be far more than the cost, and, taking the project as a whole, are already far more than the cost. The rise in land values alone supports this fact.

"These lands were given to settlers on only the payment of a small filing fee. While the average expenditure for improvements has not exceeded $50 an acre, some of the land in the vicinity of Powell sells for $100

to $150 an acre. The unearned increment of itself equals the project cost, and there is no warrant for eliminating any of these costs where the settler is out of debt, is prospering, and has already been greatly benefited by the privilege of securing public land.

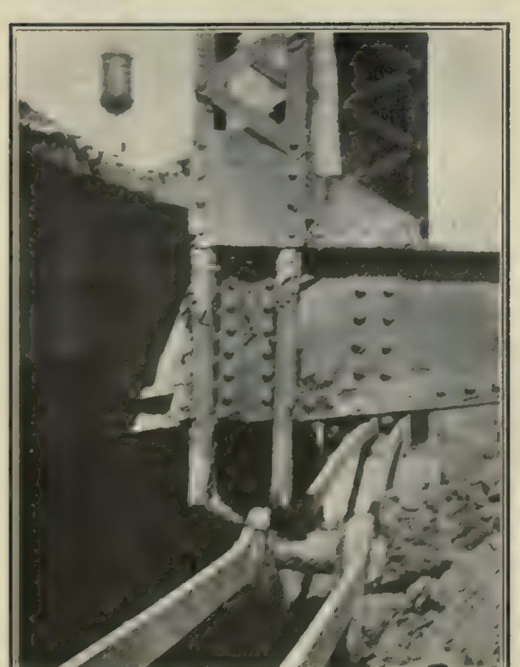
"Not all of the settlers have been thus benefited. Some of the land is not worth the sums spent on its improvement. There has been no enhancement in values beyond that created by the expenditure of money and labor. The credit of settlers who secured land of this character and their ability to borrow money are therefore restricted as compared to their more fortunate neighbors. While, therefore, some settlers are prospering and do not require assistance, there are a considerable number whose position is precarious and who are, in our opinion, entitled to adequate effective assistance from the government.

REDUCTION IN PROJECT COSTS IS DONATION

"The objection to a uniform reduction in project costs is that it makes no distinction between those who need assistance and those who are able to pay their way. A reduction in project costs is simply a donation. It does not give to those in need of assistance the amount required or in the form required. Nowhere is that more clearly illustrated than on this project. Those in need of assistance are chiefly settlers who began this development with inadequate capital; and their future is not menaced by the payment of project costs, but by the high interest rates they are charged for money, or the inability to obtain money for improvements.

"If these settlers are to be effectively aided, this country must follow the example of other countries which have a successful land settlement policy and provide money for improvements on a system of long-time loans with amortized payments of principal. This should be supplemented by an organization to direct the preparatory work in making raw land ready for cultivation."

The foregoing report is signed by Elwood Mead, professor of rural institutions, University of California, and by Brig.-Gen. W. L. Marshall, former chief of engineers, U. S. A., now consulting engineer to the Department of the Interior, and I. D. O'Donnell, supervisor of irrigation, U. S. Reclamation Service.



HANGER CONNECTION TO EYEBARS EATEN THROUGH BY RUST

Corroded Metal Found in Old Truss Bridge

Iron Highway Truss Span in Memphis, Tenn., Replaced by Concrete Culvert for Full-Width Street

By J. H. WEATHERFORD
City Engineer, Memphis, Tenn.

INACCESSIBLE parts of the last important iron highway bridge in the city of Memphis, Tenn., torn down in August last and replaced by a concrete culvert to carry a full-width street over Bayou Gayoso at Mill Avenue, showed considerable corrosion. The removal was accomplished by blocking up on a new fill over the culvert and cutting through the top chords and verticals with oxyacetylene burners.

The bridge was a nine-panel Pratt truss of 145-ft. span, 25 ft. 6 in. center to center of trusses, built in 1892 by the Penn Bridge Company. Bayou Gayoso is normally a dry creek flowing through the city, and originally drained 5000 acres of built-up city area. However, since the construction of two intercepting tunnels as a part of the North Memphis flood-protection work, described in the Engineering Record of June 10, 1916, page 775, this area has been reduced to 2000 acres, and a 15 x 24-ft. semi-

PULLING SECTION OF TOP CHORD AFTER CUTTING WITH TORCH

circular arch culvert has been built to replace the old iron bridge. The bridge carried, in addition to ordinary street traffic, a double-track street railway, and had been subjected to many vicissitudes. In 1905 a street-car derailment seriously damaged one of the intermediate posts near the center of the bridge and both diagonals, which were successfully repaired in place. It was subjected to overflow in the high water of 1907 and was then raised 5 ft.; but in spite of this it was again overflowed in 1912 and 1913.

The inaccessible portions of the bridge, as a result of failure properly to clean and paint them, and augmented by the floods mentioned, had become badly corroded. Some of the affected members—a hanger entirely eaten through above the lower-chord bars, a main floorbeam almost eaten through at the center post on the same side, and holes through one of the main floorbeams at the connection to one of the stringers carrying the street-railway track—are shown in the photographs.

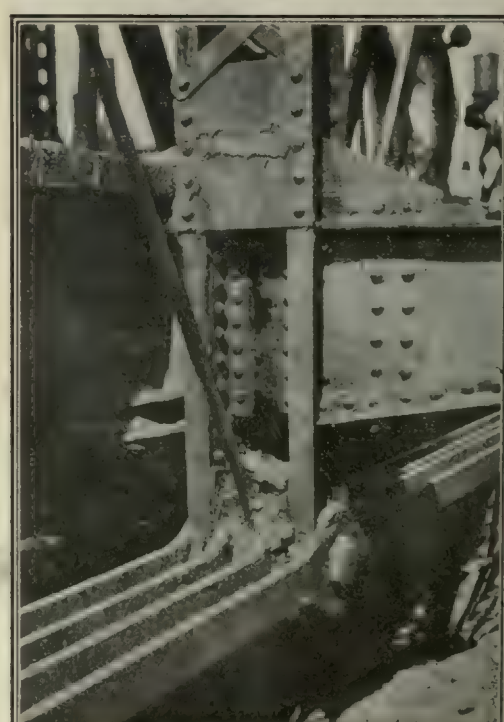
The concrete arch to replace the structure was begun during 1915, but owing to continuous high-water conditions it was impossible to finish it until Aug. 15 of this year. As soon as possible after completion of the north end of the arch a fill was placed over it to carry foot passengers and to provide a working space under the old bridge,

CORROSION AT STRINGER CONNECTION

the destruction of which was then begun.

By blocking up all of the cross-girders on the fill beneath the structure and then cutting through the top chords, and also the posts near the top of the cross-girders, with oxyacetylene burners, the post and attached section of top chord could be pulled inward, as shown in one of the illustrations. A street-railway wrecker then pulled the posts away. After the posts and top chords had been removed, the bottom pins were knocked out where not too tightly rusted, or the tension bars were cut off, the stringer rivets were cut, and the cross-girders and other materials dragged out by the same wrecker. The street-railway tracks were removed on July 26, the last top chord dropped on Aug. 5 and the entire structure taken down by Aug. 12.

When the fill is completed over the arch the street will have its full width of 66 ft., with 40-ft. roadway, instead of the limited width over the old bridge, and the grade of the east approach will be reduced from about 6 per cent to less than 2 per cent.



DIAPHRAGM AT FLOORBEAM CONNECTION ENTIRELY GONE

Should Wider Joints Be Provided in Concrete Roads Laid Late in the Season?

Heaving of Slabs on Canadian Highway Project Causes Noticeable Jar to Traffic on 6 Per Cent of 2071 Joints in Last Year's Work

By H. S. VAN SCOYOC
Chief Engineer, Toronto and Hamilton Highway Commission

DURING 1915 the Toronto and Hamilton Highway Commission laid 162,841 sq. yd. of concrete paving on the highway that will connect the cities of Toronto and Hamilton. On account of an exceedingly wet summer which delayed the work the mixing continued until late in November. An unusually mild fall allowed this to be done without any noticeable damage to the surface from frost. The surface on all of the work is in excellent condition, a recent inspection showing only one hole with a surface area of about 0.1 sq. ft. Some slabs have cracked, but less than 4 per cent of the total number laid required attention from this cause. Some of the joints have not been entirely satisfactory in their behavior, however, and it is with the hope that our experience in this connection may prove of value to other localities that this article has been written.

The paving on the main highway is 18 ft. wide, with the exception of six blocks in the town of Oakville, four of these being 50 ft. wide, the other two 30 ft. In addition, the commission built a secondary road 7200 ft. in length on which the concrete is 9 ft. wide. One-course construction was followed, the proportions being 1 part cement, 1½ parts sand and 3 parts crushed limestone. In practically all cases the space between joints is 35 ft.

Joint Material

The joint material consists of two layers of bituminated felt inclosing a bituminous filler. Careful measuring of a number of pieces of the material showed an average thickness of a shade less than ¼ in. The behavior of the material under pressure at a laboratory temperature of 69 deg. Fahr. is shown in the accompanying diagram.

In all cases the joints were made by staking the joint material against a 1-in. board. The joints were placed before any concrete was deposited in their vicinity, the boards being carefully staked in a vertical position. The concrete was placed on both sides of the board and the board and stakes removed when the concrete was deposited about 6 ft. beyond the joint. Instructions had been given that special care should be exercised to have the joints vertical on account of trouble having been reported from certain localities where joints had been inclined.

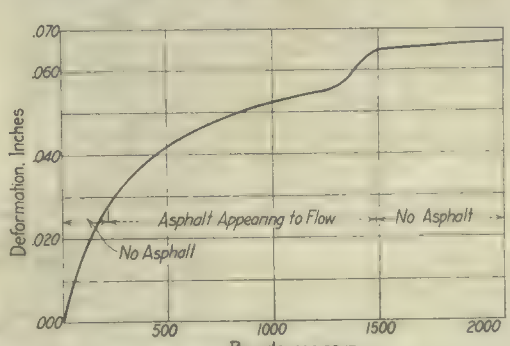
During the season six mixers were employed, but practically all of the concrete was laid by five gangs, this being true of all work done in October and November. The machines were operated over a distance of about 30 miles and the concrete was laid on soils which varied from a light sand to a heavy clay. There were limited areas of quicksand. All of these conditions are named because they prevent the possibility of deciding that some local cause was responsible for the trouble.

When the various sections were opened for traffic no perceptible jar was noticed in passing over the joints, and this condition continued until May 23, 1916. On this day and the following one a decided unevenness was noted on a number of the joints in widely separated sections of the highway. Through June and well into July there was an increase in the number of joints and in the amount that particular joints were elevated. There was not a regular increase but a variation with the kind of weather. Toward the end of July, however, a maximum was reached, and conditions improved even though the temperature increased. It is of interest to note that the summer and fall of 1915 were unusually wet in this locality and that this condition continued in the spring of 1916, there being almost continuous wet weather until June 21. In addition, the spring was unusually cold, the first warm days being May 23 and 24.

6 Per Cent of Joints Cause Jar

A careful inspection of all of the 1915 work at the end of August showed that out of a total of 2071 joints, 1944, or 94 per cent, caused no perceptible jar; 85, or 4 per cent, caused a noticeable jar, being up not more than 1 in.; and 42 joints, or 2 per cent, caused a serious jar, some of these being up as much as 2½ in. All of the joints noted as causing a serious jar have been chiseled through, and in every case they were inclined from the vertical. Twenty of the 42 joints were examined soon after the heaving occurred, and in every case water was found in the subgrade beneath the joint.

The most serious heaving was first noted on the heavier grades and on sandy soil which was impregnated with water. The direction in which the mixer worked had a bearing on which side a joint rose, the high slabs being on the side which was farthest from the mixer. The only exceptions so far noted were on the heavier grades and on joints made at the end of a day's work. A comparison of the work done subsequent to Oct. 15 with the entire year's work explains the heaving. It comprised 31.5 per cent of the total year's work, but of 42 joints which heaved seriously 41, or 98 per cent, were in sections that were laid later than Oct. 15, and of 85 joints which heaved noticeably 65, or 76 per cent, were found in them. It was almost possible to tell when certain sections were laid by the behavior of the joints. This was particularly noticeable in the secondary road, which is 9 ft. wide. It was not included in the figures given above. Work was begun on it Oct. 15 and it was completed Nov. 13. The effect of the roadway on traffic is indicated in the accompanying table.



RESULT OF COMPRESSION TEST OF ASPHALTIC JOINT FILLER

IN NEARLY ALL CASES THE SPACING BETWEEN JOINTS WAS 35 FEET

None of the concrete was actually laid when the temperature was below freezing point, but the lowest maximum temperature during any one day in the period from Oct. 15 to Nov. 30 was 33.9 deg. Fahr. During ten of the days the minimum temperature was below freezing. The lowest temperature during the winter was 9.3 deg. below zero and the highest temperature recorded during the summer of 1916 was 100.2 deg. above zero.

Beginning with work of Oct. 15 inspection showed the following results at joints ("O.K." meaning satisfactory and "Jar" signifying joint heaved upward):

O.K.	19	Jar	1	O.K.	1
Jar	1	O.K.	10	Jar	2
O.K.	25	Jar	1	O.K.	1
Jar	1	O.K.	4	Jar	1
O.K.	32	Jar	1	O.K.	1
Jar	1	O.K.	19	Jar	2
O.K.	26	Jar	1	O.K.	2
Jar	1	O.K.	1	Jar	1
O.K.	17	Jar	1	O.K.	1
Jar	1	O.K.	2	Jar	1
O.K.	11	Jar	2	O.K.	4
Jar	1	O.K.	2	Jar	1
O.K.	4	Jar	1	O.K.	4

Conclusions

It is likely that owing to the low temperature at which the concrete was laid, the unusually wet weather which prevailed during the fall of 1915 and the unusually wet and cold weather in the spring of 1916 the concrete did not set up properly. There was not the usual contraction due to the drying out of the excess water of mixing. There may not have been the usual amount of contraction due to the lowering of the

temperature, and there may have been an unusual amount of expansion due to the extremely wet weather. There certainly was not sufficient space between slabs to take care of the expansion due to the increase of temperature in the early summer. Undoubtedly there were contributing causes, as, for example, the lack of verticality in the joints and the tendency of the wet sand subbase to expand and exert an upward pressure. It may be true that more careful workmanship or an average season would have reduced the trouble, but the same workmanship and weather conditions led to no troublesome heaving in the work done previous to Oct. 15. It would seem, however, that if for special reasons work must be continued late in the fall in sections with climatic conditions similar to our own there should be wider joints provided in the later work, as well as special precautions as to workmanship.

METHODS OF REPAIR

As previously mentioned, the worst joints were chiseled through. In some cases the open space was as great as 4 in. The joints were then filled with a mixture of tar and crushed stone. Where it seemed likely that the slabs might return to their original position the abrupt offset was improved by using tar and pea gravel in such a way as to build up an approach. In some cases this strip was 18 in. in width. Where it seemed likely that there would be no settling back into place the joints were chipped off, the chipping being limited, so that the thickness of the slab was not decreased more than 1 in. All of the minor inequalities were removed in this way with a mason's hammer in a satisfactory manner and at a very low cost.

The length of this article may give an erroneous impression as to the seriousness of the trouble that has been occasioned by the heaving mentioned. At the present time the average user of the highway will not notice any of the joints. There are very few which cause any perceptible jar. In our own case the cost of the repairs made has been a very small part of the cost that would have been entailed in increasing the width of joint to ½ in. on the entire roadway. A wider joint will doubtless increase the cost of maintenance. However, our own experience leads me to feel that an increased thickness of joint material is desirable when the concrete is laid at a temperature approaching the freezing point.

Wind Pressure on Flags Determined

Tests recently made at the U. S. Navy Yard, Washington, D. C., using the largest flags that could be handled in the wind tunnel, form the basis for an empirical formula for determining the pressure of wind on flags for use in designing flagpoles. Two sizes of flags were used—one 3 x 5½ ft., and the other 2½ x 4¼ ft.—and velocities varying from 20 to 60 miles per hour were applied. The following formula was found to represent the results, the constant varying but slightly with size of flags, being less for the larger flag:

$$R = 0.0003AV^{1.9}$$

in which R is the resistance in pounds, A is the area of flag in square feet, and V is the velocity of wind in miles per hour. This formula is for steady wind pressure. It was not found practicable to measure the forces produced by wind gusts.

Road and Bridge Expenditures Increase

U. S. Office of Public Roads Publishes Statistics Based Upon Data Collected for 1915

RAPID increase in total expenditures for roads and bridges, growth of building and maintenance activities under State supervision, and a sharp decrease in the proportion of contributions in the form of statute labor mark the development of highway work in the United States during the last twelve years. These facts are brought out by statistics for the year 1915, recently compiled by the Office of Public Roads and Rural Engineering of the U. S. Department of Agriculture.

The total length of public roads in the United States, outside the limits of incorporated towns and cities, was about 2,452,000 miles on Jan. 1, 1916. Of this, about 277,000 miles, or 11.3 per cent, were improved with some form of surfacing. The mileage of surfaced roads has been increasing at the rate of about 16,000 miles a year, and in 1915 approximately one-half of this increase was made under the supervision of State highway departments. In addition, these departments supervised the maintenance of nearly 52,000 miles of main and trunk-line roads.

ANNUAL INCREASE IN EXPENDITURES $80,000,000

The increase in expenditures for road and bridge work in the United States has been from approximately $80,000,000 per year in 1904 to about $282,000,000 in 1915, an increase of more than 250 per cent. The expenditure of State funds during this same period increased from about $2,550,000 to more than $53,000,000. In addition, more than $27,000,000 of local funds was spent under State supervision in 1915, bringing the total road and bridge expenditures managed by the States to $80,514,699. This amount is greater than the total expenditures for roads and bridges from all sources in 1904.

The growth in importance of the State highway departments has been rapid. The first of these agencies was created in 1891, in New Jersey, and now some form of highway department exists in every State except Indiana, South Carolina and Texas. Since their inception these departments had expended to Jan. 1, 1916, an aggregate of $265,350,825 in State funds for road and bridge construction, maintenance and administration. They had constructed more than 50,000 miles of roads in co-operation with the States. More than 40,000 miles of these roads were surfaced.

The falling off in the value of road work performed by statute and convict labor was from $20,000,000 in 1904, when the total road expenditures were $80,000,000, to about $15,000,000 in 1915, when the total expenditures had grown to $282,000,000. This was a reduction from 25 per cent of the total in the former year to less than 5½ per cent of the total in 1915.

INCREASE IN USE OF BETTER TYPES OF ROADS

An increase in the use of better and more expensive types of roads also is shown by the recently compiled statistics. This development has been due, in large part, to the great increase in automobile traffic. It is estimated that there are now approximately 2,500,000 automobiles in use on the roads of the country, or one car for every mile of road. This present motor traffic is in excess of traffic of all sorts twelve years ago.

The cash road and bridge expenditures of the United States averaged only $28 per mile of rural roads in 1904. In 1915 this average had grown to $109 per mile. New Jersey led all other States both in 1904 and in 1915, with $221 and $475 per mile respectively. Nevada made the least expenditure in both years—$3.72 per mile in 1904 and $17 per mile in 1915.

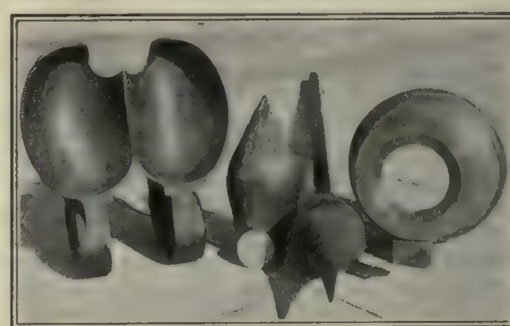
Water Will Wear Even Steel

Parts of Waterwheel Subjected to 1960-Foot Head Show Considerable Erosion After Eighteen Months of Service

By V. W. KILLICK
Glendale, California

THE great erosive effect of water on parts of a waterwheel is shown by the accompanying photograph. The needle, valve-seat and bucket were taken from a Doble wheel after having been subjected continuously for a period of eighteen months to receiving 375 miner's inches of water at the bottom of a 1960-ft. drop.

The Doble wheel was installed in power



WEAR ON WATERWHEEL PARTS AFTER EIGHTEEN MONTHS UNDER HIGH HEAD

house 2 of the Southern California Edison Company, in the mouth of Mill Creek canyon, near Redlands, Cal. The electric current generated at this plant is derived from the water power of Mill Creek. Part of the waters of the creek are diverted from their natural course about 3 miles above the power house and are piped to a reservoir on a high cliff nearly 2000 ft. above the plant, from which cliff the water has almost a vertical fall into the waterwheels.

Although the water is thoroughly strained so that it contains less than 0.1 per cent of solid matter, it has, during the short time mentioned, eroded the nickel-steel needle to the extent shown in the picture. The surface of the bucket is also considerably indented. For comparison a new needle is shown, and a silver dollar in the picture gives the relative size of the parts. When installed the needle fits into the valve seat shown on the right, and the water is turned into the wheel by screwing up the needle, leaving a space between it and the valve-seat.

Dam Work on Kentucky River Will Be Completed by November

With the completion of dam 14, probably in November, the entire system of dams on the Kentucky River will have been completed and that river put in navigable condition from its source to its mouth. Repairs to dam 2 necessitated by flood damage in 1913 have recently been finished at a cost of about $34,000.

Selecting Economical Type of Riveted Joint for Steel Pipes and Standpipes

Tables and Diagrams Developed as Result of Investigation to Determine Proper Design for Pipe Line—Effect of Efficiency of Joint on Economy

By FRANK H. CARTER
Designing Engineer, Cliftondale, Mass.

WHILE attempting to select the proper type of joint for a 54-in. riveted steel pipe line about 2800 ft. in length under 475-ft. head early in 1913, under the direction of Henry F. Bryant, consulting engineer, of Brookline, Mass., through whose courtesy the writer is enabled to publish that part of this paper relating to pipe lines, it was found that little or nothing had been written on the question of the relative economies of the different kinds of riveted joints.

The vital point in the construction of a riveted container made of plates, whether for water, steam, or air, and whether the structure be a vertical standpipe, horizontal pipe line, a steam boiler or an air tank, is the design of the joint. As the thickness of plates which must be used depends largely on the efficiency of the joint, the selection of the proper type of joint, with due regard to the differences in the costs of the various types, is obviously the principal factor in the determination of the greatest economy of design; an increase in the efficiency of the joints means a saving in the thickness of metal required.

Riveted Steel Pipe Lines

The average efficiencies of the several types of joints considered is approximately as given in Table 1. An attempt was made to ascertain the cost of these several kinds of joints by inquiry among boilermakers located near Boston, but with little success, except in the case of one prominent maker who wrote that the comparative costs of the joints might be broadly stated as given in Table 1 under "Relative Cost."

TABLE 1—VALUES FOR VARIOUS TYPES OF JOINTS

Type of joint	Efficiency	Relative cost	Cost per 100-ft. head
Single-riveted lap joint	0.576	100	$6.00
Double-riveted lap joint	0.739	170	4.63
Triple-riveted lap joint	0.750	...	4.36
Double-riveted butt joint	0.820	330	4.33
Triple-riveted butt joint	0.875	520	4.12
Quadruple-riveted butt joint	0.937	570	3.94

These values are as close as this manufacturer could give because of the scarcity of available information on the subject. A check was obtained from the statement of another of Boston's prominent boiler manufacturers that he estimates about $12 to $18 as the increase in cost of one type of joint over another for a boiler 18 ft. long; that is, a quadruple-butt joint costs from $12 to $18 more than a triple-butt joint.

Cost Based on Weight

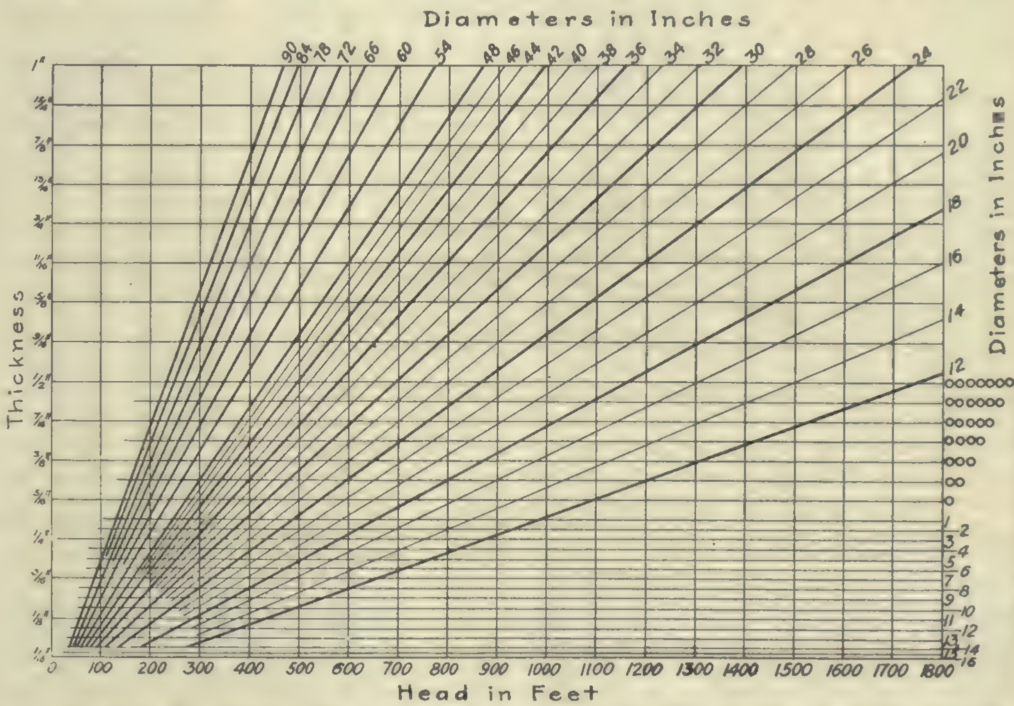
The only recourse left was to compute the weights of the different joints at some considerable labor and to estimate the relative costs from the weights alone, without regard to any other factor, notwithstanding the fact that the labor cost of a joint may vary more rapidly than the comparatively few extra pounds of metal involved in substituting, for instance, a quadruple-riveted butt joint for a double-riveted lap joint. As the diameter of the penstock increases, the requirement that the most efficient joint be selected to insure maximum economy is more apparent, and the question of increased labor cost with increased number of rows of rivets is of smaller moment. Hence any question as to the extra labor or material cost involved in the more complicated joints over and above the more simple joints is vastly exceeded by the saving in thickness of metal for the pipe itself.

Tables were computed for a pipe 54 in. in internal diameter with roundabout seams every 72 in. The weight of the lap and rivets required to make up the roundabout seams was computed, and also the ratio of the total weight of lap and rivets to the weight of 72-in. length of the "barrel" of the pipe plus the weight of the necessary straps or laps, as the case might be. This ratio was added to the overweight percentage and applied to the weight of the pipe per foot, including straps or laps, after which the weight per foot of the rivets was added to make up the total estimated weight of the pipe per foot complete. A price of 4 cents per pound was used to estimate the cost of the pipe. From data furnished the writer from time to time, through the courtesy of E. E. Lockridge, chief engineer of the Springfield Water Works, on the cost of laying 42-in. lock-bar pipe it was estimated that it would cost $0.186 times the diameter of the pipe in feet to lay the pipe in the trench and field-rivet and calk it in approximately 30-ft. lengths.

A summary of these tables is shown in Table 2, where the weight per linear foot, the cost per linear foot delivered along the trench and the allowable static head computed on a basis of 10,000 lb. per square inch net section are given for each thickness of pipe. In fact, practically the essence of this paper is found in the cost per 100 ft. of allowable safe static head given in the last column of Table 1, which was computed on a basis of ½-in. plate for a pipe of 54-in. diameter, using 10,000 lb. per square inch as the safe unit stress on the net section, with no other allowance for corrosion or for water hammer. This is practically equivalent to assuming 16,000 lb. per square inch unit stress on net section with 100 lb. per square inch assumed water hammer at the wheels and an allowance of 1/16-in. thickness for corrosion.

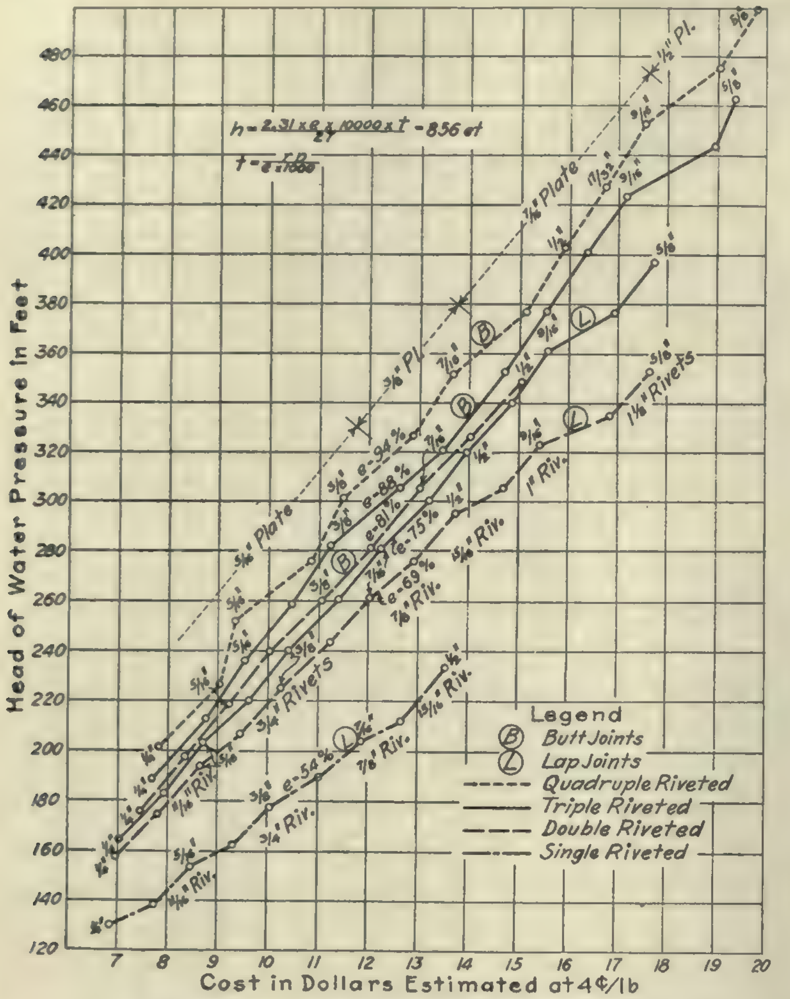
Comparative Diagrams

The fact that these two methods are so nearly equivalent is shown in an accompanying diagram. The upper line represents the allowance of 100 lb. water hammer at the lower end of the pipe at the power plant, assuming the water hammer to be practically nothing at the upper and open end of the pipe at the equalizing tank. This line is drawn 23 lb. higher than necessary for the water-hammer allowance to provide for the 1/16-in. extra thickness of pipe allowed for corrosion. The horizontal line at El. 1020 marks the full reservoir, while El. 990 is minimum low water. The line next below is drawn to represent the hydraulic gradient with the 54-in. pipe flowing full. The slanting line is a diagrammatic illustration of the profile of the pipe line itself. This is not strictly correct, as the true profile is not a straight line; but the straight line will answer as well as the true profile to illustrate the point that an allowance of 10,000 lb. on the next section is well within the truth and is probably as close a method of determining the proper thickness of pipe as any which might be devised.



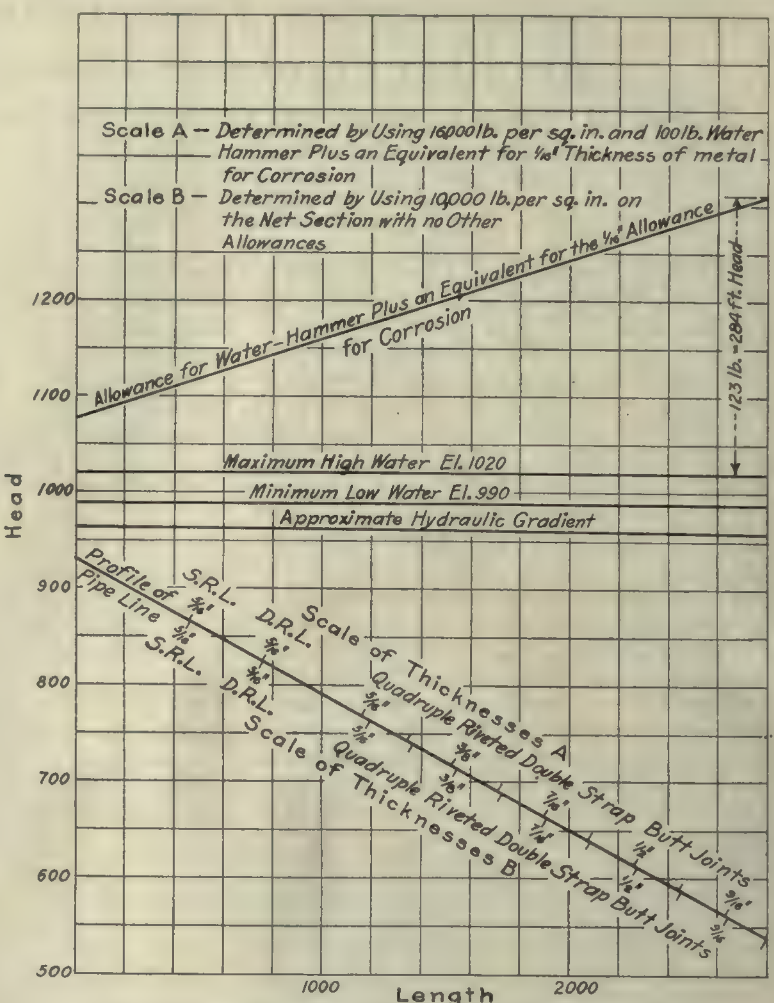
THICKNESS OF RIVETED PIPE BASED UPON 9000 POUNDS UNIT STRESS ON GROSS SECTION AND JOINT EFFICIENCY OF UNITY

Computations of thickness of pipe for an allowance of 16,000 lb. on the net section with 100 lb. water hammer at the lower end and an allowance of 1/16 in. extra throughout for corrosion are shown on the upper side of the lowest slanting straight line, which represents the profile of the pipe line, and may readily be compared with a similar scale drawn along the bottom of the same straight profile line, and



COST OF STEEL PIPE WITH DIFFERENT TYPES OF JOINTS

Based upon design of pipe of 54 inches diameter at 10,000 pounds per square inch on net section, thickness $t = rp/10,000e$. Butt strap thickness given in topmost line.



RELATIVE THICKNESS FOR RIVETED STEEL PIPE LINES

Different assumptions made in methods of computation are indicated on the diagram.

computed on the basis of 10,000 lb. per square inch on net section, with no other allowance either for corrosion or for water hammer. The latter method automatically cares for the assumption that water hammer decreases from a maximum at the wheels to practically zero at the upper end of a pipe line which is open at the upper end. At first thought 10,000 lb. on the net section, after deducting the proper amount for loss in efficiency due to joints, seems absurdly low. It is a fact, however, learned from an examination of the files of current engineering publications that many pipe lines in the Western states have been designed for a stress of from 6000 to 7500 lb. unit stress on the gross section.

RELATIVE ECONOMY

The relative economy of the different types of joints is perhaps more clearly illustrated by means of the curves given in the diagrams than by means of the tables. The quadruple-riveted butt joint is clearly the cheapest type of riveted joint, while the very poor economy of the single-riveted lap joint is obvious. Thus $1,000 will purchase 84.5 ft. of 7/16-in. single-riveted lap joint steel pipe at $11.85 per linear foot, or $1,000 will purchase 128 lin. ft. of ¼-in. quadruple-riveted joint steel pipe at $7.80 per linear foot, both of which will safely stand a static head of about 202 ft. at 10,000 lb. per square inch on the net section. No doubt the actual increased labor cost of a 54-in. quadruple-riveted butt joint over that of a single-riveted lap joint would bring these figures somewhat nearer together, but for larger diameters the actual saving effected by the use of the more complicated joints is very apparent.

The diagram on page 467 illustrates a method by which riveted steel pipe lines may be quickly laid out for approximate estimates of cost. It is well known that the thickness of a steel pipe line is determined by the formula

$$t = \frac{rp}{es}$$

where t is thickness of pipe required in fractions of an inch; r, the internal radius of the pipe in inches; p, the internal water pressure on the pipe in pounds per square inch; e, the efficiency of the joint as compared with the gross section of the plate; and s, the allowable working stress on the net section in pounds per square inch of metal. To use the diagram, bear in mind that s is 9000 and e is 1.00 for the values given; hence, to find the safe head in feet for any pipe of given diameter for any value of e other than unity and any other value of s than 9000 lb. per square inch, multiply h as read from the diagram by $se/9000$.

For instance, suppose it is required to determine the safe head which a single-riveted lap joint 54 in. in diameter pipe with ½-in. thickness will stand, assuming 10,000 lb. as the safe working unit stress on the net section. Entering the diagram at the ½-in. line at the left, and running horizontally to the inclined line, marking a diameter of 54 in., we read 385 ft. as the safe head. By the rule just given we must multiply this value by 10,000 × 0.576/9000, and the head required is 245 ft., which in

TABLE 2—WEIGHT, COST AND SAFE STATIC HEAD FOR 54-IN. RIVETED STEEL PIPE

	WEIGHT—POUNDS PER LINEAR FOOT						COST—DOLLARS PER LINEAR FOOT						ALLOWABLE STATIC HEAD IN FEET					
	Lap joints			Butt joints			Lap joints			Butt joints			Lap joints			Butt Joints		
Thickness	Single	Double	Triple	Double	Triple	Quadruple	Single	Double	Triple	Double	Triple	Quadruple	Single	Double	Triple	Double	Triple	Quadruple
¼	172.4	174.0	176.6	185.9	192.5	195.6	6.90	6.95	7.05	7.45	7.70	7.80	130	158	165	176	189	201
9/32	193.4	194.9	198.1	208.8	220.4	208.0	7.75	7.80	7.95	8.35	8.80	9.05	137	175	183	198	213	227
5/16	212.2	214.3	217.2	230.8	239.0	234.1	8.50	8.65	8.70	9.25	9.55	9.85	153	194	203	219	236	252
11/32	233.1	236.4	240.4	250.9	262.3	272.1	9.35	9.45	9.65	10.05	10.50	10.90	162	207	220	240	259	276
⅜	251.7	256.0	260.9	277.4	281.3	288.2	10.10	10.25	10.45	11.10	11.25	11.50	177	225	240	260	283	302
13/32	277.6	281.2	285.9	302.3	317.2	324.2	11.10	11.25	11.45	12.10	12.65	12.90	189	243	261	282	306	327
7/16	296.7	300.7	306.0	325.9	336.8	342.3	11.90	12.05	12.25	13.05	13.50	13.70	204	262	280	306	330	352
15/32	317.4	324.7	331.0	350.5	369.3	379.5	12.70	12.95	13.25	14.05	14.75	15.20	212	277	300	327	353	377
½	339.0	344.9	350.1	376.2	388.9	398.6	13.60	13.75	14.00	15.10	15.55	15.95	226	296	321	349	377	402
17/32	....	368.3	371.3	....	409.5	418.7	....	14.75	14.90	....	16.40	16.75	...	306	341	...	401	427
9/16	....	386.4	390.4	....	428.6	437.8	....	15.55	15.60	....	17.20	17.55	...	324	361	...	424	453
19/32	....	421.1	424.4	....	473.0	476.1	....	16.85	16 95	....	18.95	19.05	...	335	377	....	444	476
⅝	....	442.8	444.0	....	482.7	495.2	....	17.75	17.75	....	19.35	19.80	...	353	397	...	458	498

this case may be checked by referring to the other diagram.

The saving in total weight of metal by using joints of high efficiency for standpipes, especially those of large diameter, is very marked. For instance, in the case of a standpipe 40 ft. in diameter and 100 ft. high, assuming an efficiency of 93.7 per cent for quadruple-riveted butt joints, a saving in the weight of metal of approximately 10,000 lb. was effected. It has been demonstrated that the economical riveted joint for riveted steel pipes, boilers and standpipes, at least those 54 in. in diameter or greater, in so far as the economy is to

CLIFTONDALE STANDPIPE IS 45 FEET IN DIAMETER AND 85 FEET HIGH

be determined by the *weight*, is that of the highest efficiency.

The standpipe at Cliftondale, Mass., built by the Chicago Bridge & Iron Works and shown in the accompanying view, was designed according to the method indicated in this paper.

Illinois Highway Commission Gives Rules for Dragging

Illinois has a large mileage of earth roads. For that reason proper dragging is a matter of great importance. The following are a number of rules given by the State Highway Commission as an aid in accomplishing the best results:

Use a light drag.

Haul it over the road at an angle so that a small amount of earth is pushed to the center of the road.

Drive the team at a walk.

Ride on the drag; do not walk.

Begin at one side of the road, returning up the opposite side.

Drag the road as soon after every rain as possible, but not when the mud is in such a condition as to stick to the drag.

Do not drag a dry road.

Drag whenever possible at all seasons of the year.

The width of traveled way to be maintained by the drag should be from 18 to 20 ft. First drag a little more than the width of a single wheel track, then gradually increase until desired width is obtained.

Always drag a little earth toward the center of the road until it is raised from 10 to 12 in. above the edges of the traveled way.

If the drag cuts too much, shorten the hitch.

The amount of earth that the drag will carry along can, to a very great extent, be controlled by the driver, depending on whether he stands near the cutting end or away from it.

When the roads are first dragged after a very muddy spell the wagons should drive, if possible, to one side until the roadway has a chance to freeze or to partly dry out.

The best results from dragging are obtained only by repeated application.

British Standardization Aids Industries

History, Organization and Methods of Engineering Standards Committee Outlined and Its Industrial Importance Emphasized

CONVINCING EVIDENCE of the value and national importance of the work being done by the Engineering Standards Committee, in the work of which are engaged some 500 members of the five leading engineering institutions of Great Britain—the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Naval Architects and the Iron and Steel Institute—is presented in a paper read Sept. 7 before the British Association by the secretary of the committee, and published in *Engineering*. The following extracts may be of interest to engineers in this country, particularly with reference to the parallel work being done here by the American Society for Testing Materials. The value of standardization, the effect on quality of product, the history and growth of the British committee, its internal organization and the success of the movement are discussed in detail.

VALUE OF STANDARDIZATION

"It is scarcely necessary nowadays to insist on standardization as being of paramount importance to economic production, but that was not so clearly seen sixteen years ago, before the advent of the British Engineering Standards Committee. However, keen competiton from outside, the legitimate demands of labor for a higher standard of living, coupled with the desire of capital for an adequate return, have compelled the whole industry to introduce modern order and system in all its methods of production, former individualistic methods giving way to co-ordination and collective effort. These improvements, which have already resulted in marked benefits, must not only be maintained, however, but continually added to if the full advantages are to be reaped.

REVISION NECESSARY

"Crystallization, however, which would tend to impede and to stultify progress, must be jealously guarded against if standardization is to be of permanent value and the purchaser is not to be deprived of the benefit of competitive effort and inventive genius. Those responsible for the initiation of the standardization movement in Great Britain realized from the first that in order to avoid undesirable stereotyping of practice it would be necessary from time to time to revise standards.

"Satisfactory results have been arrived at not by one section of the community imposing its opinions on the other, but rather as the result of co-operative action, mutual concession and ultimate agreement among all the interests concerned. The adoption of standards agreed on in this way undoubtedly promotes uniformity of practice, avoidance of waste, elimination of harsh and unnecessary conditions, reduction of manufacturing costs, and last, but by no means least, engenders a feeling of mutual confidence between user and producer such as could not be secured by isolated action on the part of either.

"Experience, moreover, has shown clearly that such procedure does not lower the standard of quality, but tends rather to raise it, for standardization carried out along these lines reflects, in effect, the concensus of opinion as to what constitutes best modern practice.

"Successful standardization can only be arrived at by common consent of all those who take full part in the initiation and working out of the actual details of the various specifications which are intended to be recommended ultimately for public use. The realization of this guiding principle by the founders of the Engineering Standards Committee is probably one of the chief reasons for the wide adoption of the British Standard Specifications, which have no authority other than that of public opinion.

INCEPTION AND GROWTH OF COMMITTEE

"The movement, as represented by the Engineering Standards Committee, the greatest voluntary effort of its kind, in which public spirit has been so lavishly shown, was founded in 1901, through the initiative of Sir John Wolfe Barry, K.C.B., who had long been coming to the conclusion that some means were urgently required to systematize design and production of component parts. In January, 1901, he laid the matter as affecting the engineering trades of the country before the council of the Institution of Civil Engineers, with the result that a committee was appointed to consider the question of standardizing various kinds of iron and steel sections. The committee reported favorably on the project, and the council of the Institution of Civil Engineers adopted the report, and the co-operation of the five leading engineering institutions of the kingdom was subsequently secured.

"Thus from a single committee, consisting originally of seven members, appointed to discuss the advisability of standardizing rolled sections and rails, has grown the present far-reaching organization with its sixty-four committees and subcommittees, as well as numerous panels, including, in all, well over 500 members freely giving their time and experience, often at great personal inconvenience, and dealing with subjects embracing practically the whole engineering practice.

INTERNAL ORGANIZATION

"The internal organization of the Engineering Standards Committee need only be very briefly referred to, as it is fully set out in the report on work accomplished, which is issued annually. The main committee, which is composed of nineteen official representatives of the five leading engineering institutions, has charge of the administration of the whole of the work, the raising of the necessary funds, the controlling of the expenditure, the selection of subjects for standardization, and the ratification of all reports and specifications presented by the various sectional committees for its approval prior to publication. The sectional committees are appointed by the main committee, who nominate the respective chairman and arrange the mode in which the subjects are to be dealt with. The sectional and subcommittees contain representatives of the various government departments, consulting engineers, manufacturers, contractors and users, as well as

representatives from the technical societies and trade associations concerned."

A diagram, not reproduced here, shows the relation of sectional committees, subcommittees and panel committees to the main committee. The sectional committees are: Bridges and general building construction; sections and tests for materials used in ships and their machinery; railway rolling stock underframes; locomotives; cement; electrical; pipe flanges; rails; furnace; publication and calculations; cast-iron pipes; vitrified ware pipes; automobile parts; rope pulley grooves; screw threads and limit gages; wire ropes; road material, and galvanized corrugated-iron and steel sheets.

"The main committee only studies subjects at the request of the various sections of the industry concerned, and does not venture to make recommendations except on the initiative of the engineers or responsible representatives of the trade affected. The utmost care is taken at the very outset to insure that all who have or could possibly have any interest in the proposed standardization shall be adequately represented (through their recognized societies and trade associations, if such exist) on the committee intrusted with the work. If necessary, evidence is taken, the advice of experts is sought, and in this way all parties are consulted and have a voice in the initial proposals, thus avoiding much subsequent friction which might otherwise occur.

Experimental Work

"In drawing up industrial standards, experimental investigations frequently become necessary in order to establish the facts underlying the principles involved, and in this connection the National Physical Laboratory has been and is conspicuously useful. It is in effect the committee's official testing bureau, and its ultimate authority in matters concerning electrical and mechanical tests, acting in an advisory capacity in all the work in which unbiased experimental data are essential.

"Each sectional committee is given an opportunity, once a year, of passing in review the specifications for which it has been responsible, for possible revision or addition if experience shows that such is desirable, and it is this system of keeping abreast of invention and progress which adds so greatly to the practical value of the work of the committee.

"The British Standard Specifications, which are confined to the main technical clauses necessary for the purchase of the product to which the specification relates, find an increasingly wide adoption. They are being increasingly adopted throughout the country, in home and export trade in general."

Success of Movement

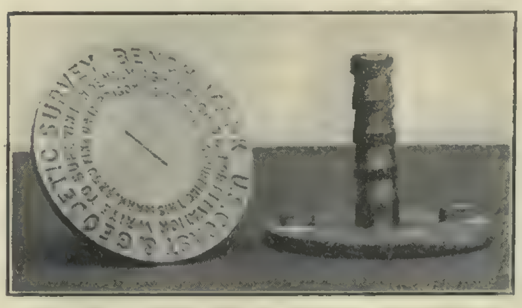
That the efforts at standardization have been successful is demonstrated by the complete statement given in the paper to show the results already accomplished. For example, of these results directly relating to the field of the civil engineers there are cited: The number of rolls in use by British manufacturers have been largely reduced; formerly 70 sections of tramway rails were rolled; these have been reduced to 5. A similar reduction has occurred for all ordinary sections, such as angles, tees, channels and beams. The British Standard Specification for Portland cement is now generally adopted by engineers and manufacturers throughout the whole country, probably 75 per cent of the total output conforms to this standard; and the London County Council has required that all rolled steel used in the construction of skeleton frameworks of buildings must comply with the British Standard Specifications, and that all cement used must conform to the British Standard.

Tablets Set in Concrete for Coast Survey Stations

Name or Number of Benchmark and Date Established Stamped on Center—Inscription Explains Point

SO THAT engineers and surveyors may take advantage of U. S. Coast and Geodetic Survey benchmarks and stations, tablets have been issued by the government for use by the engineers of the Survey. Each tablet is set in concrete or some kind of masonry structure and tells the nature of the station.

Directions for using the new devices state that "wherever a triangulation, reference,



NEW TRIANGULATION STATION TABLET

topographic or hydrographic station or a leveling or tidal benchmark is established and marked with the standard inscribed metal disk or cap, the disk or cap should be stamped with the name of the station or the number of the benchmark. There should also be stamped the year in which the station or benchmark is established. If a station or benchmark is recovered which had been marked with an inscribed disk or cap, the name or number and the date when originally established should be stamped. Also, when a recovered station or benchmark which had not been marked with a disk or cap is remarked with a disk or cap the name or number and the date of original establishment should be stamped.

"When a new or recovered magnetic station is marked with a disk, the year in which the station was established should be stamped on the disk. It is not necessary to stamp the name of the mark of a magnetic station.

"The only exception to this general rule should be when the stamping cannot be done except at excessive cost or delay to the work or when to stamp the mark would loosen or destroy it."

Give Elevations of 1000 Points in State of Mississippi

The elevations of more than 1000 points in Mississippi are given in Bulletin 639, recently published by the U. S. Geological Survey. The highest point noted in the report, but not the highest point in the state, is in the Iuka quadrangle, Tishomingo County. The highest point located in Mississippi is a few miles southwest of Iuka, where an unnamed summit rises to a height of 780 ft. above sea level.

Well-Made Concrete Tanks Affected by Few Fluids

Lard Oil, Sulphite Liquor, Cider Vinegar, Molasses and Brine Are Found to Disintegrate the Surface

RESULTS of tests made for the Portland Cement Association to determine the effects of commercial liquids on concrete tanks, extending over a period of at least thirteen months, and in some cases over longer periods as supplementary studies, have been reported by the Institute of Industrial Research, Washington, D. C. In most cases it was found that plain untreated concrete of good mixture, properly placed, resisted the action of the various liquids used in the tests just as well as the concrete given special treatment. Certain substances caused marked disintegration, although at the present time the data available are not considered complete for these materials. For example, it is claimed in some quarters that molasses has not been found to affect concrete tanks, and in other cases that concrete brine tanks have stood well under the disintegrating action of a concentrated brine solution.

Concrete Not Affected

In the case of the following fluids, plain dense concrete of 1:2:4 mix was found after thirteen months to be practically uninjured: Menhaden oil, linseed oil, rosin oil; 4 per cent caustic soda solution; tanning solution, and sauerkraut. The use of special treatments of the inside surface gave no better results than plain concrete for these materials.

On the other hand, it was found that plain concrete was affected by lard oil, sulphite liquor and cider vinegar. Lard oil softens the surface of the concrete and exposes the aggregate, and no satisfactory special treatment to prevent this action has yet been reported. Sulphite liquor lays bare and loosens the coarse aggregate under a progressive action that makes it unsafe to use untreated concrete for storage of this liquid. In a supplementary report it is stated that the only satisfactory method of protecting concrete from disintegration by sulphite liquor yet found is by surface treatment with a paint coat of blown oil-gilsonite compound. A concrete tank treated with such compound has now been used successfully for the storage of sulphite liquor for a period of 15 months and is at the present time in perfect condition. No other treatment than that just noted has prevented disintegration.

Acid Protective Paint

This blown-oil gilsonite compound should be applied as follows: Dissolve 100 parts by weight of Utah asphalt (gilsonite) in 250 parts of turpentine. At ordinary temperature, 24 hours will be required for perfect solution, stirring frequently. A perforated metal basket in which to suspend the broken lumps of asphalt in the solvent will accelerate solution. Add 5 parts of neutral petroleum oil. Two coats should be applied with a brush, allowing at least 24 hours for the drying of each coat.

Cider vinegar attacks the concrete in exactly similar manner to the sulphite liquor. In a supplementary report, it is stated that the remarks relative to sulphite liquor are applicable to the tests made with cider vinegar. The blown oil-gilsonite compound has been in use for a period of 15 months,

and as the surface treatment caused no injury to either concrete, coating or vinegar, it may be said that vinegar may safely be stored in concrete tanks if so protected. It was found that an application of two coats of paraffin dissolved in benzol gave better results than plain concrete, but was not entirely satisfactory.

Effect of Molasses

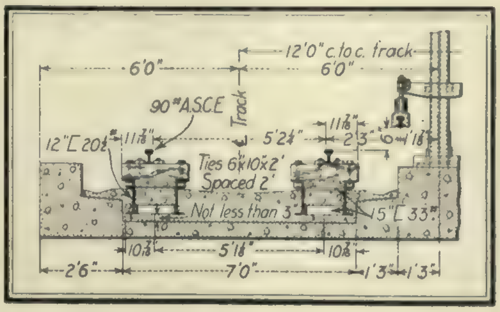
Molasses, according to a supplementary report, can be prevented from affecting the concrete by using proper varnish. At the end of 16 months' test a concrete tank covered with two coats of Bakelite varnish has proved absolutely satisfactory for storing molasses. This is the only test that has been made in which neither the concrete, coating nor molasses has been injured. It may therefore be said that molasses may safely be stored in concrete which has been properly protected by the application of two coats of Bakelite varnish.

Similarly, it is reported that concentrated brines from the manufacture of salt had no injurious effect on a concrete tank coated with two layers of gilsonite compound between which was placed asphalt burlap fabric, also covered with a heavy coat of gilsonite. Upon this was placed a 1:2 cement mortar coating and facing, and two coats of Bakelite. In the report it was suggested that probably as good results could be obtained by omitting the asphalt felt and using instead a swab coat of blown-oil gilsonite compound, after painting with a printing coat of the same material thinned with gasoline. Upon this a layer of burlap fabric and two swab coats of the compound should be placed, then the cement mortar and Bakelite treatment applied as described.

Unballasted Subway Track Proves Economical

Ten Years' Experience in Philadelphia with Ties on Concrete Bed Shows 50 Per Cent Lower Maintenance Cost

NEARLY ten years of severe service of unballasted track in the Philadelphia subway have satisfied William S. Twining, director of the department of city transit, Philadelphia, and chief engineer of the Rapid Transit System at the time the track was laid, of the economy and desirability of that type of construction. He discusses the subject in a recent issue of the *Electric Railway Journal*. Except on curves, where there had been rail renewals, the track is still as originally laid, while ballasted track on the Market Street elevated line, laid at the same time with the same type of rail and joints, required extensive rail and tie renewals in 1912 and 1913. Taking into account maintenance, Mr. Twining estimates a 10-per cent lower cost per mile for the unballasted track.



TYPICAL CROSS-SECTION OF PHILADELPHIA UNBALLASTED TRACK CONSTRUCTION

The first section of the unballasted track, the construction of which is shown in the accompanying cross-section, was placed in operation in February, 1907, and has been in continuous use since that date. The same rail and construction throughout as originally laid is still in service with the exception of the rail on curves, and probably the rail on tangents will have a life of about a year and a half more. During this period approximately 3,500,000 cars have used the track, or a tonnage of about 140,000,000.

Comparison of Types

As there is no ballasted construction on any of the subway tracks in Philadelphia, the nearest approach to a comparison of maintenance costs between the ballasted and the unballasted type of construction is afforded by the tracks of the Market Street elevated line immediately west of the subway. These were laid at the same time with precisely the same type of rail and similar joint plates. The elevated construction consists of 6 x 8-in. by 8-ft. ties on stone ballast with a depth of from 5 to 8 in. beneath the ties. The rail on the elevated structure was in such condition in 1912 as to demand renewal throughout the entire section between Twenty-ninth and Sixty-third streets. This was done late in 1912 and early in 1913, after a life of six years, and during 1912 and 1913 the greater part of the ties were likewise renewed.

Comparative yearly costs per mile are given in the accompanying table, and show a difference of $354 per mile per year in favor of the unballasted construction. The life lengths of the rail are based on actual experience in Philadelphia. There is no information at hand as to how long untreated ties will last in the subway, but the present ties are in first-class condition after nearly ten years of service, and their life length has been placed at fifteen years. The ties in each case are untreated.

Other advantages of the unballasted construction given by Mr. Twining are the cleanliness of the subway and the additional room obtained for the storage of material for repairs or renewals. The matter of cleanliness, it is pointed out, is very important. The floor is practically a granolithic surface, which can be cleaned either by flushing with water or by sweeping with ordinary brooms, both of which methods have been used effectively and to such an extent that absolutely no foreign matter of any description has been allowed to remain. The track space of station platform is swept up each night during night traffic, and the other portions of the subway are cleaned at frequent intervals.

COMPARATIVE COSTS OF UNBALLASTED AND BALLASTED CONSTRUCTION

Unballasted Construction	
Interest on initial cost ($44,352 at 5 per cent)	$2,218.00
Sinking fund for tie renewals ($4,224 in fifteen years)	192.00
Sinking fund for rail renewals ($6,336 in ten years)	496.00
Maintenance	528.00
Total yearly cost per mile	$3,434.00
Ballasted Construction	
Interest on initial cost ($24,288 at 5 per cent)	$1,214.00
Sinking fund for tie renewals ($5,808 in eight years)	600.00
Sinking fund for rail renewals ($6,336 in six years)	918.00
Maintenance	1,056.00
Total yearly cost per mile	$3,788.00

In conclusion Mr. Twining states that after nearly ten years of service there is no hesitancy in saying that the aims of the designers have been fully realized, and that no defects have been indicated that would suggest any desirable changes in the method of construction.

Record Grade for Concrete Pavement

So far as is known, the steepest grade upon which concrete has been used is in Los Angeles. The Portland Cement Association has recently distributed a photographic reproduction of Baxter Street in that city, where grades range from 11 to 29 per cent.

COMPLETED UNBALLASTED TRACK IN PHILADELPHIA SUBWAY, AND SAME IN COURSE OF CONSTRUCTION, WITH STEEL EXPOSED

American Engineers for Canadian Work

Two Contrasting Views Presented of Controversy Arising from Choice of Head for Government Valuation of Railroads

TWO contrasting views have reached this journal from Canada relative to the appointment of Prof. George F. Swain to take charge of the government valuation of the Canadian railways and the circular of protest issued by the Canadian Society of Civil Engineers. R. A. Ross, consulting engineer, of Montreal, in a letter to the editor of the Engineering Record, holds that the action of the Canadian Society is in no way a reflection on Prof. Swain, nor even on American engineers, but is the beginning of a campaign to force the Dominion's lawyer-politicians to recognize the Canadian engineers. He points to the exclusion by law of Canadian engineers from American governmental affairs, and insists that in self-defense Canadians must fight against free trade that works one way only. Another side of the matter is presented by the Toronto *Mail and Empire*, which, quoting from a government memorandum in answer to the circular and from statements by Sir Henry Drayton of the special commission, points to the necessity for getting the best man for a work of such magnitude and to the scarcity of Canadian engineers at once qualified by experience to take charge of the investigation and unaffiliated with any of the properties to be investigated.

R. A. Ross' Letter

Mr. Ross' letter is as follows:

"I have read with a great deal of interest the editorial in your issue of Sept. 23, page 369, dealing with the circular recently issued by the Canadian Society of Civil Engineers relative to the appointment of Prof. Swain as engineering adviser to a commission recently formed by the Canadian government for the study of the railway problem in this country. Your editorial is unexceptionable both in spirit and tone and affords the opportunity Canadian engineers desire to place their position before the engineering fraternity in the United States.

"As regards the case in point, it is one of a series of similar appointments made by the Dominion and provincial governments which have hitherto called forth merely desultory criticism by individual members of the society.

The Beginning of a Campaign

"In this case (a particularly flagrant one in the opinion of all) it was decided that united action should be taken, not, be it noted, so much against American engineers as such, nor at all against Prof. Swain, but against the government's total neglect of Canadian engineers. The action is intended as the opening gun of a campaign to force a recognition of the engineer on our lawyer politicians.

"In dealing with the matter we first met Prof. Swain at a small dinner in his honor in Montreal, and laid before him our intended program, in which his case was a mere incident, pointing out that we had no criticisms to offer as to his attitude, as we would all be ready to act for the government of the United States should that government decide to call in Canadian engineers for advice—a thing, by the way, which has never happened and never can happen, owing to the legislation against such appointments to which you refer in your editorial.

Ethics and Plain Living

"Your editorial deals with the Canadian engineers' action on a high ethical plane. We entirely agree with the ethics of high thinking and plain living, and have held that position up till recently without complaint, although the plain living has become plainer, especially during the last three years; but at last we have awakened to the fact that the game is not played in that way, and that the admonition is not for practical use, but only for application to others—and we apparently are the others.

"The Canadian engineer is not surrounded by carefully constructed wire entanglements of defensive laws, and has had to fight in the open against all comers—and they have come in recent years in ever-increasing numbers. We are therefore in the position of a nation of avowed free traders who find that the other fellows are protectionists, and that in order to obtain, not the free trade which they desire and have always upheld, but merely a fair trade, they must take such action as will provide at least the less desirable alternative.

"How far we may ultimately find it advisable to go in the direction of much disliked protection we do not know, but the present situation is not as yet connected with a demand for legislation, being designed merely to discourage the calling in of outsiders where such necessity does not exist. As a matter of fact, the engineer in this as in other countries resents his position under the domination of the politician and proposes to make himself felt, and with this view you will be in entire sympathy and rejoiced to know that we are at last alive and kicking.

Little Criticism of the Circular

"Your interest in the question of the reception accorded the circular will be satisfied when you know that the decision of the council was unanimous, and as to the membership in general the only criticisms we have heard are from four United States members, all directed along the lines of your editorial. This unanimous approval of Canadian members must indicate clearly that the matter is not a new question, but has been drilled in during past years by experience of governmental action, and indicates a well-grounded body of opinion indorsing the action of the council.

"The American engineer in question is a member of our society, and a valued one, and your query as to how we can protest his appointment on government work can be covered quite simply. A large number of Canadians are members of American societies and yet require a special act of Congress for each case to permit of their doing government work. May it be pertinent to inquire what would be the attitude of the American societies toward any American government which preferred Canadians, and passed over without consideration their own countrymen, or undertook to remove the legal restrictions imposed on alien engineers in the United States?

"The foregoing question does appear pertinent to such confirmed free traders as ourselves, as should we later obtain such protection as exists for engineers in your country we might be able to swap advantages and both return to that high ethical plane which we may be forced reluctantly to abandon in the not distant future, as our campaign for the recognition of the engineer develops."

The Government Viewpoint

The comments of the Toronto *Mail and Empire* on the controversy are in part as follows:

"The government memorandum says: 'It is the policy of the government to employ Canadians for all public purposes; but having regard to the magnitude and seriousness of the questions which confront the government with regard to the railways, they have not been disposed to dictate to the commissioners in the selection of the best available assistance on this continent or elsewhere. Indeed, the government could not expect the commissioners to undertake the very important and arduous task which has been set before them, unless they were given a free hand in such matters.'

"Sir Robert Borden secured from Sir Henry Drayton a report upon the matter. Sir Henry states that no apology is to be made for the appointment complained of, that of Professor Swain of Harvard, himself a member, as Sir Henry points out, of the Canadian society. Sir Henry's letter incidentally throws much light on the character of the work which the commissioners have undertaken. He states his personal preference for local men, but adds that in a situation of the present magnitude the best men available must be got, wherever they may be. Professor Swain has not been selected to advise the commission on construction or operation.

Few Canadians Eligible

"The commissioners have decided to obtain a physical valuation of the various railways, a work which calls for a large staff and six months of time. No general valuation has ever been made in Canada. It is work which Professor Swain has done in the United States for years. Sir Henry points out that all Canadian railway engineers of standing have been, at some time, or are now employed by railway companies, and the council of the protesting society includes two Canadian Pacific engineers, two Grand Trunk and two Canadian Northern, as well as engineers of the government railways.

"'Besides the matter of public interest in having an entirely unprejudiced report,' Sir Henry says, 'the interests of the companies themselves must be considered.'

"He alludes to the unfairness of having the engineers of one road value the property of another. Sir Henry expresses the belief that the protest of the society was launched in good faith, but he calls attention to the council's circular calling upon members of the society to write to members of Parliament.

"'It would be difficult,' says the commissioner, 'to imagine a more complete initiation of an attempt to achieve a result by political influence.' He gives the opinion that on permanent government work only Canadians should be employed, but says that for temporary work the best man should be got without regard to his parish or country, 'and a great hurt will be done to public ownership and administration in Canada if campaigns such as that now undertaken are to flourish in the future.'"

New Terminal Is Under Way at San Antonio

Program of Missouri, Kansas & Texas Includes New Passenger and Freight Stations and 7-Mile Subsidiary Belt Line

By D. A. TOMLINSON
Company A, Illinois Engineers, Camp Lyon, San Antonio, Texas

THE CONGESTION of present facilities at San Antonio, Tex., caused by increase in traffic, has led the Missouri, Kansas & Texas Railway to make designs for new and more adequate terminals for both passengers and freight. At present this road uses the Southern Pacific terminals, leasing certain freight facilities and running rights. The San Antonio Belt & Terminal Railway Company, controlled by the Missouri, Kansas & Texas, has been organized to construct and operate the desired terminal facilities, which for the present will be used exclusively by the latter. Final plans are now being prepared and preliminary construction is under way. It is estimated that the work now planned will cost $2,000,000.

Belt Line

The Missouri, Kansas & Texas tracks, entering from the north, now join those of the Galveston, Harrisburg & San Antonio (Southern Pacific) at June Avenue in the northeast part of the city, all trains of the former running in from there over tracks of the latter to the station at Commerce and Walnut streets. The new belt line will run due south from the Southern Pacific junction, as a continuation of the present Missouri, Kansas & Texas tracks for 2 miles, thence turn and run 4 miles west and then run northeast 1 mile to the new terminal in the block bounded by South Flores, Durango, South Laredo and Arsenal streets, half a mile southwest of the business center of the city. Thus to reach the new terminal from the present Missouri, Kansas & Texas tracks the new line will make a semicircle in the outskirts of the city on the east and south sides. The main line will be single track, with provision for a second track when desired, and increasing to two and three tracks near the terminal.

Present plans call for 7 miles of main tracks and 8 miles of yard tracks. A freight yard is to be constructed half a mile north of the present Southern Pacific junction on 200 acres of ground near Fort Sam Houston and Camp Lyon (formerly Camp Wilson), where the Illinois and Wisconsin militia is in camp.

New Terminals

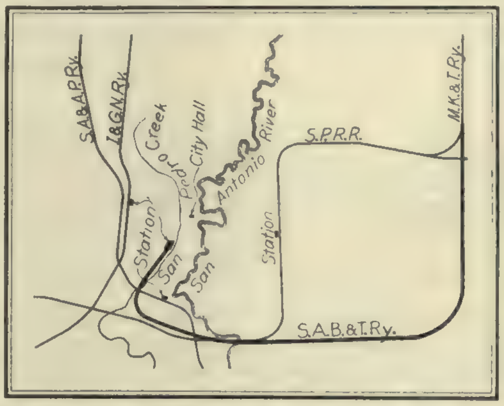
The passenger station at Durango and South Flores Streets will be a one-story structure of mission design, costing about $125,000. There are to be three station tracks, 1200 ft. in length, with provision for additional tracks when needed.

Just west of the passenger station will be a team yard consisting of thirteen tracks, placed in pairs on 12-ft. centers, with 35-ft. centers across the driveways. Beyond them, fronting on South Laredo Street, will be a one-story reinforced-concrete freight house, 50 x 255 ft., with four house tracks. At the north end will be a second story, 50 x 50 ft., for offices.

As far as practicable, street grade-crossings are to be avoided, the tracks passing under nine streets and over seven, and crossing but two at grade. There will be four railroad grade-crossings—two with the Southern Pacific and two with the San Antonio & Aransas Pass. Nearly 500,000 cu. yd. of earth is to be moved, the average haul being about a mile.

This summer work was begun on the station and approaches, but as yet construction has not been started on the main line.

San Pedro Creek flows along the station site and approaches for some 2800 ft., and to secure space and prevent washouts after heavy storms a conduit to carry it through the property is under construction. South of the station it is of mass concrete, 14 ft. 4 in. wide and 6 ft. deep, and is open. It is on the west side of the right-of-way, leaving space for four tracks on the east side. This section, which will be 1400 ft. long, is nearly completed. The creek will be carried beneath the station in a covered conduit, also 1400 ft. long, consisting of two chambers, each 8 ft. wide and 6 ft.



NEW TERMINAL WILL BE NEAREST TO CITY HALL

deep, work on which will be started shortly. The open section of the conduit is of mass concrete; in the covered section the walls and bottom will be mass, and the top over which tracks will be laid will be reinforced. The construction of this conduit requires the removal of about 17,000 cu. yd. of earth.

Design of the Conduit

In the design of the conduit the drainage area was found to be 1450 acres, and the average slope of the watershed 10 in 1000. Assuming a rain of 3 in., and computing the maximum runoff from the Berkli-Ziegler formula $Q = CrA\sqrt[4]{s/A}$, with C, the percentage of runoff, taken as 75, Q was found to be 990 sec.-ft.

In the covered conduit, with each half 8 ft. wide and 6 ft. deep, it was considered allowable for the water to reach a depth of 5 ft. 9 in., and in the Kutter formula the coefficient of friction was taken as 0.012. Using the formula $v = c\sqrt{rs}$, s was 0.00284, r was 2.36, c was 147 and v was found to be 11.9 ft. per second. With an area of 5 ft. 9 in. by 8 ft. in each half of the conduit, the total runoff at this velocity would be 1094 sec.-ft. In the open conduit, giving it the same depth and allowable depth of flow, and a width of 14 ft., s being the same as in the closed conduit, and r being 3.16, v figured 14.2 ft. per second and Q 1143 sec.-ft.

As soon as certain franchise rights are secured from the city, work will be pushed on all sections on the line, and it is expected that it will be completed some time in 1917. The work is being done by Thomas & Jones, of St. Louis, general contractors, on the cost-plus-percentage basis. L. F. Lonnbladh is chief engineer of the belt line and of the Missouri, Kansas & Texas. E. L. Martin is resident engineer in direct charge of the work.

A Law Formulated to Prevent Public Service Strikes

Henry R. Towne Proposes Enlistment Contract Between Company and Employee and Orderly Treatment of Differences

AN enlistment contract for a stated term, after a probationary period for new employees, is one of the features of a law proposed by Henry R. Towne, past president of the Merchants' Association of New York, to insure continuous and adequate service from all public utilities. Such a contract would be required between each utility and each of its employees, and would be renewable by mutual agreement. The company could terminate the contract because of misconduct by the employees, as defined by law; because of slack business, in which case the employee should have thirty days' notice, or two weeks' pay and immediate release, or because of disability or superannuation, on stated notice. The employee could terminate the contract because of valid family or personal necessity, because of sickness or unfavorable effect on health, or for cause not stated, upon fair notice, without penalty if with the company's consent, otherwise subject to fine as provided by law.

Schedules of Fines

A schedule of fines for both corporation and employee would be a part of the plan. Fines against the company would be collectible from a fund created by the company and vested in a trustee; those against an employee from a fund created by the company's retention of a percentage of the employee's first wages—the company to return this fund with interest when the employee leaves the company. Several methods are proposed for the assessment of fines, which would be payable to the other party to the contract.

Employees would have a right to join any lawful organization, and could alone or in combination with others request concessions in wages or conditions of service, and the company would be required to give prompt and fair consideration to all such requests, without discriminating against any employee for participation in such requests. The employee could appeal decisions to a joint board of award, constituted under the law by joint action of the company and its employees, and both the company and its employees would have the right to appeal to an appropriate federal or state body.

During the term of any contract between the company and an employee the discharge of an employee or the cessation of services by the employee, except as provided by law and previously stated, would be an offense at law and punishable as such.

Typhoid Decreases in St. Louis

Filtration of the St. Louis water supply is probably responsible for the low death rate of 7 per 100,000 population reported in the latest annual report of E. E. Wall, water commissioner. He states that the quality of the water delivered to consumers for 1915 has always been of a higher standard than that set by the U. S. Treasury Department for drinking water to be supplied by common carriers. The death rate for sixteen years, beginning with 1900, is as follows: 29.2, 33.8, 37.1, 47.1, 36.2, 19.0, 17.4, 15.6, 14.2, 14.9, 13.8, 15.4, 10.4, 16.9, 12.4 and 7.0.

Every Possible Precaution Observed to Make Watertight Keechelus Reservoir, Washington

Impervious Foundation, Watertight Connection to Embankment and Inclosed Stilling Pond Features of Design of Dam in Yakima Valley

By C. E. CROWNOVER
Construction Engineer, U. S. Reclamation Service, Meadow Creek, Washington

IN the central part of the State of Washington tributary to the Yakima River is a large section of arid land extending for more than 100 miles along the river. Irrigation had been practised in this valley since 1867, but confined to small areas along the small streams where diversion was not difficult. With the advent of the Northern Pacific Railway in 1886, real irrigation development began. From that time until the passage of the Reclamation Act, in 1902, irrigation developed in the Yakima Valley until 121,000 acres were under cultivation in this manner. The natural flow of the Yakima River and its tributaries had, during the latter part of the irrigating season, been overappropriated, and was leading to serious complications of water rights.

No storage had, up to this time, been provided, and it was evident that before further development could take place it would be necessary to supply storage water. With this in view, investigations were begun by the U. S. Reclamation Service in 1904. Preliminary surveys indicated that at the headwaters of the streams favorable sites for storage reservoirs existed, and that these were capable of economical development. The Secretary of the Interior required that before any work be undertaken in the valley, either for the impounding of storage or the placing of water on the land, all water rights be settled and all pending litigation dismissed. This was accomplished late in 1905, and early in 1906 construction was authorized.

The work was made possible by an act of the State Legislature of March 4, 1905, granting special privileges to the United States. In conformity with this act a notice was filed in the office of the State land commissioner on May 10, 1905, withdrawing all the water of the Yakima River and its tributaries then unappropriated. This withdrawal has been maintained by the extension of time on the part of the State for the construction of the necessary works for the use of the waters.

Water to Irrigate More Than 450,000 Acres

Extended investigations were at once begun to determine the areas that could be most economically watered and the maximum amount of storage capacity that could be developed. It was found that the amount of land susceptible of irrigation, and on which it was possible to place water at a reasonable cost, exceeded that for which water could be made available. It was discovered that storage reservoirs with a combined capacity of 1,082,000 acre-feet could be constructed at a reasonable cost, and that the water so stored, when properly handled in conjunction with the flood flows, would be sufficient for the irrigation of 452,000 acres in addition to the areas which have sufficient low-water rights.

These five reservoirs are all located near the headwaters of the Yakima River or its tributaries. In no case does bedrock exist within a reasonable depth, so that the earth or rock-fill type of dam has, in all cases, been adopted. The accompanying table gives the principal data regarding the various reservoirs.

Construction was begun in the order named, the first being completed in 1910, the second in 1912 (Engineering Record, Vol. 65, page 101), and the third, at Lake Keechelus, is now under construction. The construction of canal and distribution systems was begun in the valley below by the Reclamation Service, and the completion of these has kept pace with the development of storage.

Keechelus Lake Stores 152,000 Acre-Feet

By the construction of a dam at the foot of Lake Keechelus a reservoir will be created with a storage capacity of 152,000 acre-feet. Of that amount 40,000 acre-feet is obtained from substorage by lowering the natural surface of the lake 30 ft. and the remainder of 112,000 acre-feet by raising the lake surface 57 ft.

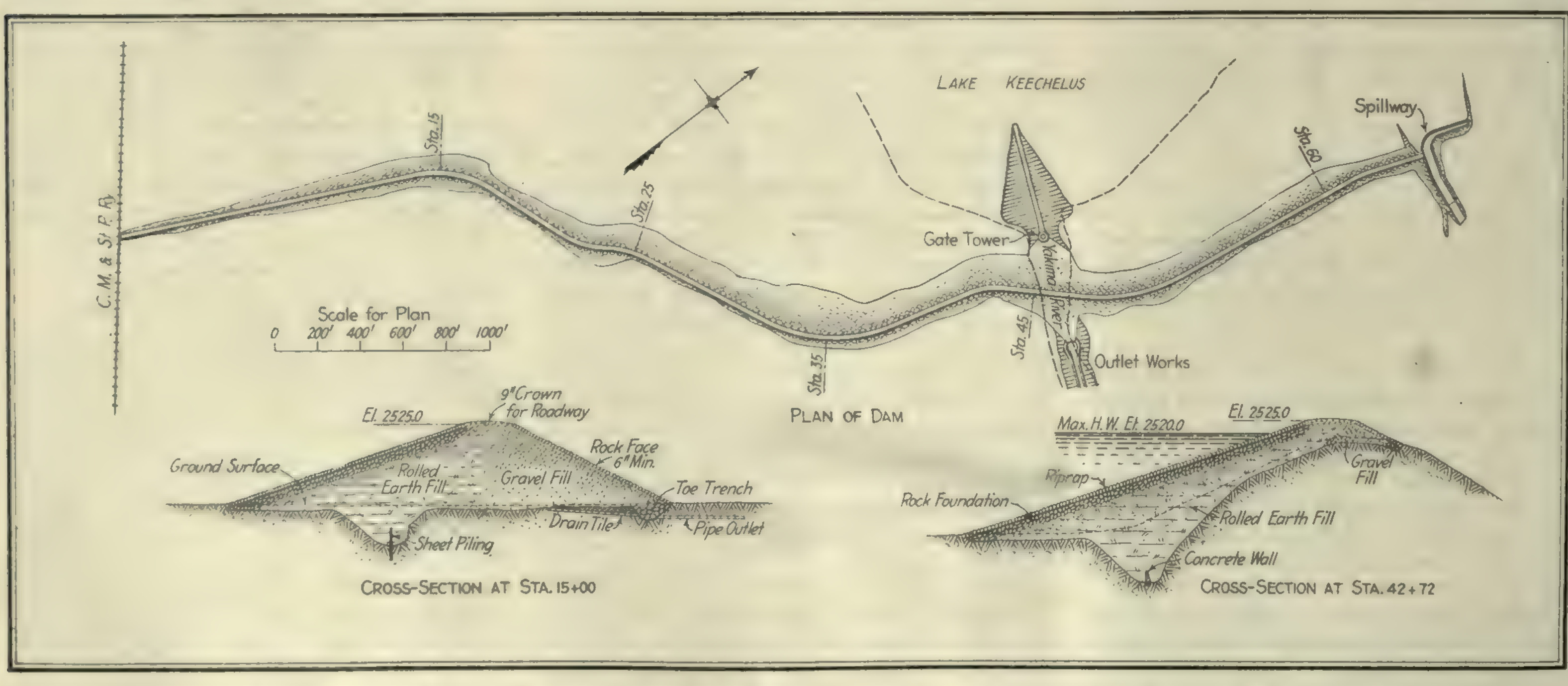
The material at the site of the dam is a glacial deposit heavily covered with forest trees. The length of the embankment is 6500 ft. at the crest. In order to utilize several natural dikes, seven curves are introduced into the alignment, as shown on the general plan. The height of the embankment above the original river bed at the river section is 70 ft., and above the gate sill at this point 100 ft. The top width at the crest is 20 ft., the water slope 3:1, while on the lower side the slope is 2:1. A cutoff trench 10 ft. wide at the bottom has ¾:1 side slopes, and varies in depth from 5 to 20 ft. At the river section it was found more economical to place the core wall in a deep, narrow trench. The position of the core wall with reference to the cross-section of the dam is shown in the sections, while its depth and height are shown on the profile.

Features of Design

In the design and construction of this dam the following important points of earth-dam construction have been kept constantly in mind: To secure an impervious foundation and embankment and a watertight connection between the foundation and embankment. It is recognized, however,

Data on Yakima River Reservoirs

Reservoir	Capacity, Acre-Feet	Length of Dam, Ft.	Maximum Height of Dam Above Gate Sill, Ft.	Contents of Embankment, Cu. Yd.	Type of Dam
Bumping Lake	34,000	3,500	40	233,800	Earth and gravel
Kachess Lake	210,000	1,400	75	182,100	Earth and gravel
Keechelus Lake	152,000	6,500	100	522,000	Earth and gravel
Clealum Lake	501,000	700	188	415,000	Earth and gravel
Tieton	185,000	1,030	192	991,000	Earth and rock fill
	1,082,000				



UTILIZING NATURAL DIKES AS PART OF DAM CAUSED CURVED ALIGNMENT; CROSS-SECTIONS GIVE DETAILS OF EMBANKMENT

that only under the most favorable conditions can a high earth dam be constructed that will be absolutely watertight. Therefore, the aim here has been to discourage, as far as possible, the entrance of water either into the embankment or under it. Should seepage reach the lower side of the core wall, provision has been made to prevent saturation of either embankment or foundation and to drain away any water that may not have been intercepted. Particular care has been taken to prevent seepage along the wall of the conduit. The spillway is in excavation, and well removed from the body of the dam.

Details of the construction methods employed on this project will appear in a future issue. In that article the methods employed to make the reservoir as nearly 100 per cent watertight as possible will be discussed.

The original designs contemplated driving an outlet tunnel 3300 ft. long, connecting with the river below by a open cut. Near the upper, or lake, end a concrete gate tower was to be placed partly through a shaft containing the outlet-control gates. The grade of this tunnel was placed 20 ft. lower than the outlet grade as finally built, and afforded 24,000 acre-feet more storage than now obtained. Construction was begun on this design and four headings were started through two shafts. After driving a total of about 200 ft. of top headings, such unstable ground—carrying a large amount of water under pressure—was encountered that further progress, except at heavy cost, was impossible. As it was not believed that the additional storage to be gained justified the expense, the scheme was abandoned and the grade of the outlet tunnel raised 24 ft. and placed in the river section.

The location shown on the plan consists of three principal features—intake channel 565 ft. long, conduit 495 ft. long, and open channel section (not shown) below the dam 3300 ft. long. The total length is 4380 ft. The total excavation was 314,000 cu. yd., and maximum cut 60 ft. A 12 x 12-ft. horseshoe-type reinforced-concrete conduit under the dam connects with a circular gate tower at the upper toe, in which are located the gates for controlling the outflow.

METHOD OF KILLING SPOUTING VELOCITY

Ordinary forms of gate control, involving slide gates discharging directly into the outlet tunnel, would, in this case, under a full reservoir head, produce spouting velocities exceeding 70 ft. per second. Such a condition is unsafe for earth-dam construction. A circular type of tower was adopted, as shown, with cylinder gates so placed that the energy is destroyed in the tower itself before entering the conduit.

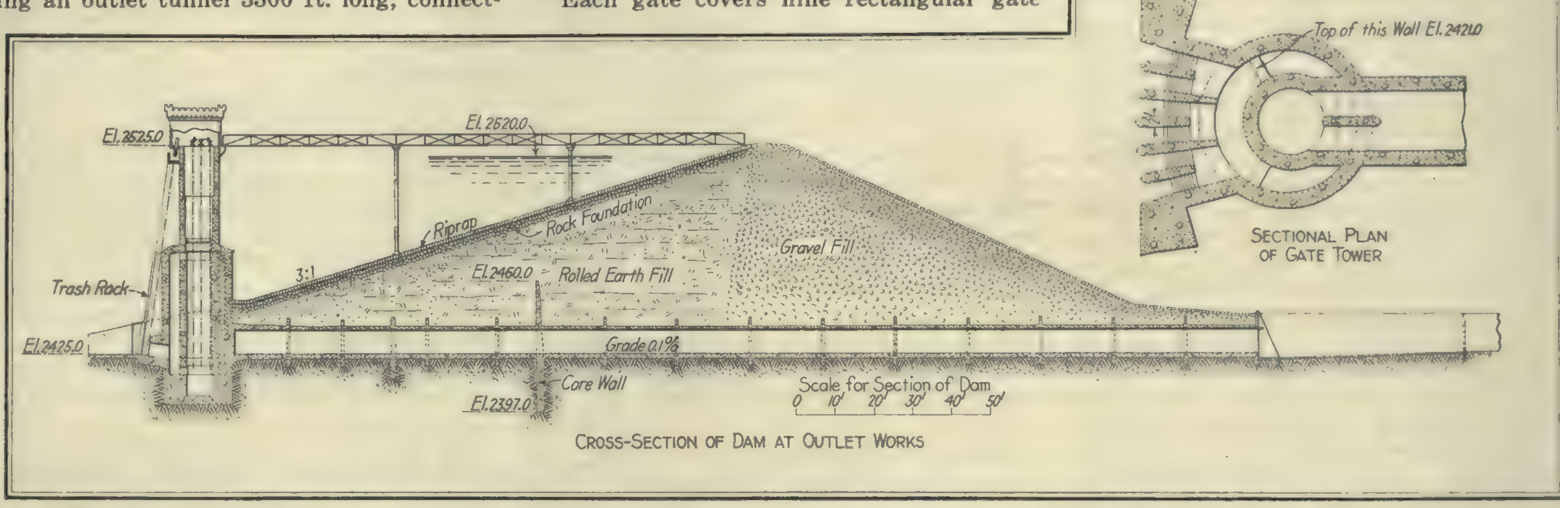
The design consists essentially of a double reinforced-concrete tower connected by radial walls. The outer tower connects at the front with the reservoir water, while the inner tower connects at the rear with the outlet conduit. The water, after entering, flows freely in the annular space between the two towers. The tendency to form eddying currents is counteracted by the radial walls, which are not continuous but in 4-ft. vertical sections. The water's entrance to the inner tower, and thence to the outlet conduit, is controlled by two cast-iron gates with smooth open interiors, each 12 ft. in diameter and 4 ft. in height, placed on the inside of the inner tower. One is half way up the tower for high heads and the other depressed below the outlet tunnel for low heads.

Each gate covers nine rectangular gate openings through the wall of the inner tower. Each of the two gate openings is formed by cast-iron top and bottom plates. The nine piers forming each opening are of hollow cast-iron, with holes in top and bottom corresponding to similar ones in the top and bottom plates. The piers are filled with concrete, and the concrete wall of the tower thus becomes continuous. The gates are guided in their travel by a circular cast-iron extension anchored to the concrete wall containing nine guide strips arranged so as to prevent rotation. The walls of the sump are lined with heavy boiler plate, while the bottom has 12-in. timber lining. Both are removable.

All water enters the space between the two towers through six 3 x 7-ft. rectangular openings. These openings are controlled by slide gates operated by hydraulic cylinders at the top of the tower. They are for emergency use and in their normal position are all open. They are closed only for inspection of the structures or in case of accident. These openings are protected by trash racks.

Water passing through the upper cylinder gate drops through free space upon a water cushion not less than 20 ft. deep before passing out through the conduit. When the lower cylinder gate is in use the water, after passing through, rises in the tower. Dangerous spouting velocities are eliminated, the head over the conduit entrance being reduced to that sufficient to produce only the initial velocity, which for maximum flood flow of 2000 cu. ft. per second is but 16 ft. per second. Each gate will be operated by three rising stems from the gate house on top of the tower. As the pressure is practically equal at all points on the circumference of the cylinder gates, there will be little, if any, friction. Therefore, a simple hand-operated raising and lowering device is planned.

The horseshoe type of outlet conduit, rather than the circular type, was adopted because at the end of the irrigation season it may be desirable to discharge relatively large amounts of water when the supply in the reservoir is low. The walls of the conduit above the core wall are designed to withstand a pressure equivalent to hydrostatic head for full reservoir, while below the core wall fluid earth weighing 90 lb. per cubic foot for a depth of 15 ft. above the arch was assumed. The conduit passes through the core wall, both having been formed at the same time. Above the core wall, collars 18 in. thick, and extending out from the conduit 4 and 5 ft. alternately for its entire circumference, were placed at intervals of 25 ft. Similar collars surround the conduit between the core wall and its lower end at intervals of 35 ft.



GATE TOWER SO DESIGNED THAT SPOUTING VELOCITY IS DESTROYED BEFORE WATER REACHES CONDUIT

To slow up the water as it emerges from the conduit, so that it will not erode the channel below, a stilling pool will be constructed as shown. Previous experience on this project has proved that under even moderate heads, where spouting velocities are produced, it is necessary to provide concrete-lined channels for at least 500 ft. from the lower toe of the dam. Even then considerable trouble is experienced in maintaining the channel below this point. The design of tower here described, by eliminating the high conduit velocities, gets rid of this very troublesome factor in the maintenance of earth dams.

DETAILS OF SPILLWAY

The spillway, located in a solid rock cut at the north end of the dam, consists of a concrete weir of the ogee type, 300 ft. long, and discharging through a concrete-lined channel into a natural ravine. This in turn empties into the Yakima River about a mile below the dam. The spillway crest is 10 ft. below the top of the dam, and, with a discharge of 10,000 sec.-ft., the water surface is 4.5 ft. deep over the crest. The greatest flood of record was 6200 cu. ft. per second. The curved channel was adopted rather than a straight one because it was impossible to place the entire structure in solid rock at a minimum cost. While the entire channel is located in solid rock, it

proved more economical to line throughout with concrete on account of the increased capacity and consequent reduction of excavation.

The work is under the general direction of the U. S. Reclamation Service, of which A. P. Davis is director and chief engineer. Until July, 1915, the work was under the administrative supervision of G. H. Swigart, supervising engineer of the Washington division. Later, S. B. Williamson, chief of construction, had supervision. The writer is in direct charge of construction on the Yakima storage project, assisted by R. E. Post, superintendent of construction, and J. R. Sherman, assistant engineer.

Winnipeg Aqueduct Cracks Can Be Repaired Within Original Cost Estimate

Consulting Engineers Suggest Wider Base and Reinforced Invert to Prevent Settlement of Concrete Conduit in Bad Ground

IN spite of cracks in the concrete invert and arch of the Winnipeg aqueduct, which developed in certain sections last year as the result of settlement of the invert under the side walls in treacherous ground, the 97-mile conduit which will carry water from Shoal Lake to the towns comprising the Greater Winnipeg Water District will be completed within the original estimate of cost, and, with repairs now in course of completion, will fulfill the purpose for which it was intended. This is the substance of a report by a board of consulting engineers consisting of Brig.-Gen. H. N. Ruttan, ex-city engineer of Winnipeg; J. G. Sullivan, chief engineer, Western Lines, Canadian Pacific Railway, and R. S. Lea, consulting engineer, of Montreal, submitted Sept. 26 to the administration board of the Greater Winnipeg Water District. Pending the results of tests which may modify present plans, the engineers indorse the following precautions, taken during this year's working season, against settlement of future construction: In foundations of boulder clay, hardpan and gravel, extend the unreinforced aqueduct base 8 in. on each side; in more compressible soils, retain the 8-in. extensions and reinforce the invert.

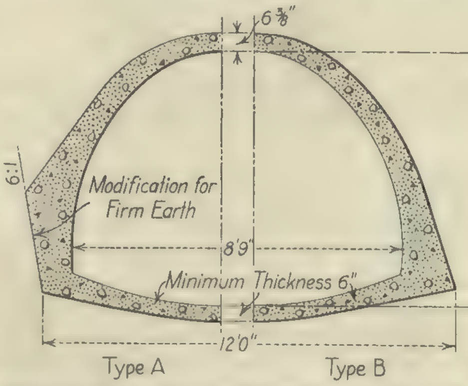
Between the reinforced invert, distributing the load over the entire width of the base of the aqueduct, and the plain invert with 8-in. extensions there is, the consulting engineers find, a wide difference in the pressure imposed upon the foundations. There are evidently intermediate designs, according to the report, which may be safely and advantageously employed. Experiments now under way will indicate what modification in the designs may be desirable. As for the cracked sections of aqueduct, these are being repaired by cutting grooves along the cracks and filling them with neat cement. The report points out that the damaged sections have shown no settlement since last April, and it is believed that they have reached a permanent bearing. Hydrostatic tests also have developed a satisfactory degree of watertightness in the repaired sections of the work.

Defects in the aqueduct constructed during the 1915 season were first discussed in a report submitted last February by James H. Fuertes, consulting engineer of the Winnipeg aqueduct, and W. G. Chace, chief engineer. To secure an independent expression of opinion on the subject matter of this document the administration board of the aqueduct appointed the special board of three consulting engineers, Messrs. Ruttan, Sullivan and Lea, previously referred to. A summary of their findings, which have just been made public, is given below.

The total length of the aqueduct is 96.6 miles, most of it being of the cut-and-cover, flow-line type, with a horseshoe-shaped plain concrete section varying from 5 ft. 4¾ in. high and 6 ft. 4¾ in. wide to 9 ft. high and 10 ft. 9 in. wide. The depth of earth cover over the top of the arch is 4 ft. The concrete is proportioned 1:3:4.

Extent of Cracking

The construction of the aqueduct was carried on at ten different points during 1915, and altogether more than 65,000 ft. were completed. In about 14,000 ft. of this total length invert cracks developed, usually a single crack along the middle of the invert, but in a few cases, in badly cracked sections, damage appeared at the side walls of the arch as well. Close observation has been kept of these cracks from their first appearance. The last movement was observed at the beginning of April, since which time there has been no indication that any further settlement has taken place.



TYPICAL AQUEDUCT SECTIONS SHOWING, AT LEFT, MODIFIED FORM FOR FIRM EARTH

In 4815 ft. the cracks vary in width from 1/16 to ¼ in., and in a few cases slightly larger. A total of 4017 ft. has cracks from 1/64 to 1/16 in. wide. In the remaining 5193 ft. the cracks are merely hair cracks, which can be discovered only by very careful examination. In many arches where the invert cracks are of considerable size corresponding cracks have occurred along the crown.

Settlement Caused Cracks

The cracks which formed at Mile 23 are much more extensive and much larger than in other portions of the work, and are practically continuous. Mile 23 is in the "prairie section," where the material is clay. The type of invert referred to as "standard invert for firm soil" was used. The bearing power of the foundation material, according to the report, proved to be much less than was anticipated, and, as a consequence, the considerable settlement under the load, as distributed by the type of invert used, has resulted in the cracking of the invert and then of the arch. In fact, the report attributes practically all of the cracking throughout the work to this same general cause.

At Mile 43 all of the larger cracks occurred in the shallower cuts. Here the subsoil is referred to as "moist sand with tendency to springs." All of the invert cracks, and most of the arch cracks, according to the report, were caused, as in the case previously referred to, by settlement under the side walls, much of which—and probably the greater part—was apparently due to insufficient protection of the trench bottom before the inverts were put in place.

It appears from the report that the backfilling of the arch on the 1915 work was postponed until the end of the season. "If the backfilling had closely followed the arch construction," the consulting engineers state, "the appearance of cracks due to settlement would have suggested and permitted the prompt adoption of measures which would have prevented most of those which have occurred."

Methods of Repair

The cost of the portion of the entire aqueduct structure in which settlement cracks have occurred is $104,360. The cost of the invert alone is $34,198. The damaged work, it is said, can be repaired to be as permanent and efficient as other portions of the aqueduct. Hydrostatic and other tests made during the present season on portions of the completed aqueduct lead to the belief that none of the work so far built will have to be removed.

The method of repairing the cracked aqueduct sections is as follows: The section to be repaired is thoroughly cleaned. The cracks are cut out to a depth of 1½ to 2 in., and to a width of about 1 in. This groove, as far as possible, is made wider at the bottom than at the top, and never V-shaped. It is carefully cleaned with water and then packed with neat cement, slightly moistened and hammered solidly into place, using a special calking tool. This makes not only an exceedingly tight joint but a very strong one. Several sections of invert, including portions of these joints, have been cut and tested. The cement filling, even after having been in place only two or three days, was found to adhere so strongly to the concrete that when broken the break has generally been in the old concrete, sometimes in the filling, but never at the junction of the two.

Leakage Tests Satisfactory

Two sections of aqueduct at Mile 23, each about 270 ft. long, and purposely selected to include the most seriously damaged portion of the 1915 work, were repaired in this way in July. Watertight bulkheads were built at each end of the sections, which were then filled with water to the level corresponding to the rated discharge of 85,000,000 gal. per day. Daily records were kept of the loss of water as indicated by the fall in level. The results thus far, according to the report, are very satisfactory. The total loss at the present time is only about 250 gal. per day from each section, each of which has between 200 and 300 lin. ft. of expansion joint below water level. This leakage, it is pointed out, is equivalent to that which would escape through a single hole the size of a match. "The result shows," the report states, "that the cracks have been thoroughly closed. The loss of water stated is equivalent to less

than 5000 gal. per mile of aqueduct, which is much less than the limit usually specified for large concrete pipes under low heads."

Evidence furnished by a series of tests of portions of the completed aqueduct provided with special facilities for accurate observations of settlements, taken in connection with the fact that no settlement has taken place in the cracked sections since early in April, gives some indication that in most, if not all, of these sections the aqueduct has come to a permanent bearing. There is plenty of time to obtain assurance of this, and until another year's experience is available it would probably be advisable, the consulting engineers believe, to restrict repair work to what may be required to secure such further information as may be considered necessary in the meantime.

COST OF REPAIRS

The entire cost of repairs described in the foregoing, including labor, materials and incidentals, amounts to about 93 cents per lineal foot of aqueduct. As the sections repaired are of large size, and were cracked more seriously and extensively than any other parts of the 1915 work, the average cost per foot of such repairs will no doubt be much less, so that even if much of it should have to be done over the total cost of repairing will probably not be very great.

In an interim report, submitted May 5, the board of consulting engineers indorsed certain tentative measures to insure the integrity of future work. These involved an extension of the aqueduct base 8 in. on either side, and, where conditions demanded, the use of a reinforced instead of a plain concrete invert. The recommendation for the 8-in. extensions on each side of the aqueduct was made, according to the later (Sept. 26) report, notwithstanding the fact that nearly 10 miles of the 1915 work, with similar inverts, but without extensions, had stood without cracks or other indications of undue settlement. The 8-in. invert extensions were used in the hardest foundations on all of the 1916 work to date. The report states that they are probably being now employed in many places where they are unnecessary, and in the future the extent to which they may be used should be decided by the engineers of the aqueduct.

The reinforced invert design was used in compressible soils throughout the 1916 work, except where the character of the foundation, in the judgment of the engineers, justified the use of the plain extended invert. About 15 miles of aqueduct was constructed during the present season in accordance with these recommendations, and the greater part of it has been backfilled. So far, no settlement cracks have developed in any of this work. The reinforced invert in use, it is pointed out, is designed to distribute the load over the entire width of the base of the aqueduct. This reduces the unit pressure to such a small amount that the 8-in. extensions are said to be unnecessary, and can be safely omitted. Between the reinforced invert, distributing the load over the entire width of the base, and the plain invert with 8-in. extensions there is, according to the report, a wide difference in pressure imposed upon the foundations. There are evidently intermediate designs which may be safely and advantageously employed. Tests to determine what these designs are are now being carried on.

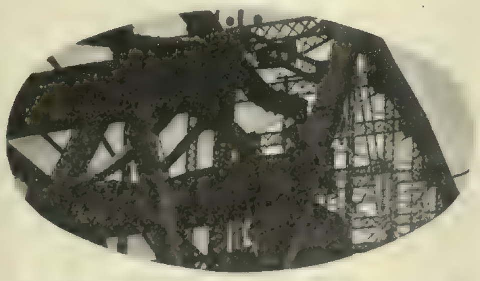
COST OF MODIFIED DESIGNS

Cost estimates indicate that if construction were to be continued as at present, without any changes in the modified designs followed during 1916, except the omission of extensions to the reinforced inverts, the total increased cost of the project would be in the vicinity of $500,000. If it is found that intermediate forms of reinforced invert, less heavily reinforced, may be safely used in portions of the work, this amount will be materially reduced.

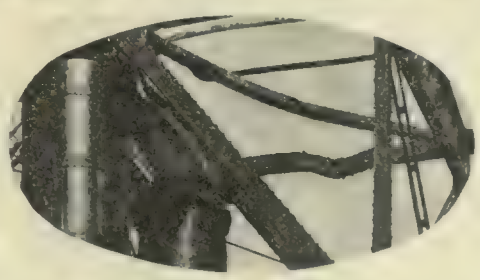
The original estimate of cost of the aqueduct from Deacon to the intake, including the cost of cement, and based on the contract quantities of the different items, amounted to $7,097,640. In these quantities a liberal allowance was made to cover contingencies, uncertainties as to foundations, etc. A revised estimate, based on the accurate information made available since the work was actually placed under construction, and including the cost of continuing the present expensive methods of constructing the inverts, amounts to only $6,867,700. According to these estimates the aqueduct will be completed, under the modified designs, well within the original estimate.

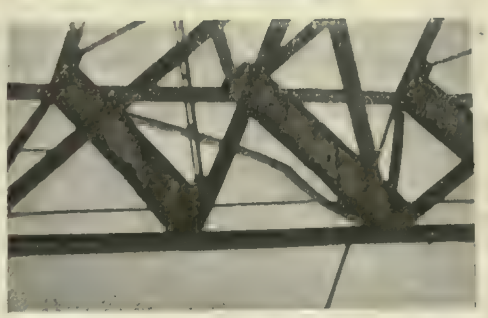
The board of consulting engineers concludes its report with statements to the effect that the aqueduct, when completed, will satisfactorily perform the service for which it was designed; that the work will be of such substantial and permanent character as to require only a reasonable charge for maintenance; and that the cost of the project will be fair and reasonable.

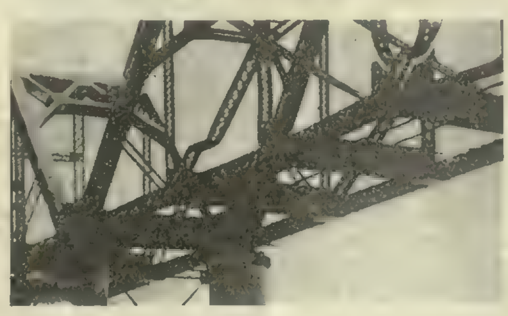
Heat From Burning Timber Floor Warps Steel of Bridge Over Missouri River at St. Charles, Mo.



THESE pictures of damage to the steel work of the St. Charles (Mo.) bridge caused by the burning of the timber floor, described in last week's issue, tell the story better than words. The upper photograph was taken from a point southeast of the structure. That to the left shows the buckling of several members of the deck truss span which caused the damage to the concrete pier in lower right view. Buckled floor-beams and laterals of this span, seen from beneath, are shown in the lower left cut. The lower center view indicates the bent sub-struts in the east through span. Right center shows the west end of the deck truss span.







Literature

For the Civil Engineer and Contractor

New Publications

DEPENDABLE CONCRETE—HYDRATED LIME and Its Effect on Workability, Segregation, Uniformity, Strength and Permeability. Paper, 6 x 9 in.; 14 pages; illustrated Pittsburgh, Hydrated Lime Bureau of the National Lime Manufacturers' Association.

SOUTH AMERICA—STUDY SUGGESTIONS. By Harry Erwin Bard, A.M., Ph.D., secretary of the Pan-American Society of the United States. Cloth, 5 x 7½ in.; 68 pages; illustrated. Boston, D. C. Heath & Company.

METHODS OF MAKING ELECTROLYSIS SURVEYS. By Burton McCullom and G. H. Ahlborn. Technologic Paper 28, U. S. Bureau of Standards. Paper, 7 x 10; 84 pages; illustrated. Washington, Government Printing Office.

CONCRETING IN COLD WEATHER. Paper, 6 x 9 in.; 15 pages; illustrated. Chicago, Portland Cement Association.

A GRAPHICAL METHOD FOR THE CORRECTION OF STEEL TAPES. By Walter Scott Weeks. Paper, 7 x 10½ in.; 8 pages; illustrated by chart. Berkeley, Cal., Publication in Engineering No. 9, University of California. 10 cents.

REPORT OF THE STATE ENGINEER AND SURVEYOR, NEW YORK, 1915. Vol. 2, on Hydraulic Data. Cloth, 6 x 9 in.; 428 pages; illustrated. Albany, J. B. Lyon Company.

CENTRIFUGAL PUMPS AND SUCTION DREDGES. By E. W. Sargeant. Cloth, 6 x 9 in.; 188 pages; illustrated. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Ltd.

A TEXT BOOK OF PRACTICAL HYDRAULICS. For the use of mining schools, technical colleges, county and hydraulic engineers. By James Park, dean of the faculty of mining engineering at Otago University, New Zealand. Cloth 5½ x 7¾ in.; 284 pages; illustrated. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Ltd. $4 net.

Books Reviewed

The Stability of Arches

Author, Ernest H. Sprague. Vol. 20, Broadway Series of Engineering Handbooks. Cloth, 4½ x 7½ in.; 141 pages; illustrated. London, Scott, Greenwood & Son; New York, D. Van Nostrand Company. $1.25 net.

This little volume is one of a series of engineering handbooks issued in London, and is designed to give satisfactory methods in investigation of masonry arches, based upon the elastic theory of deformation. For its size it is unusually complete in treatment, covering in more or less elementary fashion the principles and practical formulas used in the design of three-hinged, two-hinged and hingeless arches. Much of the treatment in the latter case follows Melan's analysis, and credit is also given to Tolkmitt.

A short historical sketch of the development of the arch forms an interesting introduction, Chapter 1, followed by a table of long arch spans, which, however, is not brought quite up to date for American bridges. The three-hinged, or three-pinned arch as it is designated in the text, is treated in Chapter 2, beginning with a general statement of methods of solving arches of any type. An example is given for uniform loading, using three methods of solution—(1) line of pressure, (2) calculation and (3) influence lines. A spandrel-braced arch is then solved, using the methods of composition of forces and influence lines.

In Chapter 3, after showing that the actual arch tests made in 1900 and the results of experiments on arch models using polarized light have dispelled early distrust of the elastic theory, the fundamental general formulas are derived, including the values for thrust and change of temperature as well as bending. Approximate formulas by which allowance can be made for thrust and temperature are included.

In Chapter 4 the two-hinged arch is treated, the true pole distance for the pressure line being computed by ratio, using a trial diagram. An example (150-ft. arch) is fully solved by three methods. The parabolic arch is also considered, and influence lines are drawn for bending moment at a given section. Chapter 5, on the hingeless arch, includes the graphical method for dividing the arch ring to give constant ratio of length to moment of inertia of section, and contains a good analysis based upon such sections, applying the elastic theory. The use of tables and influence lines makes the solution as simple as possible. A short method by Mesnager is reproduced.

The last three chapters treat the generally accepted analysis for masonry arches by the middle-third limit (using the principle of least work and reduced load contours), the design proper (including empirical formulas and the form of the arch ring) and the loads and unit stresses (including formulas for live loading) and a complete analysis for stresses across the normal section, using the elastic theory of Melan. An appendix contains useful graphical methods for constructing circular and parabolic arcs.

Aside from the crowded figures and poor lettering of the illustrations, the book is well printed, especially the mathematical formulas. Those who desire the simpler treatment of arch problems should find it satisfactory and useful.

The Planning of the Modern City

Author, Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City. Cloth, 6 x 9 in.; 423 pages; 149 illustrations. New York, John Wiley & Sons, Inc. $3.50 net.

The prime purpose of this book is to bring out the engineering side of city planning. As the author points out in his introduction, most previous works have featured the architectural or the administrative side. The author is modest in his justification of the book—so much so that when he states his illustrations, of which he favors plans and diagrams, are chosen rather to visualize a certain point than to adorn a book of travel, one might expect a prosaic technical work of the textbook type, useful but not entertaining. The reader does not go far, however, before he finds that this is no ordinary textbook. The pleasing style would keep the reader absorbed even if the real merit of the subject-matter were less. The thoroughness with which the author has handled a subject with which he is so evidently entirely at home would force the reader to give his attention if the style were less pleasing. Combining the thoroughness with the pleasing style, and adding these alleged utilitarian illustrations, which are drawn from all parts of the world, we have a book that should certainly be accessible for its technical value to all who have to do with city planning, and that will not prove wholly unentertaining to engineers and others who are not especially interested in city planning.

The first three chapters are introductory. They go into the reasons for city planning and the history of the movement, and the third chapter shows how a large part of city planning is the correction of mistakes.

It is in the fourth chapter, "Elements of a City Plan," that the author gets at the heart of his subject. While other authorities that he cites have enumerated other elements, he, as in his paper presented at the International Engineering Congress in 1915, gives four elements—the transportation system, the street system, the park and recreation facilities and the location of public buildings.

This chapter and the four succeeding ones devoted to the four elements of the city plan, like some other parts of the book, are elaborations of the engineering congress paper, but those who have read that paper should not suppose they have learned all of the author's ideas on those subjects. The chapter on the street system, which contains 44 pages, is one of the best in the book. The author is emphatically in favor of a radial street system and opposed to an inflexible rectangular system that rides roughshod over topography and landmarks. By public buildings the author means not merely buildings publicly owned, but markets, hospitals, railroad stations and the like, and even bridges and monuments. The pages are replete with illustrations of the good and the bad.

A short chapter on the economical value of the city plan is followed by one on the industrial district. "Street Traffic" and "Street Details—Utility and Adornments," are next taken up. Chapter 13, "The Railroad in Its Relation to the Street System," is devoted mainly to grade-crossing elimination. The author goes to some extent into the grade-crossing laws of various states, but does not commit himself as to which laws he deems best. The chapter on restrictions gives those as to heights, arrangement and use of buildings in many American and European cities, and contains many useful suggestions for communities considering the placing of restrictions.

In a chapter on the environs of a city the author points out the mistake of stopping the city plan at the city line. He realizes the difficulty of getting co-operation between towns, but thinks metropolitan planning districts could do much for the highway systems as they do now for water supply, sewerage and parks.

Chapter 16 is on garden cities, and four of the five remaining chapters have to do with the financial and administrative side of the work, their titles being respectively "City Planning Legislation," "Progress and Methods," "Financing a City Plan" and "Municipal Land Policies." The author has presented part of the chapter on financing the plan before, but it is a very pithy discussion of the subject. The closing chapter is on the opportunities and responsibilities of the municipal engineer.

Possibly some phases of the subject of city planning have been more fully presented by others. There is no phase, however, that stands out in the reviewer's mind as inadequately treated. Surely the author is to be congratulated on having ably presented the engineering side of city planning, and the book deserves a wide circulation.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

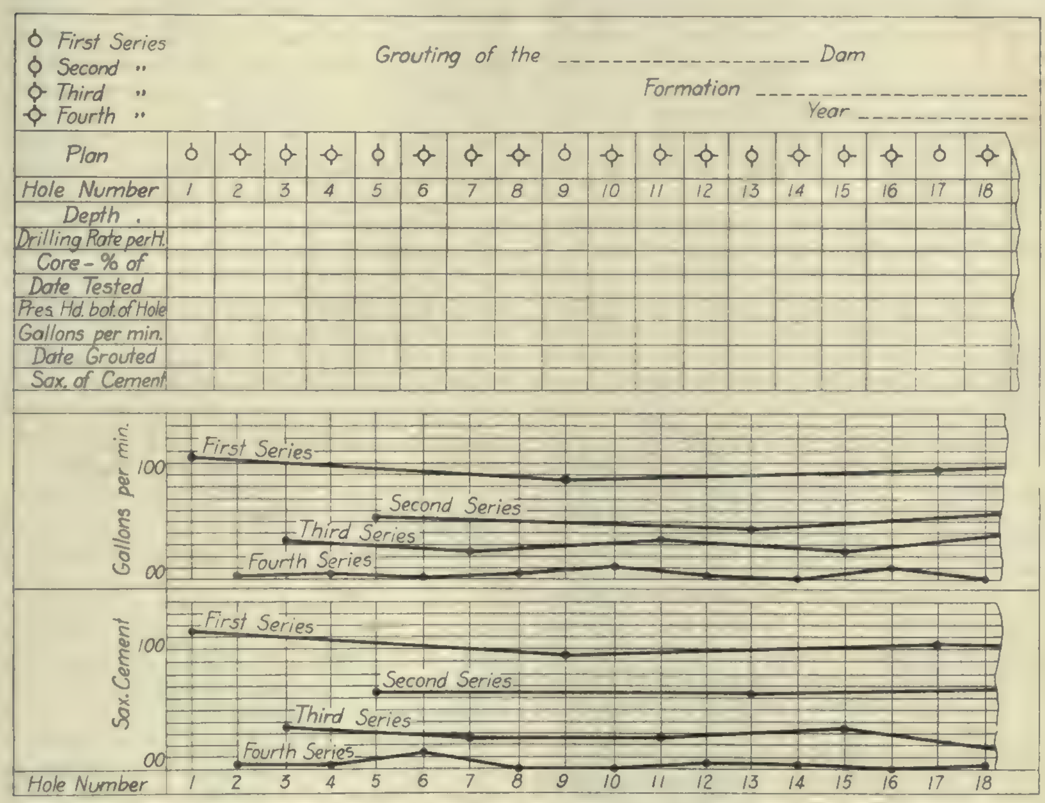
Grouting Alternate Holes Reduces Drilling Time

SIR: In your issue of Sept. 2, 1916, appears an article describing the construction of the dam in the Ripogenus Gorge of the West Branch of the Penobscot River, in Maine. Here it is stated that the dam is being built on traprock, "the joint cracks of which are being grouted to an elevation 50 ft. below the footings."

As grouting is being resorted to more and more as a means of closing the seams and cracks underlying large dams, and as the attempts have sometimes resulted in indifferent success, it would be interesting to know more concerning this part of the work in connection with the Ripogenus Dam. Costs, too, would be of value to those having in hand similar problems in other places. Past experience indicates that grouting will be successful in firm rock having definite seams and cracks, but of less value in conglomerates and breccias. At least we may say that success is much easier of accomplishment under the former conditions than under the latter. Based on this experience, it would seem safe to predict success for the dam under consideration.

In order to know at all times what progress is being made it is best to do all testing from a tank located at any convenient point somewhat higher than the crest of the proposed dam. This tank should be provided with a gage, and the loss of water for each minute recorded. A good plan is to first drill, test, and grout a row of holes on rather wide spacing, say 12 ft. or over, clear across the bed of the stream, or as far as circumstance will permit, each hole being tested and grouted as soon as drilled. Sometimes it is well to make mid-depth tests of the hole as drilled. When the holes on this wide spacing have all been drilled, tested and grouted, the drill may be returned to the beginning point, and a row of secondary holes put down intermediately between those already grouted. These, too, should be tested and grouted as soon as drilled. These secondary holes should show decreased loss of water on testing, and by continuing the process of putting down holes intermediate between those already in, tightness may be secured, though not in all materials. At least, that is the writer's experience.

As grouting is becoming more common, it would be of benefit, in a measure, to standardize the methods of tabulating and presenting the results; and as a contribution to this end the writer would suggest the form here presented, which is substantially such as he has seen used on two different jobs.



CLOSING OF SEAMS BY GROUTING ALTERNATE HOLES SHOWS AT GLANCE ON THIS RECORD

There may be some question as to the value of giving the rate of drilling and the percentage of core in a report having as its principal object the setting forth of the progress of the grouting. This is explained by the fact that the grout, when forced into each hole as drilled, sometimes has a marked effect on the rate of drilling, and possibly, too, on the amount of core, though this matter may not often be the case, as much time would have to elapse before the cement would have hardened sufficiently to come up as stone in the cores. The effect on the rate of drilling is sometimes very marked. In the case of the cutoff for the Lahontan Dam of the U. S. Reclamation Service, the time required to drill the tertiary and succeeding holes over one section of the work was but a trifle more than half the time required for putting down an equal footage of the primary holes. That is, the grouting, by stiffening up the material, had eliminated the caving of the holes (the dropping in of small particles of rock from the side of the hole) and had increased the speed nearly 100 per cent.

H. A. RANDS,
Rands & White, Civil and Hydraulic Engineers.
Portland, Ore.

Topping Trees with Dynamite

SIR: I notice in your issue of Sept. 23, page 392, a paragraph describing the cutting off of the tops of trees by dynamite. I used this method of "topping" trees some years ago in British Columbia, and it is certainly cheap and satisfactory. However, it is quite unnecessary to put a ring of cartridges around the tree. My method was to send a man up on a pair of lineman's climbers and let him bore 2-in. holes with a ship auger at right angles to one another, one about 1½ in. above the other. A stick of ⅞-in. dynamite was then placed in each hole, capped with regular electric-fuse caps, and connected by wire to an ordinary blasting machine or "pull-up battery." By this means the man can descend at leisure and explode the dynamite from a safe place behind a neighboring tree.

The effect produced is remarkable. A tree that is from 10 to 14 in. in diameter at the point where it is cut is taken off without splitting, or even brooming to any extent. It is far the cheapest and safest way that trees can be topped.

In passing, it may be a matter of interest to mention the object of the tree-topping described above. On account of the heavy snows and generally adverse conditions existing in the British Columbia woods in the winter, our construction work was set back, and it was difficult even to get supplies to the camp. On top of these troubles we were in urgent need of electric power at the camp for the running of air compressors and hoists, but it was practically impossible to construct a pole line until spring. In this emergency it occurred to the writer that by felling a little timber to clear the line, and selecting small hemlocks or firs to act as poles, these could be topped, crossarms bolted on and the wires strung with little difficulty. This was done very quickly, several miles of line were built and current was furnished the camp long before it would have been possible by other means.

GEORGE S. BINCKLEY,
Consulting Hydraulic Engineer.
Los Angeles.

Manufacturers Should Tell What Parts Wear Out First

SIR: Referring to Major Amos A. Fries' letter in the Engineering Record of Sept. 30, page 419, "Manufacturers Should Tell What Parts Wear Out First," brings out precisely what the writer has endeavored to get manufacturers to state when buying and ordering machinery. When ordering machinery that is to be set up and operated on the opposite side of the globe it is quite impossible for an engineer who orders the machinery or apparatus from makers' catalogs to form an idea what spares should be ordered at the same time, to keep the machinery in operation, say one year, as he usually cannot guess what parts are liable to break or wear out first.

Who can be expected to know better than

the makers what parts are subject to the most wear or liable to breakage? They are the only ones who know the factors of safety that have been allowed for. Yet it is most difficult to get one to give a list of parts that should be kept in stock to meet emergencies, and enable the machinery to be kept in service. This seems to be a most deep-rooted trait of American manufacturers, and does not reflect anything to their credit. Frequently machinery is out of service for months through the breakage or rapid wearing out of some part. Now it certainly does not seem like presuming a great deal to expect that the manufacturers of the apparatus should be able to supply a list of parts that should be carried in stock to prevent shutdowns. It is to be supposed that the manufacturer who has been building a line of machines for some time would be in a position, through experience, to know what parts wear out and require renewal; also the approximate number of spares or replacement parts that should be required to cover any specified period. Yet when you endeavor to obtain this information they try to put you off and make you believe that renewals will not be required for a long time, that the machinery should not require spares, as it is designed for long service, and similar piffle, whereas quite the contrary is true.

This is only one of the difficulties that exporters and importers in foreign countries are up against when dealing with American firms. J. P. STONE.

Franklin, N. J.

What Caused the Quebec Failure?

SIR: Doubtless you have been, or will be, deluged with a flood of comments, criticisms and suggestions as to the recent Quebec Bridge disaster. I hesitate to attempt any participation in the discussion, particularly as I am not a bridge engineer at all, and the matter is therefore one outside the province of my practice and experience. However, there are involved fundamental principles of mechanics which any engineer, even if not a bridge expert, may recognize and discuss in relation to the great problem of the cause of this deplorable disaster. Saying that the cause was the failure of a certain casting is not an explanation but a mere statement of an incident of the disaster, comparable to saying that a person died because his heart stopped beating. The engineering world wants to know what caused the rupture of the casting properly assumed to be adequate, just as one seeks for the disease or functional disorder that caused the heart failure.

To suggest that the very scheme itself for the raising of this span was radically and fundamentally wrong may seem like presumption, in view of the array of able talent engaged upon this bridge, but that such is strictly the fact may be clearly demonstrated to anyone familiar with mechanical principles. Whether this is due to too many engineers attempting to act jointly, resulting, as is likely to happen, in each man treating his assigned elements, but no one possessing a large perspective of the whole problem and a strong responsible grasp of its solution, or whether there was lacking a necessary proportion of mechanical engineering talent, I have no information upon which to venture a suggestion.

However, it does appear that a mechanical engineer experienced in the design and erection of heavy machinery would not have proposed the scheme which was used for jacking this span. Exclusive attention to the problems of stresses and strains does not qualify, and may disqualify even a most brilliant civil engineer from the handling of nice problems of the design of machine elements and special castings.

Without attempting here any criticism of the lifting girders, the suspender bars, the jacks or the details of the pumps and the piping, all of which seem to have been worked out with much care, note that this span was swung up suspended independently at four points. With this four-point system of suspension it would require almost mathematical nicety in the jacking operations to preserve uniform tension in the four suspenders, something almost impossible even with jacks resting on solid foundations, and not to be expected or considered with jacks transmitting their loads to the cantilever arms and through long suspender bars. Lacking this condition, some three of the four points must bear the load practically all of the time. To realize this it is only necessary to try a simple experiment, namely: Try to hang a box or any rectangular block or object by four strings, one attached to each of the four corners. One of the four strings will always be slack.

Now, if the support at any of the four corners was ever so little slack—that is, if the jacks at that corner failed to follow the other sets of jacks with utmost accuracy—one of two things would happen: either the entire load would be carried on the other three sets of suspenders or the whole mass would rotate about a line drawn diagonally through the structure from one bearing to the diagonally opposite bearing, depending on whether the center of gravity happens to be slightly on the one side or the other side of this diagonal. Wind and vibration might cause this rotation when the structure so supported at three points was nearly in equilibrium. With the failure of one set of jacks and then another to quite keep up with the other three there would be alternately three point suspension and then rotation. The action might be scarcely observable in a great structure, but constantly occurring, nevertheless, and any moment likely to become very considerable. It seems likely that there was anything but uniform lifting at the four corners of the truss, for it is reported that at one time one end was about 2 ft. higher than the other.

Now, further, the two rollers under each corner of this truss, one placed longitudinally and the other transversely, were admirably arranged to permit the structure to swing from its suspension either longitudinally or transversely. But what about a wind blowing at an angle, causing a swing neither lengthwise nor crosswise, but at an angle? In case the mass should swing off at an angle to the axis of the bridge, and in case of the rotation referred to, the latter being almost certain to occur, these two rollers constituted just the wrong device. A rotation of the structure due to failure of one or another of the four supports to carry its exact fourth of the load would rotate neither the one nor the other of the two rollers of the pair, but would set up a destructive effect in the two sets of bearings, wrenching the rollers and wrecking the bearings. This destructive effect could be expected to be tremendous, however slight the rotation, with such an immense weight as that of this span.

Note here also that while these suspenders and roller bearings were probably designed on the idea that each corner would carry one-fourth of the load, when the rotation about the diagonal occurred two bearings carried the whole weight, each bearing double that for which it was intended. Considering the enormous weight of the truss in question, it is only remarkable that the bearings were not wrecked before they were. That they were not can only be accounted for by the fact that on the erecting piers and on the scows the weight could be more nearly equalized than was possible when swung on flexible connections and structures, so that the movement in rotation was not too great for the endurance of the bearings, notwithstanding the pronounced destructive action.

A casual examination of available photographs of the wrecked bearing indicates that the foregoing supplies the explanation of what happened and why. It is needless critically to investigate the structure of the casting of the southwest bearing. Something might be said of the shape of these pieces from the standpoint of designing a casting, but no metal could endure the punishment that must have been inflicted on those bearings with this design when that enormous mass swung in diagonal rotation at the same time that double the normal weight was being carried.

A ball-and-socket joint was required instead of a pair of rollers. A large ball in spherical seats could have been used with properly designed castings. It seems, too, that some scheme of cable hoist properly equalized, perhaps followed by jacks as an extra precaution, could have been devised and thus a more flexible suspension made possible. W. K. PALMER,
Consulting Engineer.

Kansas City.

[While the foregoing explanation sounds plausible, the fact remains that only one of the four castings failed, although during the collapse at least two other castings were subjected to even greater twisting and overloading than that suggested by Mr. Palmer. This truss span was not like a rigid box, but flexible enough to adjust itself to any slight unevenness in the four-corner suspension.—EDITOR.]

Forms for Concrete Test Specimens

The forms used for 6x12-in. cylindrical concrete test specimens are generally made of cast iron, and on account of the machining involved have cost from $10 to $12 apiece. Two years ago the structural materials testing laboratory of Lewis Institute, Chicago, began using forms made of cold-drawn seamless steel tubing, 3/16-in. thick. A size slightly larger than 6 in. in diameter was selected, and the pipe slit lengthwise with a cutter. The pipes were then sawn apart to 12-in. lengths. For service they are used with a ¼x1-in. steel band drawn up by a ⅜-in. bolt 3 in. long. A bolt of this length is used so that a 1¼-in. sleeve can be put beneath the nut. This sets the latter away from the cylindrical surface far enough so that an ordinary wrench can be used for drawing up the bolt. The size of pipe selected is such that when tightly drawn the inside diameter is exactly 6 in. The cost of these forms was $1.20 each. With the great advance in the price of steel during the last year they would probably cost quite a little more now.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Boiler Loaded on Two Trailers for 130-Mile Trip in Rockies

By GEORGE S. YOUNG
Bend, Oregon

HELD in place only by its own weight, a 6½-ton boiler was recently transported from Bend, Ore., to Alkali Lake, a distance of 130 miles, on two 3-ton trailers. The 100-hp. boiler was loaded on a cradle so made and supported that it acted like the platform of a tank car, with the two trailers occupying the place of the front and rear trucks. No ropes or chains were used to secure the boiler. The frame of the trailers was not sprung in the least by the trip.

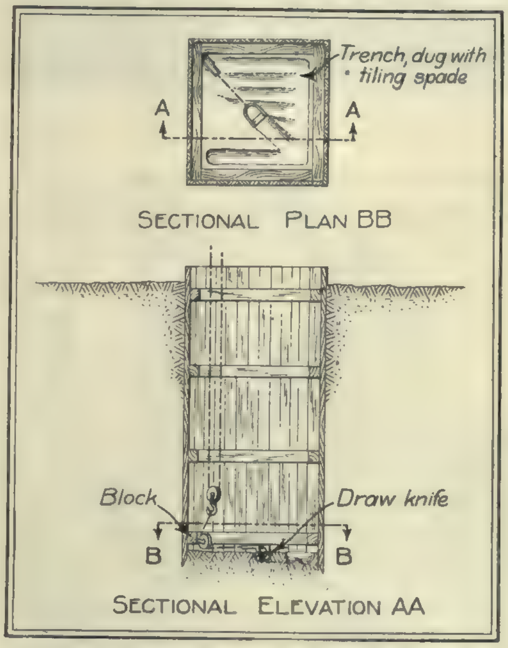
The two trailers were placed between two motor trucks, so that one truck acted as pusher. Both trucks were loaded with lumber, hardware, groceries, etc., to full capacity. George B. Milne of Bend, who had the contract to move the boiler and the 6½ tons of miscellaneous freight, etc., received his idea for this truck train from the "double headers" used on heavy railroad grades. A Cadillac preceded this truck train and acted as helper on heavy grades, being attached to the head truck with a long chain.

The trip is remarkable for its length, the great variety of roads hauled over and the heavy grades negotiated under this load. Grades as steep as 20 per cent were encountered and were easily overcome. No extra grading was done for this trip, and the roads, though used for a number of years, had never been graded except to pick out the rocks here and there. The trucks were new Four Wheel Drive trucks, never used before this run. The trip was made on 92 gal. of distillate and with less than 2 gal. of engine oil, in 25 hours' driving time.

Drawknife Pulled by Hoist Digs Tough Clay in Shaft Bottom

By D. H. FLEMING
Assistant City Engineer, St. Catharines, Ont.

THE ACCOMPANYING sketch shows how a hoisting engine was rigged up to pull a drawknife for cutting out strips of puttylike blue clay in sinking a 12-ft. square shaft for constructing a brick-lined sewer tunnel. A steam hoist and buckets were the only plant on the job, and excavating the tough clay by the pick-and-shovel method proved a very slow process.



DRAWKNIFE PULLED BY HOIST

To get around the difficulty the contractor fastened a single block at the bottom of the shaft, in one corner. Through this was run a line to the upper end of which was hooked the hoisting fall, and the lower end of which was attached to an ordinary excavating draw-knife. In order to give the knife a start, an advance trench about 6 in. wide and a foot deep was cut on the two sides, opposite the corner in which the block was located. Long slices extending across the shaft could then be cut out by the drawknife. These were cut up into 18-in. lengths by one man with a spade, while another threw the pieces into the bucket and two others guided the drawknife. The device more than doubled the amount of excavation taken out in a day, while the daily cost remained the same.

Belts Used Successfully in Floating Concrete Roads

By H. B. BUSHNELL
Division Engineer, Illinois State Highway Department

HEAVY BELTS are being used to float concrete road surfaces on the Illinois state aid roads in Kane County between Elgin and St. Charles. Some time ago the possibility of using belting for the purpose was suggested to the writer, and as the theory seemed to have merit as a means of securing a better surface at a reduction in cost to the contractor he induced the Illinois Hydraulic Stone & Construction Company of Elgin, contractor for the work, to co-operate in giving the belt method a trial.

The road upon which this trial was made is 18 ft. wide, built under the standard specifications of the highway department and without joints. The belt used was an ordinary 3-ply canvas belt, 8 in. wide and 20 ft. long, with small wooden handles nailed and cleated to the ends. It was laid flat on the surface of the concrete and was worked back and forth over the side forms with practically the same motion as that used on the strike board. The concrete was mixed at the same consistency ordinarily specified, namely, so that when deposited in a pile it would tend to flatten but not to run at the edges. The deposited concrete was struck off in the usual manner with a common strike board. The surface was then gone over with the belt, very shortly after being struck off. If any porous, honeycombed or low places appeared after being

BOILER CONVERTED INTO A TWO-TRUCK CAR BY LOADING ON TWO 3-TON TRAILERS FOR 130-MILE TRIP OVER MOUNTAIN ROADS

FIRST FLOATING LEAVES CORRUGATIONS, AT RIGHT, WHICH SECOND FLOATING, AT LEFT, ELIMINATES

FINISHING WITH BELTS FOLLOWS MIXER CLOSELY ON MICHIGAN CONCRETE ROAD

struck off they were filled with soft concrete before the belt was used. The belt leveled off this material and filled all porous spots in an almost perfect manner.

Just before the initial set took place in the concrete the surface of the pavement was again gone over with the belt. After the first belt floating, slight ridges or corrugations of mortar appeared on the surface, but the second floating took out all of the corrugations and left a gritty, granular mortar surface absolutely free from ridges, pockets, depressions or float marks. An 8-in. belt gave better results for the first floating, while a 10-in. belt appeared to work better for the second floating. The heavier belt for the first floating had a tendency to cut into the surface and flatten the crown, but there is no such tendency with an 8-in. belt. The finished surface of the pavement can be made as granular as desired by retarding the time of the second floating.

Hand floating by means of wood floats has certain objections that it appears impossible, or at least impracticable, to eliminate. It is the practice of the Illinois Highway Department to require floating to be done just prior to the initial set in the concrete, so as to insure a fairly gritty and dense mortar wearing surface and to eliminate water pockets. It is very difficult to do this at all times with a reasonable expenditure for labor on the part of the contractor. The floater is obliged to stay behind early in the morning when the temperature is low, and in the middle of the day when the concrete sets up faster he is hard pressed to catch up. Again, when it starts to rain it is often difficult to get the floating done at all before it is necessary to cover the pavement with canvas. Even with a very careful hand floating by use of wood floats it is hard to secure a surface free from slight depressions or pockets, and this is especially true late in the day, when the floater tries to keep close to the strike board. Using a belt, 100 ft. of pavement can be floated in a very few minutes; and as the contractor expressed it, the labor is so ridiculously easy that it is almost play. The strike-board men can also handle the belt, and the contractor is therefore saved the cost of finishers or floaters.

[One of the accompanying photographs shows the use of belts close to the mixer on the Seven-Mile Road near Redford in Wayne County, Mich., where this method has also been used. As in Kane County, the strike-board is used first, but following it a wide 12-in. belt is employed, the final floating being acomplished by an 8-in. belt. In Wayne County a Baker finishing machine is considered superior to the belt, but the belt method is believed to be better than hand floating. The officials state that the belt method seems to produce a very level surface, but how well the surface will wear as compared with other methods cannot be foretold.—EDITOR.]

Auto Truck Hauls Grader for Soldiers

IN MAKING army roads in Mexico all kinds of expedients are resorted to. Sometimes they become the regular thing after trial. A fleet of small scrapers and a number of the heavy side-conveyor type of grader have been kept busy ever since General Pershing's punitive expedition swept over the line. The photograph shows three Jeffery Quad trucks hauling a Russell grader. Only one truck is required for the smaller machines. The procedure is to set the scalping knife, slung on a 45-deg. angle, beneath the machine flush with the wheel line, so that it will slice off all bumps and eliminate all ruts. Often a bump will represent a sheer cut of 5½ in. through glutinous earth. The material is simply dumped to one side of the road.

Move 2600-Ton Building

A three-story class A steel-frame structure with brick facing is to be moved from lower Market Street in San Francisco to a point approximately 300 ft. distant on Mission Street. The structure, which weighs about 2600 tons, is being lifted by 200 jackscrews and will be hauled by three donkey engines in a manner similar to that employed in moving the Commercial High School, described Nov. 22, 1913.

MOTOR TRUCKS PULL MACHINE THAT SMOOTHS ROADS FOR ARMY TRANSPORTS

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Iron Span Falls When Post Is Struck by Runaway Car

West Third Street Bridge in Cleveland Drops 25 Feet to Baltimore & Ohio Railroad Tracks Below

When a runaway car jumped the track on the West Third Street bridge over the Baltimore & Ohio Railroad tracks in Cleveland, Ohio, on Oct. 3, and struck the hanger a glancing blow, then crashed into the first vertical post, the whole 105-ft. span sank gradually down to the railroad tracks, a distance of about 25 ft. Two persons were killed and many injured, as reported in the short note in the news pages of last week's issue.

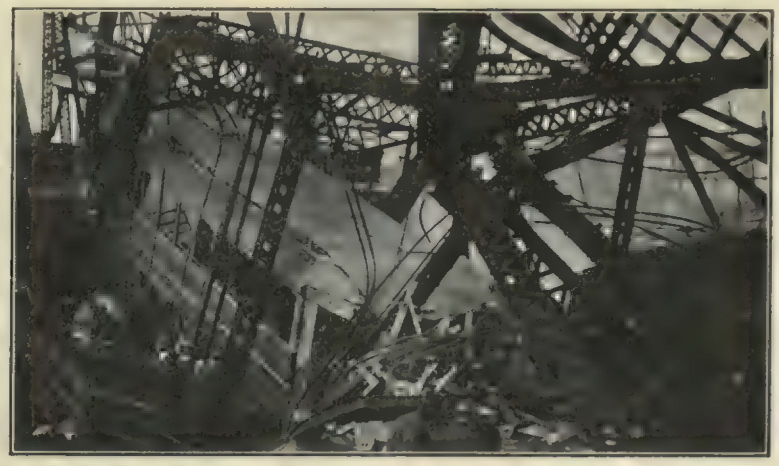
The bridge was constructed in 1888, of wrought iron, the trusses being spaced 32 ft. 6 in. apart. It carried the double tracks of the Cleveland Railway Company, which cross the structure at the foot of the West Third Street hill. This hill, about 500 ft. long, has a grade of 9.6 per cent, and the tracks enter the span on a 30-deg. curve. A heavily loaded car, starting at the top of the hill, got beyond the control of the motorman, took the curve at the bottom of the hill at high speed, jumped the track and hit the south truss of the bridge, striking first the 3 x ⅝ in. hanger or end vertical, then completely displacing the next vertical post composed of two 7 in. channels laced together. In one of the accompanying photographs the damaged post and bent diagonal bars can be seen in the center of the view. In the other photograph, taken from the north side, two cars are seen in the wreckage. The one on the left is the runaway which caused the failure. The one on the right was just entering the bridge and was carried down with the span as it fell.

Investigation of the accident in order to fix responsibility has been begun for the city of Cleveland by A. J. Himes, chief engineer of the Nickel Plate Railroad; Robert Hoffmann, city engineering commissioner; Fred Richards, assistant engineering commissioner, and Henry Merton, of the Osborn Engineering Company of Cleveland. W. J. Watson, of Wilbur J. Watson & Company, consulting engineers, and W. C. Carter, former city engineer of Cleveland, are investigating for the railroad company.

Robert Hoffmann, city engineering commissioner, reported to Mayor Harry L. Davis: "The force of the collision of the car with the truss members was such that it tore an iron post, near the middle of the span, from its bottom connections, and so deflected the iron post and adjacent diagonal iron rods connected with the top chord of the truss that the chord was broken, thereby destroying the truss connection. The bridge fell as an inevitable consequence. No evidence was found that indicated that the bridge had failed in a manner otherwise than that due to the unusual strain brought upon it when the heavy moving car smashed into the truss at the side of the bridge. The bridge was never supposed to be subjected to any such abnormal shock, and it was unable to withstand it."

Reports by Mr. Merton and Mr. Himes are of similar character. Both hold that the wrought-iron members of the bridge stood up remarkably despite 28 years of service. Whether the motorman of the runaway car became confused or the brakes were bad has not yet been decided by the Cleveland Railway Company. While the reports clearly absolve the city from any responsibility they do not attach any blame to the railway company.

A new span, costing $25,000, has been ordered from the King Bridge Company, Cleveland. It will be erected by the Ferro Construction Company, Chicago.



RUNAWAY CAR STRUCK VERTICAL POST AND WRECKED BRIDGE—CAR ON LEFT OF LEFT VIEW CAUSED THE ACCIDENT

Major-General George W. Goethals to Head 8-Hour Board

Major-General George W. Goethals has been selected by President Wilson to act as chairman of the board created by Congress to investigate the railroad eight-hour law. The other members are Edward E. Clark, of the Interstate Commerce Commission, and George Rublee, of the Federal Trade Commission.

While the law does not go into effect until next January, the President desires the members of the board to give close study to the entire situation. Besides observing the operation and effect of the institution of the eight-hour day, the commission will be authorized to conduct a general investigation of "the facts and conditions affecting the relations between such common carriers and employees."

After an inquiry of not more than nine nor less than six months from Jan. 1, the commission will report to the President and Congress. Pending the filing of this report, and for thirty days thereafter, the law provides that there shall be no reduction in wages of the employees affected for the standard eight hours of work.

Bidders Pay for Advertising Proposals

A resolution adopted by Trenton, N. J., provides that when bids are rejected because of the failure of the bidder to comply with all requirements and readvertising is necessary, the cost of such publicity shall be deducted from the amount of the certified check deposited with the proposal.

Plan Immediate Activity of Research Council

Engineering Foundation Resources at Disposal of National Research Council—Science and Engineering Well Represented

Arrangements have just been completed in New York whereby the resources of the Engineering Foundation, under the auspices of of the four principal national engineering societies, are placed at the disposal of the National Research Council, which was appointed by the National Academy of Science at the request of President Wilson. The object of the council is to co-ordinate the scientific research work of the country in order to secure efficiency in the solution of the problems of war and peace. The council was without funds until the Engineering Foundation, established to further scientific and engineering research, offered to place its resources at the council's disposal, including the services of its secretary, Dr. Cary T. Hutchinson, to act as secretary of the council. The offer was accepted and plans for immediate activities have been placed in the hands of an executive committee.

Personnel of Council

In indicating how thoroughly every branch of science and engineering is represented in the council, Dr. George E. Hale, director of the Mount Wilson solar observatory and chairman of the council, who was in New York last week attending to the details of the arrangement, called attention to the personnel of the body. He said that it is the purpose of the council to enlist the co-operation, in the solution of our industrial and military problems of a scientific character, of every possible established agency. Medicine, for example, is represented by Dr. William H. Welch, president of the National Academy of Science; by Brig.-Gen. William C. Gorgas, surgeon general of the United States Army; Dr. Simon Flexner, director of the Rockefeller Medical Institute, and by Dr. Victor C. Vaughan, past-president of the American Medical Society. Biological science has as its representative Dr. Edwin G. Conklin, professor of zoology, Princeton University, while Dr. A. A. Noyes, of Massachusetts Institute of Technology, and Dr. L. H. Baekeland, form the chemical representation. Physics is represented by Dr. A. A. Michelson, of the University of Chicago, and electricity by Professor M. I. Pupin, of Columbia University.

Engineering Representatives

These branches, with the exception of medicine, are in the realm of pure science. Recognizing, however, that the practical applica-

tions of the principles which the pure scientists discover rest largely with engineers, there is a strong representation from the great engineering societies. Clemens Herschel, president of the American Society of Civil Engineers; John J. Carty, chief engineer of the American Telephone & Telegraph Company; Gano Dunn, president of the J. G. White Engineering Corporation; C. E. Skinner, director of the research laboratory of the Westinghouse Company, and Dr. W. R. Whitney, director of the research laboratory of the General Electric Company, are among those who will represent the engineering side of the council's work.

Military Representatives

The important military aspects will be presented to the council by Major General William Crozier, chief of ordnance of the U. S. A.; by Lieut. Col. George O. Squier, chief of aviation, U. S. A., and David W. Taylor, chief constructor, U. S. Navy. Other branches of the government are represented by Dr. S. W. Stratton, director of the National Bureau of Standards; Van H. Manning, director of the Bureau of Mines, and Prof. Charles F. Marvin, chief of the U. S. Weather Bureau.

It will thus be seen that the council includes representatives of all of the important scientific activities bearing on military or industrial problems. The executive committee's plans are of wide scope. The support already pledged will insure immediate action where the need is greatest.

The other members of the council are Dr. John A. Brashear, Pittsburgh; Dr. W. F. M. Goss, dean of engineering, University of Illinois; Dr. William H. Holmes, curator, U. S. National Museum; Dr. W. W. Keen, president, American Philosophical Society; Prof. E. C. Pickering, director, Harvard University observatory; Charles F. Rand, president, United Engineering Society; Prof. Theodore W. Richards, Harvard University; Prof. R. A. Millikan, University of Chicago; Ambrose Swasey, Cleveland; Dr. Elihu Thomson, Swampscott, Mass.; Dr. C. R. Van Hise, president, American Association for the Advancement of Science; Dr. Charles D. Walcott, secretary, Smithsonian Institution; Dr. J. M. Coulter, professor of botany, Princeton University; Prof. R. H. Chittenden, dean of Sheffield Scientific School, Yale University; Prof. Raymond Pearl, biologist, Maine Experiment Station, Orono, Me.; Marston T. Bogert, professor of organic chemistry, Columbia University.

Other members of the council will be appointed from time to time as the needs of the work dictate.

Think Government Nitrate Plants Legislation Unwise

The American Electrochemical Society, through its committee on public relations, constituted of the president and past-presidents of the society, has expressed the opinion that the recent legislation empowering the President to make an investigation to determine the best, cheapest and most available means for producing nitrates is unwise.

In a note addressed to the President, the Secretary of the Navy, and the Secretary of War, it is pointed out that the prime necessity of the hour is the prompt provision of an 18-months' supply on a war basis of Chilean nitrate, to be stored at various strategic points. The committee deprecates the entrance of the government into an industrial field that can, in their opinion, be much better and more rapidly developed by private interests.

300 Inspect Monolithic Brick Pavements at Paris, Ill.

About 300 engineers, contractors, highway and municipal officials, university professors, brick manufacturers and good-roads enthusiasts inspected the making of monolithic brick roads at Paris, Ill., Oct. 6, as the guests of the National Paving Brick Manufacturers' Association. This was the main feature of the second day's program of the thirteenth annual meeting held in Terre Haute, Ind., the first day being devoted to association affairs. All officers of the association were re-elected. C. C. Blair is president and Will P. Blair, secretary.

A section of brick road under construction on the outskirts of Paris near the waterworks system was used as a demonstration. The contractor, Allan Jay Parrish, had all operations from aggregate to covering the grouted surface with earth going on at the same time. The Parrish double template, putting on a ¼-in. layer of 1:1 dry grout, was hauled forward by the Cube mixer with swinging beam. This template was preceded by a single one of channel iron drawn by hand to roughly level up the concrete. Both templates have rollers and ride on the Heltzel side forms. The operations of laying the brick and subsequently rolling and grouting with a small Marsh-Capron mixer, the first coat direct from the spout and the second from wheelbarrows, were carried out much as described by W. T. Blackburn in the Engineering Record, July 10, 1915, page 54.

Following a barbecue the guests were escorted over the monolithic roads around Paris. On most of the monolithic roads which were built in 1915 and 1916 the grout finish has not yet entirely worn off. The time in service is too short to show any appreciable difference in the sections of 3-in. and 4-in. brick, both laid on a 4-in. base. A section of state-aid 13-ft. monolithic, 4-in. block on 4-in. base, laid this year with the new template, appeared to be slightly smoother than some of the earlier work, but both are excellent. Even in the narrow 9-ft. sections the edges have not been loosened, nor is there any sign of breaking down.

Dr. Cary T. Hutchinson Selected Secretary of Engineering Foundation

Dr. Cary T. Hutchinson has been selected secretary of the Engineering Foundation. Under the arrangement made with representatives of the National Academy of Science he will act also as secretary of the National Research Council.

Dr. Hutchinson was born in St. Louis and educated at Washington University, in his native city, and at Johns Hopkins University. He was with the Sprague Electric Company and the General Electric Company for several years and then became a member of the firm of Sprague, Duncan & Hutchinson, consulting electrical engineers. Since 1891 he has been in private practice. Among the important installations carried on under his direction were the electric equipment of the McCalls Ferry Power Company and the electrification of the Cascade tunnel.

The Foundation has taken offices in the Engineering Societies' Building, 33 West Thirty-ninth Street, New York City.

Engineers Turned Away from Booster Dinner at Chicago

Although plates for 270 engineers were provided Oct. 6 for the annual booster dinner of the American Association of Engineers in Chicago, many men had to be turned away. For the speaking, however, 350 crowded into the hall.

Prof. C. Francis Harding of Purdue University addressed the association on "Marketing Engineering Ability." He analyzed the popular criticism of technical graduates and suggested that encouragement of the use of good English, both spoken and written, cultivation of tact and executive ability in young engineers, and the promotion of education in modern business methods would aid in lifting the engineer from the slough into which many feel he finds himself.

John Ericson, city engineer, discussed the

Will Dedicate $5,000,000 Elephant Butte Dam To-day at El Paso, Texas

TODAY, the first day of the twenty-third International Irrigation Congress, will witness the formal dedication at El Paso, Tex., of the $5,000,000 Elephant Butte dam. The huge structure, which was completed May 12 of this year, contains 611,400 cu. yd. of masonry, and has a total length of 1674 ft. and a maximum height of 306.2 ft. The maximum width at the base is 215 ft. At the top is an 18-ft. roadway. The 275-ft. spillway, of the combination weir-tunnel type, is divided into five sections. The elevation of the crest is 193 ft. above the original river level. The excavation for the foundation totaled 407,300 cu. yd. The reservoir has a total capacity of 2,642,292 acre-feet, or 115,098,000,000 cu. ft., an average width of 1¾ miles and an average length of 45 miles. The available capacity is given as 2,683,860 acre-feet. The area of the water surface with the reservoir full is 40,680 acres. The cost of the dam proper was about $4,500,000; the total project cost approximately $5,000,000. Borings and surveys were made in 1904, construction was begun in 1910 and concrete was first poured June, 1913. About 23 miles of wagon road and 12 miles of railroad were built.

way in which the engineer can best render service in public life. Coming from one who has so long held office in Chicago, his remarks on the need of tact by the engineer were doubly impressive.

W. H. Rosecrans, consulting engineer, made a plea for more boosting and less knocking of the other fellow's work. J. N. Hatch, consulting engineer, outlined the progress of the organization and what it stood for. A year ago the membership was 100. Now it is 1200. L. K. Sherman, member of the Illinois Rivers and Lakes Commission, urged engineers to register and vote.

J. H. Prior, chief engineer, Illinois Public Utility Commission, pointed out the success of the organization. J. Holland, assistant engineer, North Works of the Illinois Steel Company, detailed an experience with draftsmen in the organization who were about to form a union. These men were taken in a body to the association and educated up to better things. The principles of the association, ideals of ethics and co-operation with their employers, so as to engender a better feeling all around, prevailed.

Other speakers were: Dabney Maury, consulting engineer; J. N. Lewis, mining engineer, Denver, and Arthur Kneisel, secretary of the association.

Who Wants a Permanent Job?

"Unless the members of the society are deceiving the secretary maliciously, they are all, or very near all, profitably employed. At least, it is like the old job of hunting for a needle in a haystack to find a man now when a position is open.

"To be sure, many are but 'temporary positions,' but when you get to the bottom of the whole thing there are no others. And who of us want a permanent job, anyhow?

"I well remember seeing a gray-haired draftsman packing his tools and books preparatory to leaving a 'temporary position' which he had accepted a short nineteen years before. When he found that it promised to merge into a permanent one he quit—and you would too, wouldn't you?"—*Bulletin, Oregon Society of Engineers.*

What Engineers and Contractors Are Doing

MAJOR-GENERAL GEORGE W. GOETHALS, Corps of Engineers, U. S. A., who recently resigned as Governor of the Panama Canal, has, as noted elsewhere in this issue, been appointed by President Wilson chairman of the board created by Congress to investigate railroad conditions in accordance with the Adamson law. After graduation from the U. S. Military Academy in 1880 General Goethals spent two years at the Engineer School of Application. For the next two years he was engineer officer at Vancouver Barracks, Department of Columbia, following which he directed improvements on the Ohio River. After a year at Cincinnati he went to West Point as instructor, later becoming assistant professor of civil and military engineering. From 1889 to 1894 he had charge of Tennessee River improvements from Chattanooga to Paducah, and for the succeeding 3½ years was assistant to chief of engineers of the army. Six months as chief engineer of the First Army Corps at Porto Rico was followed by his return to West Point as instructor in practical military engineering and to direct construction of the library building and filtration plant. General Goethals had charge of river and harbor improvements and fortification works in Rhode Island and southern Massachusetts from 1900 to 1903, and from then until 1907 he was a member of the general staff of the army. In March of that year he was made a member of the Isthmian Canal Commission, and a month later was appointed its chairman and chief engineer. When the great ditch was practically completed early in 1914, General Goethals was appointed Governor of the Canal Zone. He was honorary president of the International Engineering Congress, held last year in San Francisco in 1915, and was present at the celebration of Goethals Day at the exposition.

H. G. SPARKS, formerly division engineer of the Chicago & Eastern Illinois Railroad at Salem, Ill., has been made assistant superintendent of the Chicago division. His headquarters will be at Brazil, Ind.

A. W. WHITE has been promoted from office engineer of the Chicago & Eastern Illinois Railroad to division engineer at Salem, Ill., succeeding H. G. Sparks, whose transfer is noted elsewhere in this issue.

J. S. MCBRIDE has been appointed principal assistant engineer at Chicago for the Chicago & Eastern Illinois Railroad. He will continue to perform the duties of his former position as valuation engineer in addition to those of his new appointment.

C. H. BLITMAN, formerly instructor in the college of engineering at the University of Minnesota, and later engineer in charge of municipal and paving work at Minot, N. D., is now city engineer and manager of Glasgow, Mont. Mr. Blitman is a graduate of Rensselaer Polytechnic Institute.

OSCAR S. MAPLE, who has for the last four years been associated with the Texas Power & Light Company at Dallas, Tex., as assistant construction engineer, is now with the Fargo Engineering Company of Jackson, Mich.

G. H. NICHOLS has left the employ of the Miami Conservancy District to become engineer on construction with the American Rolling Mill Company, of Middletown, Ohio. Mr. Nichols began his engineering career as chainman in the Department of Public Works of Ohio and was soon promoted to transitman and then to assistant engineer. After about three years with that department he resigned to join the forces of the Miami district.

EDWARD T. BAILEY, formerly with the Emerson Building Company, has become associated with Joseph O'Connor, formerly of the Fidelity & Casualty Company. They have opened offices at 103 Park Avenue, New York City, and will turn their attention to general contracting.

ROBERT F. OLDS, formerly consulting engineer, of El Paso, Tex., is now general superintendent of construction in the Philadelphia division of the Austin Company. After graduation from the University of Maine in 1906, Mr. Olds entered the employ of the Pennsylvania Steel Company and later joined the faculty of Pennsylvania State College as instructor in geometry and surveying. Late in 1907 he became associated with Charles W. Fenn, civil engineer, of Portland, Me. The year 1909 found him as civil engineer in the quartermaster's department, U. S. A., in which capacity he directed the construction of waterworks, warehouses and various buildings in the United States and the Philippine Islands. He resigned about a year ago to open consulting offices in El Paso.

JOHN EVANS, division engineer of the Michigan Central Railroad at Detroit, has been made division engineer of the Detroit Terminal and Toledo division. He will continue with office at Detroit.

J. D. ELDER has been appointed division engineer for the Michigan Central Railroad, with office at Niles, Mich.

C. C. HILL has been transferred from division engineer for the Michigan Central Railroad at Niles, Mich., to the valuation department.

CHARLES HARDING, erecting engineer for the New York Continental Jewell Filtration Company, has completed the plant at New Albany, Ind. He is now at Lawrenceville, Ill., to direct the installation of a 1,000,000 gal. plant.

LIEUT. COL. J. B. CAVANAUGH, Corps of Engineers, U. S. A., builder of the Lake Washington government canal, was recently entertained by the Seattle Chamber of Commerce at a banquet in the Butler Hotel. Tributes to his engineering ability were paid Colonel Cavanaugh by 300 of Seattle's representative business and professional men. Among the speakers were Judge Thomas Burke, president of the Chamber of Commerce; former U. S. Senator Samuel H. Piles; Will H. Parry, member of the Federal Trade Commission; Representative William E. Humphrey, and R. H. Thomson, former city engineer and present councilman.

C. E. GRUNSKY, of San Francisco, and George G. Anderson, of Los Angeles, were recently selected by the directors of the Imperial Irrigation District as an advisory board of consulting engineers to serve the district for a period of one year. Following the earlier appointment, which was noted in the Sept. 2 issue of this journal, the action of the irrigation district retains the engineers so that they will be available throughout the year for consultation on water supply, silt disposal, intake arrangement, flood protection and other problems that confront the district.

S. A. BROWN has resigned from the employ of the Pennsylvania Steel Company to enter the service of the Owosso Sugar Company at Lansing, Mich.

C. R. THOMAS, civil engineer, of Wilmington, N. C., has been appointed division engineer in the Kentucky Highway department to succeed O. S. Canning, resigned. After graduation from the University of North Carolina, Mr. Thomas took up special work at the University of Wisconsin. He later entered the employ of the government, where for six years he was engaged on highway work. Following his work with the government he was assistant engineer of the Pennsylvania state experiment station and then associated with a contractor of Wilmington, N. C.

EVERETT N. BRYAN has resigned as chief engineer and assistant superintendent for T. K. Beard, contractor, of Modesto, Cal., to become chief engineer of the Waterford (Cal.) Irrigation District. The district recently voted a bond issue of $465,000 and as soon as plans and specifications have been prepared the contracts will be let for the construction of the system. Mr. Bryan was associated with T. K. Beard for 3½ years, during which period he directed work in the Oakdale, Turlock, Modesto and South San Joaquin irrigation districts. Previous to that he was superintendent of the Modesto Irrigation District.

C. H. DANCER, formerly deputy minister of public works for Manitoba, has been appointed district engineer at Winnipeg for the federal Department of Public Works.

EDGAR A. VAN DEUSEN, for the past four years chief draftsman in the New York office of the Southern Power Company, has been transferred to Charlotte, N. C.

Civil Service Examinations

Illinois—Examinations will be held Nov. 4 for testing engineer (salary, $125 to $200), architectural designer (salary, $120 to $200), topographical draftsman (salary, $100 to $150) and examiner of efficiency (salary, $125 to $175). Particulars may be obtained from the Illinois Civil Service Commission at Springfield.

United States — Examinations will be held Nov. 8 for copyist draftsman, junior drainage engineer, assistant inspector of hull material and laboratory assistant qualified in petrography. Applicants should ask for Form 1312.

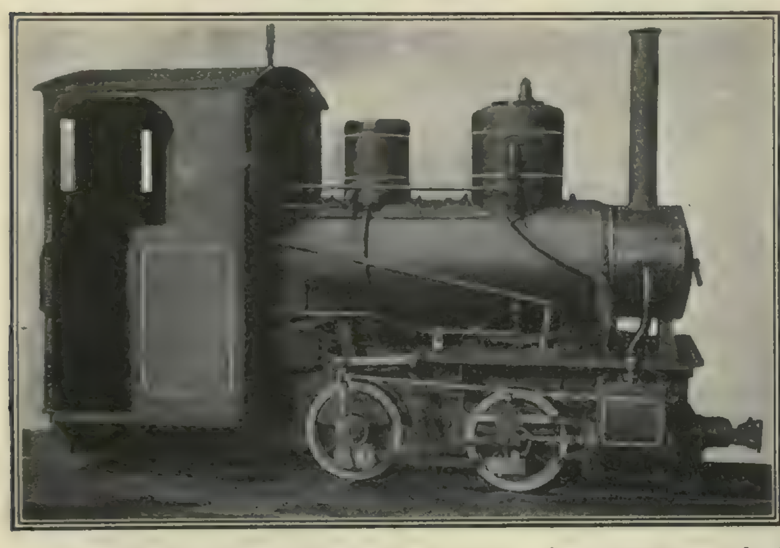
Examinations Previously Announced

Date		See Eng. Record
Nov. 4.	Junior engineering assistant, New York	Sept. 30

Low Center of Gravity Claimed for Contractor's Locomotive

A number of locomotives of the Decauville type which meet the requirements of contractors have recently been built by the Baldwin Locomotive Works for export trade. Aside from strong and simple construction, the low center of gravity obtained by placing the water tank between the sides of the steel-plate frames is claimed as another advantage.

The four-coupled locomotive was built for the Pleystowe Central Mills Company, Limited, Australia. It operates on a 2-ft. track on grades of 3 per cent and curves of 198-ft. radius. The boiler carries a steam pressure of 176 lb. per square inch and has a steel outside shell, a copper firebox and brass tubes. A box of 8 cu. ft. capacity is placed in the cab to hold bituminous coal. The tank capacity is 102 gal.



FOUR-COUPLED LOCOMOTIVE BUILT FOR 2-FOOT TRACK WEIGHS 12,000 POUNDS AND OPERATES ON 3 PER CENT GRADE

The steam dome is placed well forward on the boiler and the live-steam pipe passes out of the right side of the dome. The cylinders are 6 x 10 in. and fitted with plain slide valves. The equipment includes a handbrake with shoes on the rear driving wheels only. The locomotive weighs 12,000 lb. in working order.

Drop Box of Dynamite Caps 50 Feet with No Explosion Taking Place

Although it is dangerous to carry dynamite and caps in the same vehicle on account of the sensitiveness of the caps to shock, and the probability that their explosion would fire the dynamite, there are times when separate loading or two trips are inconvenient and expensive. To provide for such cases, and also to care for caps in the field, a safety box has been designed by E. I. du Pont de Nemours & Company.

The box, made of ⅞-in. oak with a top of ½-in. pine, is lined inside with ½-in. felt, obtainable at harness shops. The cap board is removable, but should fit snugly on and between the felts. The space between bottom of cover and top of bottom felt should be just right to hold caps firmly without undue pressure. The holes in the cap board—100 in number—should be large enough to permit easy entrance of caps, but not large enough to let them fall out.

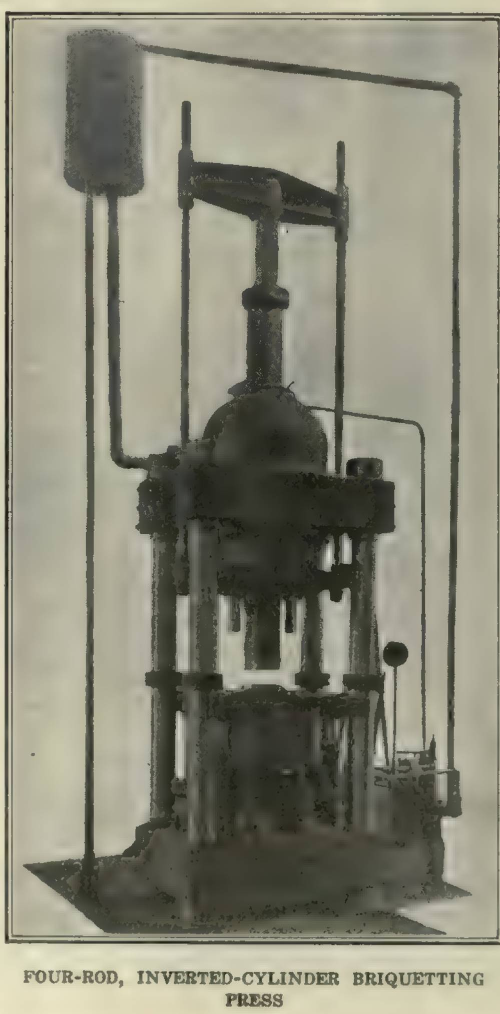
A box made this way is said to have been filled with 100 caps and thrown over a 50-ft. embankment into a quarry, where it bounced around on the rocks with no resultant explosion.

1000-Ton Hydraulic Press Used for Briquetting Metal Borings

A new design of hydraulic press recently built by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio, is illustrated herewith. The press is used for briquetting metal borings, turnings, etc., so that they may be remelted without the loss of valuable ingredients and to prevent oxidation. It also puts the material in a convenient form for handling. The design is of the four-rod inverted cylinder type, built in three different sizes and pressure capacities—1000, 750 and 300 tons. The illustration is a reproduction of the 1000-ton press.

It is claimed that the briquette-forming mechanism of these presses is unique in design and operation, capable of forming a briquette quickly and of uniform density. The material is placed in a floating mold, which is supported by four springs. When the pressure is applied from above, the friction of the material on the sides of the mold causes it to move down over a stationary plunger, which projects into the mold from below, thus applying pressure on the bottom as well as on the top to form a briquette of uniform density.

The briquette is ejected from the mold by the pressure of the main ram applied upon the briquette after the lower plunger has been removed by a simple movement of a controlling lever. The briquette then falls through to the base of the press, whence it is removed by a conveyor installed by the customer. On the 1000-ton and 750-ton presses hydraulic push cylinders lift the floating mold while the lower die is withdrawn or returned to place. A collar surrounding the lower die is held against the mold by a spring to close up all clearance between the mold and the lower die in the 300-ton press. The briquette-forming mechanism of these presses has been patented in the United States, Canada and several foreign countries.



FOUR-ROD, INVERTED-CYLINDER BRIQUETTING PRESS

Business Notes

The Westport Paving Brick Company has removed its offices to Westport, Md. The company's mailing address is P. O. Box 23, Baltimore.

The John Kline Brick Company, Wickliffe, Ohio, is the newest and the thirty-fourth member of the Dunn Wire-Cut Lug Brick Company's family of licensees. This plant has a daily capacity of 40,000 brick.

The Modern Iron Works, Quincy, Ill., has opened a waterworks supply department. The officers of the firm are now busy organizing the new branch and will soon make a more complete announcement to waterworks men.

Wilbert O. Cornell, a graduate of the civil engineering department of the University of Pennsylvania, has been made a sales engineer for the General Fireproofing Company. His headquarters will be at Youngstown.

William H. Cummings, formerly of Providence, R. I., has become associated with the Waugh glazing department of the Asbestos Protected Metal Company.

Charles F. Ames has been appointed manager of the New York office of the Epping-Carpenter Pump Company.

C. W. Hays, formerly with Boyts, Porter & Company, of Connellsville, Pa., is now in charge of the pump department of the Ross Mechanical Supply Company, of Pittsburgh.

Albert & Davidson, Inc., Brooklyn, dealers in contractors' supplies and specializing in second-hand wrought-iron pipe, will move their offices to Oakland and Kent Streets.

The Walter A. Zelnicker Supply Company, of St. Louis, has just issued its September bulletin, said to be the largest published in several years.

The American Railway Bridge and Building Association will hold its twenty-sixth annual convention Oct. 17 to 20 in the Gruenwald Hotel, New Orleans.

Trade Publications

The following companies have recently issued trade literature:

The William Powell Company, Cincinnati. Folder, 3 x 6 in., 20 pages. Describes Powell valves.

Ingersoll-Rand Company, New York City. Bulletins 3033, 9024 and 4122, describing type XPV duplex steam-driven compressors, Beyer barometric-type steam-condensing plants and Leyner drill sharpeners respectively.

Independent Pneumatic Tool Company, Chicago. Circular devoted to Thor pneumatic tools.

Pneumatic Placing Company, New York City. Folder, 6 x 9 in., 4 pages. First of folders punched for binding and devoted to pneumatic concrete-conveying machinery.

Holt Manufacturing Company, Peoria, Ill. Bulletin C-108. Describes and shows in operation Holt caterpillar tractor.

H. M. Byllesby & Company, engineers and managers, Chicago. Booklet, 8 x 11 in., 68 pages. Describes and shows buildings of public-utility properties in which the Standard Gas & Electric Company, a client of the Byllesby company, owns investments.

John F. Byers Machine Company, Ravenna, Ohio. Bulletin 1003. Advocates use of Byers "Auto-Crane" for handling material.

Sterling Motor Truck Company, Milwaukee, Wis. Folders describing 5-ton worm-drive and 7-ton chain-drive Sterling motor trucks.

Federal Motor Truck Company, Detroit. Portfolio of pictures showing different uses of Federal trucks by contractors and commercial houses.

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Co-operation Between Local Societies

AN interesting example of how local societies can be of assistance to one another is afforded by a communication recently addressed by Horace H. Lane, president of the Detroit Engineering Society, to other local bodies in the Middle West, asking for information regarding good speakers and subjects for their programs. Local societies are frequently hard pressed to get suitable program material, but the difficulty would quickly disappear if the various bodies would co-operate. The speakers themselves will be glad to have a second and a third opportunity to present their subjects, while if a talk pleases one body it is poor economy to let it go unrepeated. Mr. Lane reports that the societies to which he has written have very kindly offered to co-operate. This is but one of many directions in which the local bodies can assist one another. It is just such inter-society relations which the Conference on Co-operation, of which Prof. F. H. Newell is chairman, is encouraging.

Latest Style in Highways

"THE road would be a quarter of a mile wide and would be a model highway, with a centerway for an automobile speedway and side roads for local traffic—straight for 100-mile stretches." In these words Miss Lillian Stuart of St. Louis described before the congress of the American Prison Association a 1000-mile highway from the Lakes to the Gulf, which is expected to be a "huge step in solving unemployment, poverty and crime." We have given improved highways credit for many things, but this road is to be a panacea for all social ills. But what less could one expect from a highway one-quarter of a mile wide and straight for 100-mile stretches?

High-Price Men in Demand

YOUNG ENGINEERS with ambition for the future, and older engineers who may be dissatisfied with the salaries they now receive, should ponder the meaning of an advertisement which appeared in last week's issue. Two men, each at $7,500 per year, one for superintendent of plant and one to design and construct a new plant, both with experience in mechanical and steam engineering, are desired by a firm of engineers in New York City. In addition to salary the men will be given a share in the profits of the company. They must have had continuous employment with at least one reliable company for over three years at a salary of $5,000. That such an advertisement should appear is proof positive that high-priced men are not only in demand, but are difficult to find. The advertisers undoubtedly canvassed their acquaintances thoroughly beforehand. The incident emphasizes the statement so often made to young men regarding the rewards which await those who can master the technical details of their work and then acquire that knowledge of human nature which marks the successful executive.

Fire Menace in Bridge Floors

ANOTHER expensive demonstration of the serious hazard to steel bridges with improperly protected timber-floor systems was witnessed in the fire of the St. Charels highway bridge over the Missouri River, reported in the last two issues. These fires, often started by sparks from locomotives operating on tracks below the structure, the reported cause in this case, are of periodic occurrence. The magnitude of the losses in such cases as this, where long-span trusses have been buckled by the heat and require rebuilding, again raises the question discussed editorially in the issue of May 15, 1915: Are designing engineers valuating properly the fire hazard when unprotected combustible floors are used? It is doubtful whether the percentage decrease in cost of expensive spans is large enough to justify the adoption of all-wooden instead of solid floors, with wood-block, asphalt or other surfacing. In the absence of fireproofing to protect the structure it is evident that a very high insurance rate could properly be charged against the cheaper construction. Disaster is certainly invited by exposed timber, whether creosoted or not, combined with the probability of high winds in river valleys.

Saving New York—The Next Step

SPACE has been given in these columns on two occasions to the movement in New York for securing the removal of factories from the theater, hotel and the shopping district. As was set forth in the Engineering Record of August 5, the campaign has been remarkably successful. Of the 220 manufacturers in the district bounded by Thirty-third and Fifty-ninth streets, Third and Seventh avenues, 202 have agreed to move as soon as their leases expire. The committee in charge of the movement having accomplished its main object is now busy on a complementary task—that of securing for the restricted zone the proper class of tenants. There will be much space available when the factories move out. Naturally the landowners will incur a considerable loss if the property remains idle. The committee is therefore pointing out to the business men of New York the opportunity that will exist for securing good quarters in this very convenient and desirable portion of the city. Attention is called to the subject here because a great many other cities have displayed an interest in this radical city-planning expedient. If other cities, unable to handle the situation by legal enactment—and that was the case at New York—adopt similar methods, they should realize that in addition to securing the removal of undesirable classes of tenants they should take steps to replace these by a class of occupants that will be in harmony with the character of the district in question.

Selling Lumber Honestly

PRESUMABLY the merit of branding lumber has by this time been proved to engineers, architects and contractors so conclusively that they are now demanding it in sufficient volume to make the retailers want their business. At any rate, a small number of retailers in the Middle West have seen the light with reference to branding and other methods of merchandising. They recently formed a national organization whose purpose is to combat dishonest practices in the way of mixing grades, giving short measure and misrepresenting the quality of lumber offered for sale, to discourage the practice of manufacturers selling direct to the consumer, and to support the branding practice which insures the integrity of the grade with consequent protection to the retail dealer and the consuming public. Whether the engineer, architect or contractor is responsible for this awakening because of his insistence on getting branded timbers and in buying direct from the manufacturer when he could not get it from local yards is of little moment. The fact remains that hereafter at least a small group of retailers making up the National Retail Lumber Dealers' Association will be likely to carry branded lumber showing the kind, grade and manufacturer in their yards. Gradually the lumber industry will get down to the same sound selling methods as are prevalent with other materials of construction.

A Ban on Juggernauts

IF present signs have been correctly interpreted New York City will soon have an ordinance regulating the weight, size, and speed of motor vehicles. Up to the present time no such instrument exists. That one is sorely needed was shown by the evidence of pavement damage presented by Eugene W. Stern, chief engineer of highways, Borough of Manhattan, in a paper delivered before the convention of the American Society of Municipal Improvements in Newark, N. J., last week (see page 495). In New York to-day a con-

tractor's tractor-trailer outfit having steel tires and carrying a load of 15 tons—a veritable Juggernaut—has raised havoc with city pavements, but there is no legal way in which its owner may be taken to task. The pavements in this case were granite block and sheet asphalt, both on 6-in. concrete foundations and only four years old. Clearly a halt should be called on such unreasonable use of city streets. It is true that the trucks are operated on a work of public improvement—the construction of the new subway—but even this fact does not justify the damage that has been done.

The matter of regulating motor vehicles is one that can best be solved by co-operation between municipal authorities and manufacturers of trucks. In the case of New York it is understood that such co-operation is now well established. It is well that this is so, for the interests of the city and of the manufacturers themselves will thus be better served. Into the making of such an ordinance as the one proposed more than the mere weight of the vehicle must enter. There are the correlated factors of speed, overall dimensions of the vehicle—an important element in traffic congestion—diameter of wheels, width of tire, character of springs and material of tire, whether of rubber or steel.

In some localities in this country legislation controlling motor vehicles has been enacted, but Mr. Stern believes that the best work in this respect has been done in Europe. Not the least interesting part of his paper is the digest of such ordinances as are now in effect.

It is safe to predict that the general subject of motor-vehicle regulation will soon receive far more widespread attention than it has in the past. This will not mean any diminution of the use of motor trucks. They have demonstrated their value far too convincingly for any such result. It means merely a greater degree of team work between the builders and the users of our highways.

Condition of Long Steel Pipe Line in Australia

EVER since it was completed fourteen years ago, the 30-in. steel pipe line supplying the Goldfields area of Western Australia has occupied a position of unique engineering interest. It was a daring project —the delivery of water by a conduit and relays of pumping plants a total distance of 351½ miles across a semi-desert country. But the construction features alone, despite their boldness, were not the only objectives upon which attention has been focused. The pipe line, in many sections, was laid in soil containing soluble salts which, because of their highly corrosive properties, caused grave concern for the permanence of the exterior coating and the metal underneath it. The interior also was subject to attack by water having unusual corrosive properties.

It soon became evident that the maintenance of the steel pipe under these trying conditions would be as big a problem as the one of actual construction. In 1909 a board of experts investigated the condition of the steel and its protective coating (see Engineering Record of May 21, 1910, page 671) and, among other things, recommended that the water be deaërated and treated with lime to minimize its attack upon the interior of the conduit. As for the exterior damage, the board suggested new coatings and a layer of slaked lime. Since that time the pipe line has continued in service, and the latest authentic records of its condition are contained in the annual report for 1914-15 by P. V. O'Brien, the engineer in charge (see page 501).

The report tabulates the expenditures on maintenance since 1902, discusses both internal and external corrosion of the coating and the steel plates and considers the matter of repairs. For the next three or four years, Mr. O'Brien believes, it will not be necessary to resort to such extreme measures as removing any great number of pipes, but the progress of general corrosion on certain sections of the main and the thinning of many of the pipe ends are, he states, inevitably bringing the time nearer when these measures must be resorted to. As for the present, careful attention is required to minimize the corrosive quality of the water, presumably by the lime treatment practised in the past, and to watch the progress of corrosion in order to determine the economic time for relaying sections of the mains.

The Australian records should prove valuable to those who are interested in the service of steel pipe under extremely adverse conditions.

How Not to Run a Society Convention

THE CONDUCT of the annual convention of the American Society of Municipal Improvements in Newark last week sustains in full the arraignment of that organization's methods made by the Engineering Record in its editorials of Sept. 30, page 398, and Oct. 7, page 428. The first of these directed attention to the absurdity of a technical program of such interminable length as the one prepared. The second dealt with the scandalous practice of specification-making which the society has followed for years and which was shown up in all its viciousness at last week's meeting. As a result of the proceedings at the Newark convention there can be but one verdict: Guilty on both counts.

In another column the paving specification fiasco is discussed at length. The following comment will be confined to the lamentable exhibition of bungling in the handling of the technical session on sewage treatment—a session rich in possibilities under intelligent management.

The technical program was characterized by the Engineering Record as top-heavy, and its collapse was predicted. This journal was specific in objecting, not to the character of the papers—for many of unusual excellence were listed—but to the overwhelming number. These predictions were made: That adequate treatment of all the subjects listed would be impossible; that discussion from the floor—always the most interesting and valuable feature of conventions—would be curtailed; that authors who had taken the time and trouble to prepare papers would be summarily disposed of by the "reading-by-title" route; that engineers who, after personal sacrifice in time and money, had made the trip to Newark to present or to discuss papers would be doomed to disappointment. The result last week vindicated the forecast.

Due to the insufficiency of the time available for the sewage papers, the intrusion, at the outset, of a long paper on a topic entirely foreign to the avowed purpose of the session, and the necessity for quitting the room early to allow for banquet arrangements, the sewage-treatment meeting fell far short of expectations. Its possibilities were great, particularly as regards information on the activated-sludge process. The audience contained an array of sanitary-engineering talent such as seldom can be brought together. The stage was set for an important conference, yet there was no opportunity for discussion, and several important contributions had to be omitted or summarized so briefly that their effect was lost. It was a woeful exhibition of lack of foresight, all the more deplorable because the convention management permitted a manufacturer of a patented pavement—"standardized" by the society—to deliver, not one, but two addresses exploiting his product.

Apropos of the conduct of the sewage-treatment session the opening remarks of George A. Carpenter, chairman of the society's committee on sewerage and sanitation, are, by contrast, a sharp condemnation of what happened. He said, in part: "The committee wishes to emphasize the necessity of an intelligent discussion of the papers presented, arranged for in advance, if engineers of prominence are to be persuaded that it is worth their while to prepare papers for meetings of this character. Replying to the committee's invitation to prepare a paper upon certain experiments which were being carried out under his direction one engineer wrote, 'I find that it is not worth while spending the time which it takes to present such a paper unless some discussion is given to it, and unless men able to discuss such a subject are selected by your committee and have a copy of the paper in hand for the convention.' "

This is not the first time that the Engineering Record has had occasion to criticise the management of engineering conventions. A number of organizations that have expanded in membership during recent years are still trying to administer their affairs by the methods which proved satisfactory when the associations were small. The situation at Newark last week is almost precisely the same as that which developed at the New York convention of the American Waterworks Association early this summer, and which was commented upon editorially in the Engineering Record of June 17, page 789.

Both cases indicate forcibly that in the

handling of convention programs there is need of a man who can sense the important things and give them due prominence. Any man with such characteristics would have been quick to feature the activated-sludge session at Newark last week and give it ample time—to the exclusion, it would be hoped, of some of the commercialized papers.

As election day draws near we hear a great deal about "business administrations." Why can we not have business administrations in the conduct of society conventions?

A Disgrace to the Engineering Profession

IN the issue of Oct. 7 the Engineering Record characterized the specification-making procedure of the American Society of Municipal Improvements as a reflection on the engineering profession. After attending the society's convention in Newark last week it is desired to amend the characterization and to say that the procedure was a *disgrace* to the profession. Throughout, the manufacturers occupied the foreground. One gained the impression that their interests were paramount, and that the public, regarding which the convention literature spoke so solicitously, was not a factor. Some may have doubted the justness of the Engineering Record's previous condemnation of the society, but there will be no doubt in the minds of those who were at Newark or who read the proceedings of that meeting, as described in the news columns of this issue, page 513. In fact, the society itself voiced dissatisfaction with its procedure by authorizing the appointment of a committee to revise the constitution, while from the floor on Thursday night two speakers, themselves in the thick of the mêlée, condemned proposed actions, saying that they were of the type that had brought criticism on the society from the engineering press.

The "battle of the materials" started on Monday morning before the subcommittee on specifications for creosoted wood-block paving. Following the usual custom the specifications were *not* issued to the membership in advance; the members were asked to consider a highly technical document and to give a decision instanter. Some few—those who had attended a private meeting in New York last month—were provided with copies of the tentative requirements. Of the sixteen or more men in the room during the hearing eleven represented manufacturers of creosoting material, while of the other five, only three were bona-fide city officials. The other two were consulting engineers, one of them much in the service of material manufacturers.

The session need not be described in detail here. It was a fight for "our interests," the only persons not material men participating in the discussion being the chairmen of the subcommittee and of the general specifications committee. When the subcommittee adjourned the air was filled with predictions as to the storm that would break loose in the convention if a water-gas tar alternative were not included in the specifications.

The climax came Thursday night, but strangely not in connection with the subject on which a fight had been predicted—the wood-block specifications. They came up Friday morning. The subcommittee reported a water-gas tar alternative. The warring interests were satisfied and the specifications went through without an objection.

The initial fight Thursday evening was precipitated by an amendment which proposed to substitute an alternative type of specification for the present blanket asphalt specifications. The resolution, apparently, was a surprise to the membership. They were asked, without an opportunity to criticise or study the alternative specifications offered, to reverse the society's Boston action.

The debate was stormy, discussion was shut off by the chair while a member was demanding the floor, and the question was so put that it was impossible to understand what was being voted on. The chair at first refused to give the count, although declaring against the amendment, and a demand for a recount, made by two members, went unheeded. Apparently this was the end, for the evening, of the asphalt specifications.

Next came the report of the subcommittee on bituminous pavements. It was a brief document and made no reference to the Bitulithic specification, which comes within the purview of the subcommittee. The report was quickly adopted. Later it developed that it was the intention of the subcommittee, by refraining from mentioning the Bitulithic specification, to have it eliminated from the society's standards. Then pandemonium broke loose anew. Every wile of the experienced parliamentarian was invoked to kill the resolution eliminating Bitulithic. The ignorance of parliamentary procedure displayed at this stage of the meeting would have disgraced a high-school debating society. The resolution was finally laid on the table, and Bitulithic still holds its proud position as the only patented paving which is a standard of the society.

Then it was moved to reconsider the asphalt specifications, and the battleground was shifted from the Warren to the asphalt interests. Again an attempt was made to quash the question, but finally, on a roll-call vote, the amendment to adopt the alternative form of specification was lost. During this roll call a well-known official of one of the large asphalt-producing companies brazenly stood in the front of the assembly hall and tabulated the vote as it was taken.

The recital here does not do justice to the evening, but is sufficient to indicate the chief cause of the trouble—a constitution that allows entirely new matter to be brought up at a meeting and to be adopted at once as a standard of the society. Had the membership been notified a month in advance that the alternative asphalt specification would be proposed and that the elimination of Bitulithic would be considered, argument would have taken the place of obstructionist tactics. It is, of course, not desirable to prevent the introduction of new matter on the floor of the convention. The society should restrict itself in its constitution, however, to the privilege merely of referring such new matter to committee.

The other cause of the disturbances is the influence of the materials manufacturers. Their pulling and hauling is looked on as a legitimate feature of the society's work, while the impression is strong that too many men holding active membership hearken to "their master's voice."

In the revision of the society's constitution it would be desirable, in the opinion of this journal, to eliminate entirely the making of specifications. That work should be left to bodies with more conservative traditions, with a well-ordered procedure which cannot be manipulated by manufacturers. Paving specifications made by the American Society for Testing Materials and the American Society of Civil Engineers would command the respect of everyone in the municipal field.

It is too much, however, to expect that the society will go that far. Its members feel that specification-making is one of its legitimate functions. The material interests, moreover, have a great influence, indirectly, in the society and it is certain that they would strenuously oppose (not by vote, for they are not allowed to vote) the giving up of this part of the society's work. The best that can be hoped for is a revision of the specification-making procedure. Tentative drafts should be placed before the membership in advance of conventions so that the requirements can be scrutinized and voted upon intelligently. The specifications should then be adopted tentatively for a year, and their final adoption, after a second vote in convention, should be by letter ballot.

This procedure would help to place the society on a better basis. Further than that, however, the society must go. Those who in the past have exercised the chief control in the organization must be eliminated. They have been accustomed for so many years to the scheming of the materials manufacturers that they are callous to the disgraceful manipulation and will not be likely to insist upon the needed reform. New men, not those of the old régime, should constitute the committee which will revise the constitution.

Then, too, the membership requirements must be raised and those barred and eliminated who have suspicious relations with paving material interests.

Finally, consulting engineers who are retained by material interests should be ineligible to membership on committees whose work affects those interests. The Engineering Record submits that it is ethically improper for these men to pretend to represent the public where such interests are at stake.

While the procedure at Newark last week was disgraceful in the extreme there is indication that just such an exhibition was needed to awaken the society to a realization of the sorry exhibition it was making. If that has been accomplished, the meeting of Oct. 12, bad as it was, will not be without benefit to the engineering profession.

Contractors' Methods on Welland Ship Canal Work Present Interesting Variations

Traveling Concrete Tower Introduced on Lock Construction Rivaling That of Panama—Central Crushing Plant Utilizes Heavy Rock Excavation—Entire Canal Laid Out as Single Piece of Work

REHOISTING towers—traveling on the low level and working at the point of deposit—are being used on the Welland Ship Canal for placing from 400,000 to 1,500,000 cu. yd. of concrete in lock structures nearly 100 ft. high and from 800 to 2500 ft. in length. Although the method will perhaps be improved as the work progresses, it is said to have already shown a clear advantage under these conditions over handling large buckets of concrete with cranes and derricks, and over direct chuting from a central plant.

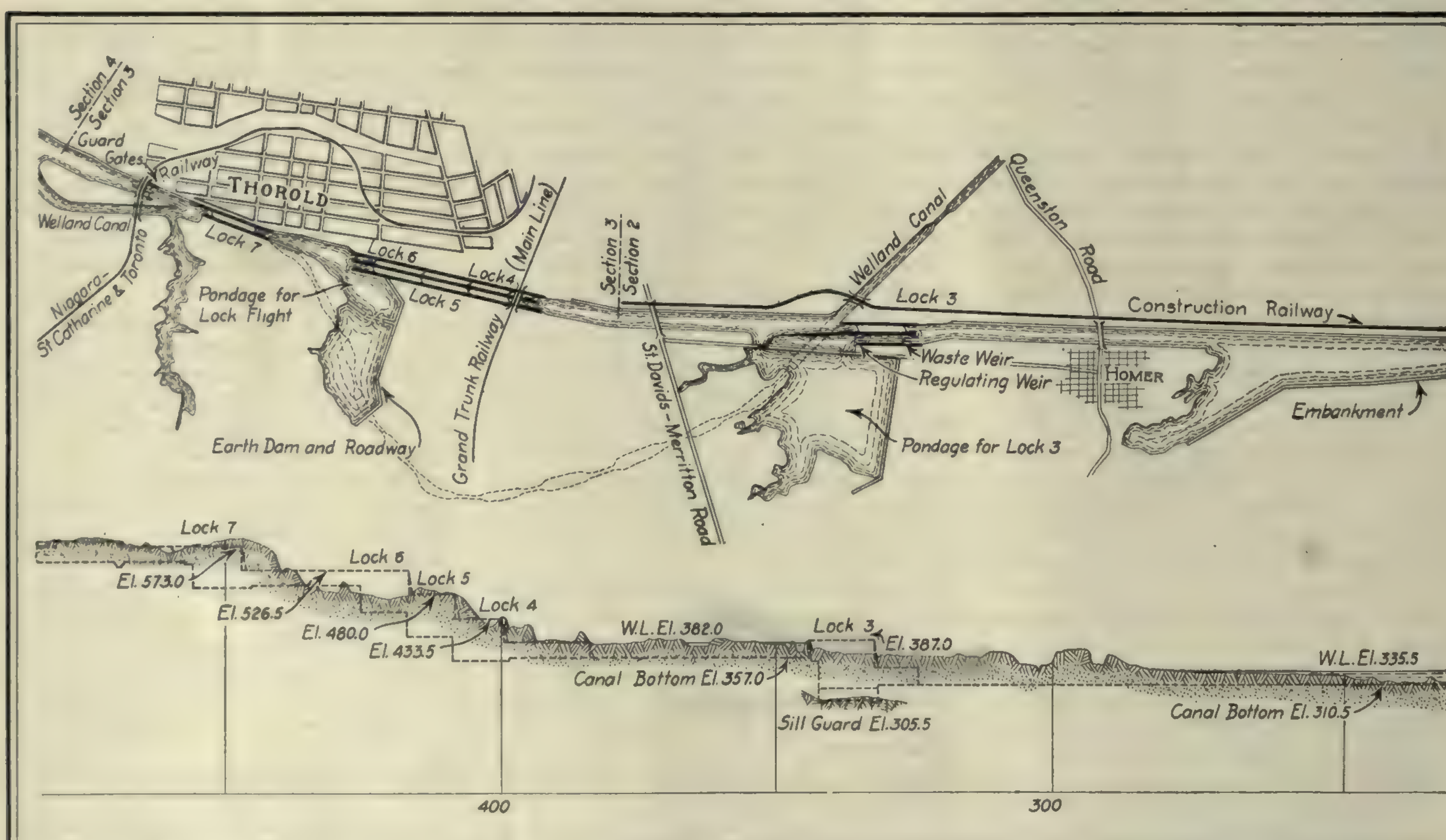
Apart from the immense volume of concrete work, interest in the construction centers in the manner in which the entire canal has been laid out as a single piece of work, although actually divided into nine distinct contracts, ranging up to $10,000,000 each in cost. The bulk of the concrete and rock excavation being at the north end of the canal, the first three sections were let at once, so that rock excavated on one of the sections could be crushed to supply aggregate for most of the large structures. For distributing this stone and to furnish transportation from the steam-shovel cuts to the 7000-ft. jetties that will protect the new Lake Ontario entrance at Port Weller, a double-track railway, ballasted with stone, was built and is maintained by the government along the west side of the canal for joint use of the first three sections. As the only large volume of concrete outside of these sections is in the guard lock, No. 8, near the south end of the canal, and as the only other available aggregate was gravel brought in from Lake Erie, a considerable saving is realized under this plan.

In addition to the three northerly sections, Section 5, which consists chiefly of excavation that could be carried on without interfering with the operation of the Present Canal, was started and the material removed is being used to refill part of the Old Canal which supplies water for power developments. Although two large sections—Section 8, which contains the guard lock and is the next on which bids will be asked, and Section 4, on which there is heavy earth and rock work—remain, the back of the work will be broken when the four sections under way are finished. The remainder of the work required is the widening and straightening of the existing canal and of the Welland River and the construction of improvements needed in the harbor at Port Colborne, the Lake Erie terminus of the canal.

Large Crushing Plant for Utilizing Excavated Rock

The main crushing plant, which has reached an output of 3000 tons in a day of two 10-hour shifts, is located at the north end of the rock cut for the triple flight of twin locks on Section 3 and is the southern terminus of the construction railroad. Being north of the point where the Grand Trunk Railway crosses the canal, this location made a crossing of the construction railroad with the Grand Trunk unnecessary. It also made it possible to lay out an approach line with easy grades for the construction trains, from the downgrade end of the excavation for the lock flight, while still keeping the crusher plant outside the lines of the canal. Rock from the construction trains is dumped into a gyratory crusher capable of breaking a 42-in. stone. A bucket conveyor carries the stone from this crusher to the screens and secondary crushers, the final product being carried by belt conveyors to bins under which cars on the main construction railroad are run to be loaded by gravity. This plant is furnished and operated by the contractors for Section 3 as part of the contract, stone being supplied for the other sections in cars at the plant.

The good rock strata were interleaved in many cases with red shale, and as all the rock excavation was taken out by steam shovels this shale became mixed with the hard rock in excavating the lifts. Accordingly, much of it was crushed and, although a large percentage was removed by screening, still some of it was stored in the large stock pile west of the plant. Being suitable for concrete when first broken, this shale in the storage pile weathered during the first year until it could not be used as it stood. A washing and screening plant was therefore added to the crushing plant, and is being operated, using the stone from this pile as a reserve. Water is obtained by gravity from the canal through a 12-in. cast-iron pipe. The sludge is caught in a



PLAN AND PROFILE OF WELLAND SHIP CANAL FROM THOROLD TO LAKE ONTARIO—LOCATION OF LOCKS, EMBANKMENTS

settling pond adjoining the canal near the crusher.

CONTRAST IN CONCRETE-PLACING METHODS

At the present time four methods of placing concrete are in use on the first three sections. On Section 1 the concrete is being mixed and delivered to cars on the lock floor, which are carried to either of two rehoisting towers, one of which brings the wall up to half height and the second of which is considerably taller and follows the first, completing the wall.

On Section 2 two different methods are being employed. One of these comprises a spouting plant with double hoisting towers and an extensive system of chutes, located at the head of Lock 2. This plant is building the upper entrance walls to the lock, the breast wall and the upper forebay. A single 2-yd. mixer feeds both the towers. The remainder or main portion of the lock is built with concrete handled from cars on the lock floor to place in 4-yd. buckets by locomotive cranes.

On Section 3 the concrete is being mixed on the lock floor, hoisted and spouted to cars on a trestle at convenient height for pouring the footings direct and for dumping into the skip of the rehoisting tower, and is being placed by the latter, which extends the full height of the wall. This plant is being used to concrete Lock 7, while the guide walls of Lock 6 have already been largely concreted with derricks. Derricks were also used in building the guide walls on the upper level at Lock 1.

CONCRETING FROM CARS ALONG TOP OF WALL

The west guide wall on the lower side of the lock on this section has been concreted from cars running along the top of the wall on a track supported by the structural-steel reinforcement required for the counterfort-wall section used here. The

MIXING PLANT USED AT LOCK 7

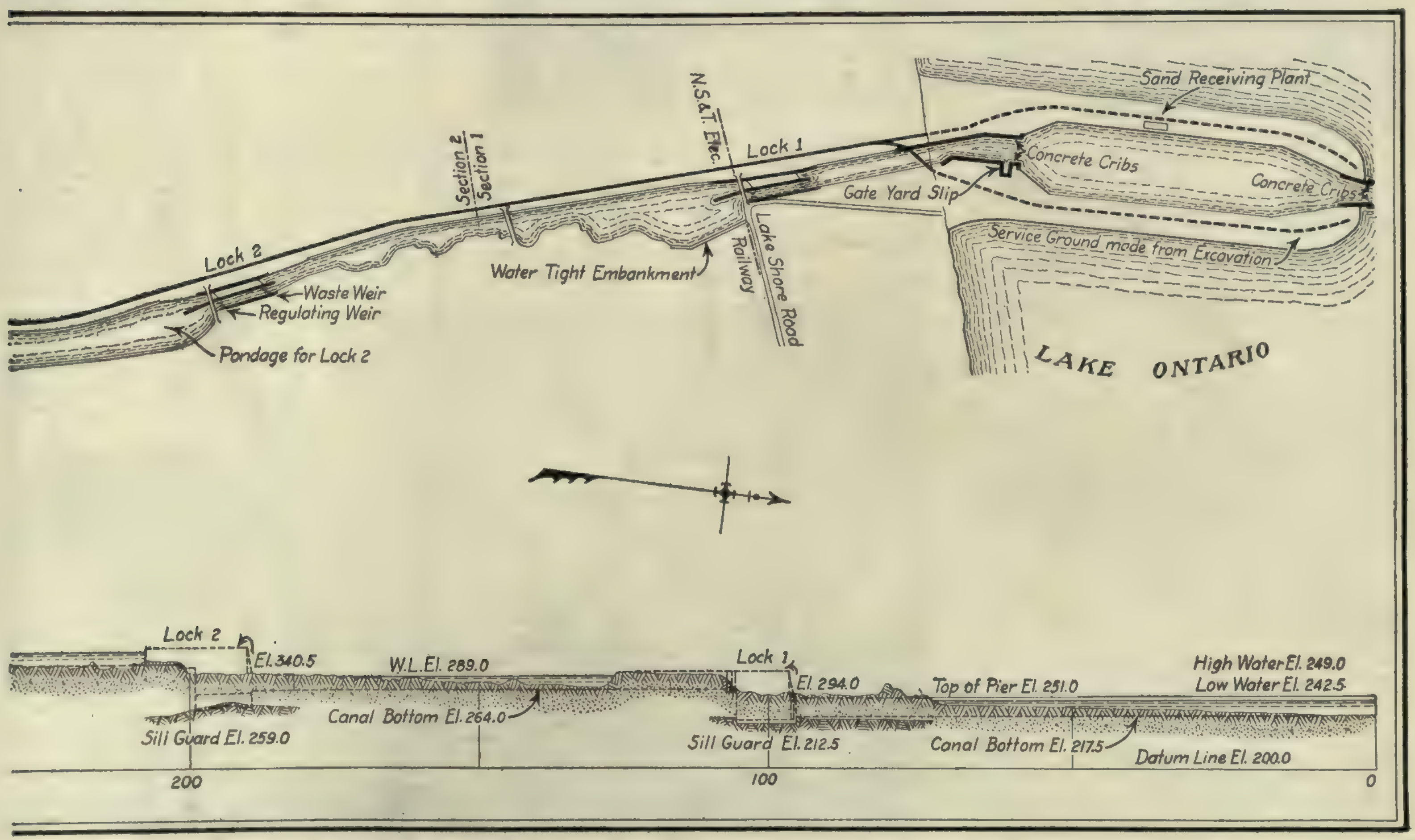
concrete is raised to this level by a tower located at the central mixing plant. It was only on Lock 1 that this method could be used, as under the bids received for the other sections it was found cheaper to use mass concrete and gravity sections for the approach walls. On Sections 1 and 3 for practically all of the time only a single 1-yd. mixer has been employed. On Lock 3 in Section 2 a smaller volume of concrete has been placed so far with the cranes, although a 2-yd. mixer is employed. On Lock 2, where two 2-yd. mixers are employed with the spouting plant, about half of the concrete in the lock walls proper has been placed. The tendency seems to be to keep the unit batch for hoisting in the towers down to 1 yd., while the batch transported varies in all cases from 4 to 6 yd.

The mixing plant at Lock 1 is located north of the lock chamber near the middle of the west guide wall, a section of which has been left out temporarily. Sand and stone are dumped from a siding on the main line construction railway into bins on the side of the bank back of this plant. The sand for this, as well as for the section above, is received by boat on Lake Ontario and unloaded with grab buckets into bins over the tracks on the west jetty at the canal entrance. After being dumped into the sidehill bins at this plant, either sand or gravel, as required, is raised by a belt conveyor to bins erected over the mixer. This mixer discharges either into a lower skip in which concrete is hoisted to be placed in the guide wall or into a 6-yd. capacity hopper which is used to load the cars taken to the rehoisting towers in the lock.

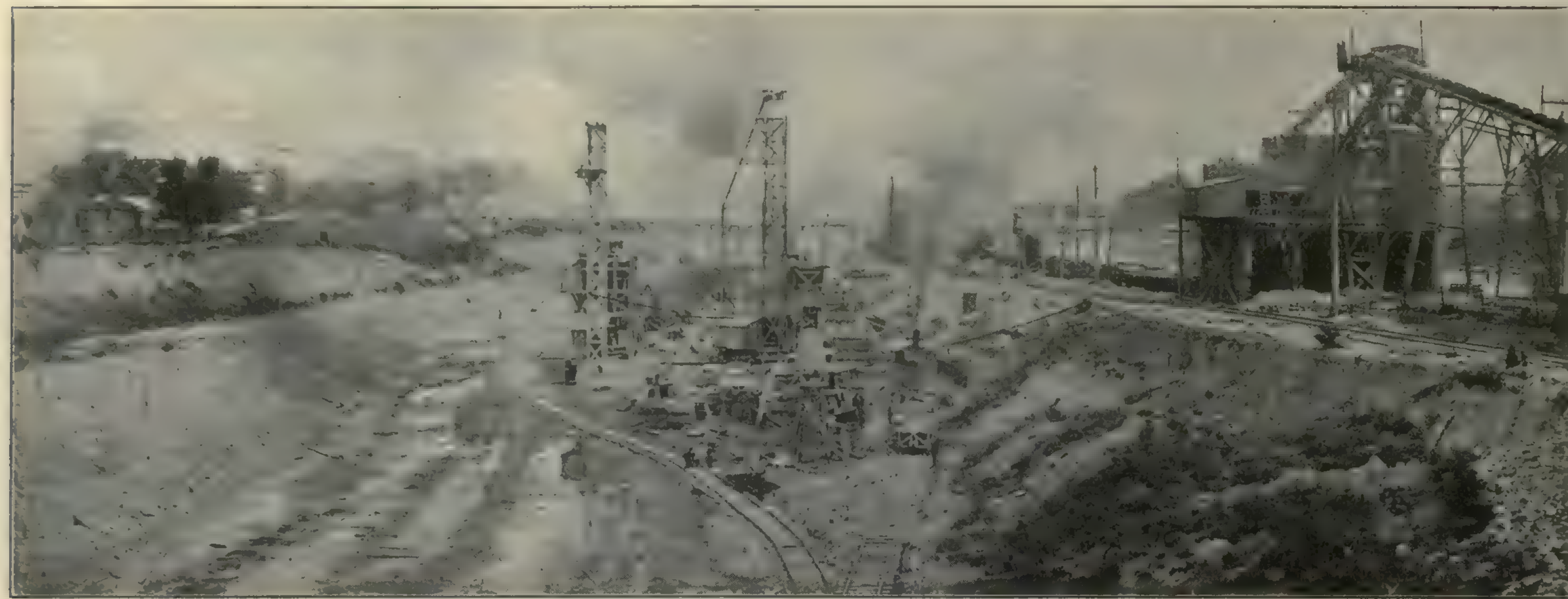
TIMBER BASES FOR REHOISTING TOWERS

Each of these rehoisting towers rests on one corner of a timber base about 30 ft. square, on the opposite corner of which is the hoisting engine. Four trucks under the corners of this base carry the tower on two tracks which form a part of the delivery track system on the lock floor. On one of these tracks next the lock wall rides an inclined track, which is supported from and carried along with the base of the tower. The lower ends of the rails of this track are cut off on a bevel and rest directly on the running rails wherever the tower happens to be. Two 6-yd. cars, each handled by a dinkey, transport concrete to these towers. The cars are pulled up the incline by a cable from the hoist. They dump into hoppers from which concrete is drawn as needed to the tower skip.

At the head of the tower a short length of chute supported from a boom is used to distribute the concrete in the form. This has been found much superior to using a



AND PONDAGES FOR LOCKS—DOUBLE-TRACK CONSTRUCTION RAILROAD, STONE BALLASTED, PARALLELS NORTH BANK OF CANAL



CONCRETE LAYOUT AND REHOISTING TOWERS AT LOCK 7—PRESENT CANAL BEHIND SCREENING PLANT IN RIGHT BACKGROUND

chute hung between the tower and some support on the wall. It is noticeable that here, as well as on other hoisting towers on the canal, small hoists and low rope speeds are used. While no time studies have been made, it is thought that, as now arranged, this hoisting speed is the limiting factor in the speed with which concrete can be placed by this method. Blaw steel forms have been used on this lock, and are fastened by rods extending diagonally downward to anchor blocks set in the previous lift. These forms and also the wooden end and corner forms have been handled by derricks traveling along the cut bank back of the walls, leaving the lock floor free for the traveling towers.

Just south of this lock is a crossing of a single-track electric line, which will be carried on a drawbridge resting on the upper approach walls. North of this line these walls have already been concreted by a separate plant, from which the concrete was transported in buckets on cars to derricks which placed it in the wall. One of the traveling towers will probably be used to hoist concrete to the upper level from the north mixing plant to complete this work. The method of placing concrete in the counterfort walls north of the lock has already been described in the Engineering Record of July 10, 1915, page 56.

Cranes Handle 4-Yard Batches on Lock 2

The mixing plant on Lock 2 differs from that at Lock 1 in that a spur track on a trestle is run out over the canal excavation to bins from which the 2-yd. mixer is fed by gravity. This mixer discharges directly into 4-yd. skips, four of which on a platform car constitute a concrete train handled by a dinkey. Two of these trains are used when placing concrete. Double-line buckets are employed, which are dumped in the form by a 25-ton locomotive crane with an 80-ft. boom. Two of these cranes are used. They also handle the wood forms used on this section.

It is said that the spouting plant on Lock 2 of this section has never been correctly adjusted so that it could be given a real tryout. The rope speed here is also considerably less than that commonly used in American practice. This plant is located near the center of the upper forebay floor, and is supplied with materials from the construction railroad, which are hoisted by bucket conveyors to bins over the concrete mixers.

On Lock 6 of the third section the concrete plant for building the outside walls was located at the southeast corner, where it could readily be supplied by rail. Concrete carried in skips on cars was run from this plant on a trestle along the base of the east wall to the point of deposit, where it was handled by a derrick. For the opposite wall, a tower and chute were employed to spout the concrete across the width of the lock to a hopper over a similar trestle along the base of the west wall, from which the bucket trains were filled. The derrick work, however, was found to be the slowest of all the methods tried for depositing concrete, and last season in beginning the construction of Lock 7 the contractor built an elaborate rehoisting tower braced in two directions so as not to require guys, which are used on the larger tower on Section 1. Like the towers on this section, the one at Lock 7 travels on track laid on the lock floor and is pulled along by tackle operated from its hoist. In order to concrete the wall progressively so as to have several working points available at once without providing a second tower, this contractor built a trestle about 20 ft. above the lock floor for the cars which supply the tower. These cars are thus able to dump directly into the forms for the first and heaviest lifts of the wall. They are of the side-gate type. To fill these cars without having to bring them down to the lock floor, a tower was erected at the mixing plant in the center of the lock, from which concrete is spouted to a hopper built on the trestle. This mixing plant is supplied by rail, and the bins over the mixer are supplied by bucket conveyers from the level of the lock floor. It would have been possible, as with Lock 6, to bring stone from the main crushing plant and sand from Lake Ontario up through the flight of locks on the construction track. However, the contractor has elected to buy gravel and sand from Lake Erie, bring them down through the present Welland Canal on barges to a point where this canal passes within a stone's throw of the chamber of Lock 7 and unload them at an independent screening plant. Railway cars are loaded from overhead bins at this plant and switched down to the lock floor. Much of this sand and gravel also have been stored in the lock chamber of Lock 6 for the construction of the center wall and floors and for use on Lock 5.

Spoil Used to Build Jetties

The dry excavation on the canal has been handled with steam shovels and with dragline excavators with $1\frac{1}{2}$-yd. to 4-yd. buckets and Western graders. It has been disposed of in three ways, besides the use made of the limestone excavated for aggregate. By far the larger part of the earth excavation has been carried to Port Weller and used

REHOISTING TOWERS WITH SHORT CHUTES PROVE EFFECTIVE AT LOCK 1

in constructing the jetties protecting the entrance to the canal. A considerable yardage of the earth excavation of Sections 1 and 2 has been used in constructing levees and an earth dam forming the pondage for Lock 2.

Much of the earth excavation of Section 3 has been disposed of in a similar manner in building a large earth dam, which has a concrete core wall to rock where it could be reached and a sheet pile cutoff for the remaining length. This dam will form pondage for the flight of twin locks. The area covered here extends across the present canal, which is in operation and cannot be interfered with until the new canal is in use. A temporary dam, shown on the plans, has therefore been built in the same way as the permanent earth dam to provide pondage for the initial operation of the new canal. The old canal here makes a loop to the east of the new one, recrossing it a short distance north of the lock flight. It will be possible to take boats from the new canal into the old at this point, if desired. When the construction for this purpose has been completed, the temporary dam referred to will be removed as soon as the permanent dam can be completed across the old canal.

Making Embankments

The fill for these structures is being delivered by train from the steam shovels, dumped and rehandled by two large steam drag-line machines equipped with 5-yd. clamshell buckets, which are able to scatter the material so it can be leveled with scrapers and rolled in about 1-ft. layers. The material in the levees on Section 2, on the other hand, put in place with teams and wagons loaded principally by Western graders, has been so packed in placing that rolling is not required. Practically all of this material is clay, though there will be a rockfill at the toe of the dam on Section 3.

The only dry excavation not disposed of as outlined is being used to fill in low land outside the navigation lines of the canal at the north end of Section 3.

As will be remembered from the article in the Engineering Record of July 12, 1913, page 35, the structures on the canal are being built to provide a navigable depth of 30 ft. at extreme low water, while the excavation is being carried only to a depth of 25 ft. Future depth can thus be obtained at any time by dredging out 5 ft. of the canal bottom. A drainage cut has been carried 20 ft. wide in the floor of the canal prism as far south as Lock 3. This cut is 10 ft. deep, and is for the purpose of allowing the locks to drain off during periods of repair in the winter and spring. It was also of advantage in keeping the prism dry during construction.

Rock Cut Taken Out Full Depth

The contractor for Section 3 is removing the 2,500,000 yd. of rock from the site of the flight of twin locks by steam shovels. Electric well drills are used to drill the blast holes, which are usually 40 ft. in depth. From 20 to 57 holes containing from 5 to 13 tons of dynamite are fired at a time. The steam shovels on this work are, of course, operated from the downgrade or north end. The rock excavation for the flight of locks itself, representing more than half the total for the section, is practically complete in the pits for the two upper locks of the flight. The rock in the pit for the lower lock of the flight has only been partly stripped as yet.

It is intended to pour the concrete of the lock walls against the sides of this rock excavation without forms or backfill. For securing a vertical face, as required by the specifications, the contractor elected to use channeling machines. As these only had a vertical range of about 10 ft., the full-depth excavation was not carried to the edges of the cut. The benches left at the sides were shot down in lifts of convenient height for the channeling machines, of which a number were employed at one time.

Dipper-Dredge Work

Section 5, where the work consists of widening and deepening the present Welland Canal, is being excavated by dipper dredges loading into dump scows. These scows are towed down the present canal to a point just below Allenburg, at the north end of the section, and dumped into a basin adjoining the canal. The material is pumped from this point by an 18-in. hydraulic dredge over the west bank of the canal into low ground, which is to be filled as described at the beginning of the article.

The contractor for Section 1 also has in service a number of dipper dredges which have been used to excavate the entrance channel as far as the shore line. This material was loaded into dump scows and used to fill to within a few feet of low water the site of the jetties surrounding the entrance basin. This preliminary filling rendered it much easier to construct and maintain the temporary trestle used for handling the spoil trains from the dry excavation sections. The sides of the channels leading from this basin, both into the lake and into the canal, are protected by the reinforced-concrete cribs, the construction and placing of which were described in the Engineering Record of April 10, 1915, page 458. The dredging in this basin is well along, while the fill on the west side is almost complete, and that on the east side is more than half finished. The basin now furnishes a sheltered harbor for the dredging fleet, which at the beginning of the work was forced to run for Port Dalhousie at every storm.

A core of earth has, of course, been left between the shore line and Lock 1, to be taken out by the dredges after the lock is finished. Little water comes through this core from the lake, and pumping is almost unnecessary.

The sections of the canal now under construction are crossed by seven highway, two trolley and two railroad bridges. A temporary trestle structure has been used for one trolley bridge and one or two of the highway bridges, while the other highways have been cut or carried across on low embankments. One trolley and one railroad bridge, however, both of which are on Section 3, were a different matter. These lines were carried across the canal section on steel bridges supported by concrete piers extending below the lines of the excavation. So far as possible the piers were placed to come within the lines of the completed concrete structures, guard gates being located at the crossing of the Niagara, St. Catharines & Toronto Railway and the Grand Trunk, crossing the lower end of Lock 4.

BETWEEN LOCKS 5 AND 6, SHOWING CHARACTER OF EXCAVATION ENCOUNTERED

As during construction these bridges had to be about twice their final length to allow for the side slopes of the excavation, it was decided not to attempt to place the permanent steel until the canal structures were complete. Short spans, which it is hoped can be sold at the conclusion of the work as complete railroad bridges, have accordingly been used at both locations. For the foundations of the Grand Trunk bridge it was necessary to construct cofferdams more than 80 ft. deep on one side and only 55 ft. deep on the other, with the railroad line in operation on the high side. Some heavy shoring was required, but the work was accomplished without accident.

Progress Delayed by War

It is thought that, so far, a fair test of methods and rates of progress possible has hardly been furnished by the construction operations on the canal. The labor shortage in Canada has been even more serious than in this country, and the few men that could be obtained are difficult to hold and to work with. In addition, the proposition, which is a large one, has presented many problems to the contractors engaged, and

more attention has been paid to getting started on lines that will prove economical in the long run than to making rapid progress.

The entire work on the Welland Canal is in charge of the Department of Railways and Canals of the Canadian Government, for which department J. L. Weller is engineer in charge of the work, and W. H. Sullivan principal assistant engineer. The general contractors for the four sections now under construction are: The Dominion Dredging Company, Section 1; Baldry, Yerburgh & Hutchinson, Section 2; O'Brien & Doheny and Quinlan & Robertson, Section 3, and the Canadian Dredging Company, Section 5. In addition to numerous other subcontractors on the work, Lane Brothers are carrying on the concrete work described on Lock 1; the reinforced-concrete cribs on Section 1 are being built and placed by J. H. Tromanhauser & Co.; the steam shovel excavation on Section 2 is being carried out by Yale & Reagan, and that on Section 5 by J. H. Corbett & Sons.

Public Drinking Fountains Gain Popularity

Total First Cost at Portland, Oregon, $364.80 Each — Monthly Water Cost for Twenty Fountains, Running Continuously, $15.30

TWENTY public drinking fountains of the type shown in the illustration have been installed in the downtown streets of Portland, Ore. The locations were determined with respect to the heaviest pedestrian traffic, and the fountains were placed in such a way that one is to be found every

THESE FOUNTAINS RUN CONTINUOUSLY

few blocks throughout the entire business district. It is notable that they have advanced rapidly in popularity as the public has become accustomed to their use, and the "drink habit" is now common to all classes.

The standards are made of cast bronze and the spouts and interior of the bowls are highly polished. The standards cost $317 each, f.o.b. Portland, and the installation charge was $47.80, making the total cost, installed, $364.80 each. The funds for this improvement were donated by S. Benson, a philanthropist interested in civic improvement. The park bureau of the city provides for the cleaning and polishing, which totals about $200 per year, and for repairs amounting to about $100 per year. The water is supplied from the municipal system.

The fountains run continuously 24 hr. per day throughout the entire year. This amounts to an estimated daily flow of 3825 gal., or 510 cu. ft. On this basis, the flow per month is 15,300 cu. ft., which, figured at 10 cents per 100 cu. ft., costs the city about $15.30 per month for water.

It is believed that the advertisement in this manner of the city's abundant supply of exceptionally good water is well worth the cost entailed, and there is little doubt that since residents have become accustomed to the plan any suggestion of its abolition would meet with a storm of protest. It is not unusual to find all four units of a fountain engaged, and during business hours each fountain is usually in service the greater part of the time.

Bazin vs. Ganguillet and Kutter

Peculiar Relation Is Found to Exist Between Formulas Commonly Used for Calculating Flow of Water

By A. G. HILLBERG
Hydraulic Engineer, New York City

ENGINEERS working constantly with problems pertaining to the flow of water in open channels as a rule prefer the Ganguillet and Kutter formula to the Bazin. Some engineers, however, especially in some countries abroad, prefer the Bazin equation, because it is of later origin than the Kutter.

As is well known, the Kutter formula was first published by the Swiss engineers Ganguillet and Kutter in 1869, four years later than the appearance of the first Bazin formula, which was published in 1865. The second Bazin formula appeared in 1897, or twenty-eight years after the Kutter formula, and its form makes it the most convenient to work with. Logically, it being the latest of all, it should also be more accurate, as the experimental material available was most extensive.

Second Bazin Formula

However, if the second Bazin formula is compared with the Kutter it is found that the values of C vary considerably for different conditions. This is shown in the following:

For smooth channels the coefficient of roughness as given by Bazin is about 0.06, while that given by Kutter is 0.012. The coefficient C, therefore, as figured by the Bazin formula and for R varying from 0.6 to 3 varies from 138.2 to 148.1, the difference being about 10. On the other hand, the coefficient C for the same variation in R as figured by the Kutter formula, using slopes varying from 0.000025 to 0.01, will vary from 90.1 to 149.4, the difference being about 60.

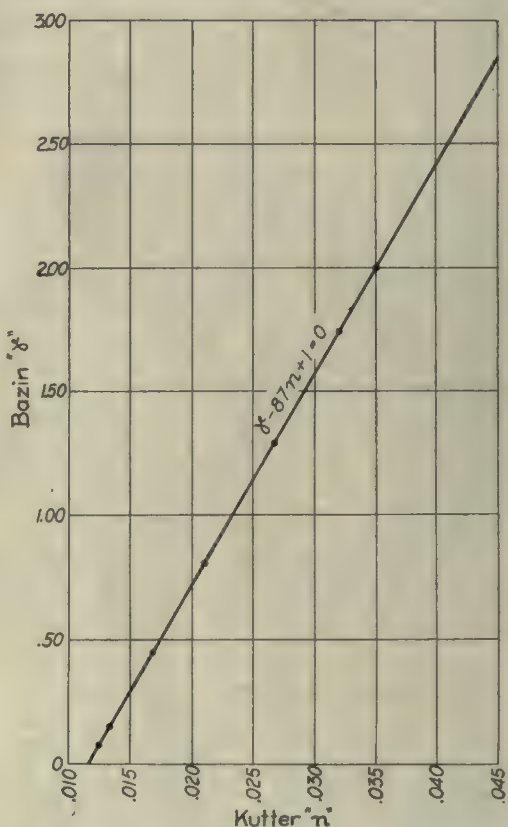
For river beds in bad order the Bazin coefficient is about 2, while the Kutter coefficient is about 0.035. The coefficient C by Bazin therefore for R varying from 0.6 to 3 varies from 27.8 to 50.9, the variation being about 23. For the same variation in R and for slopes from 0.000025 to 0.01 the Kutter formula gives a C from 25.8 to 50.7, a variation of about 25.

Consequently for rivers in bad order the formulas agree better than for smoother channels. It is also obvious that, when the slope is steep, and consequently the influence of the term $0.00281/S$ in the Kutter formula is negligible, both formulas give almost identical results.

These facts have led the writer to investigate the relation between these formulas, so as to make clear the relation between the different coefficients, as he believes that for ordinary calculations of the flow in rivers the Bazin formula should be used. However, as the Kutter coefficients are widely known, and as nearly all experiments made in this country have been made in order to determine the Kutter coefficient, it is necessary to establish a relation in the form of an equation, a curve or a diagram from which the corresponding Bazin coefficient can be obtained.

In doing this a very close relation has been found, so close as to make one doubt the originality of the Bazin formulas. This will be shown in the following:

Both formulas were published in the metric system, but as the reader is more familiar with them in their transcribed



RELATION BETWEEN COEFFICIENTS TAKES FORM OF STRAIGHT LINE

form the English system will be used. Obviously, it does not matter in a discussion of this kind which form is used, and the computation given in the following can easily be repeated in the English system by those interested in checking the result.

Comparison of Formulas

As is well known, the English form of the Kutter formula reads:

$$C = \frac{\dfrac{1.811}{n} + 41.65 + \dfrac{0.00281}{S}}{1 + \left(41.65 + \dfrac{0.00281}{S}\right)\dfrac{n}{\sqrt{R}}} \qquad (1)$$

while the second Bazin formula (1897) reads:

$$C = \frac{87}{0.552 + \dfrac{\gamma}{\sqrt{R}}} \qquad (2)$$

The latter formula, through multiplying

both terms by 1.811, can be given the following shape:

$$C = \frac{157.6}{1 + \frac{1.811\gamma}{\sqrt{R}}} \qquad (3)$$

When studying the shape and construction of these formulas it becomes evident that they are of the same general form, or

$$C = \frac{a}{1 + \frac{b}{\sqrt{R}}}$$

Now for certain conditions both formulas will give the same result. When this occurs, because of their being of the same form, the numerators can be equated and the denominators likewise. In that way the following system of equations has been established:

$$157.6 = (1.811/n) + 41.65 + (0.00281/S) \qquad (4)$$

and

$$1.811\gamma = [41.65 + (0.00281/S)] \times n \qquad (5)$$

If now equation 4 is multiplied by n and equation 5 subtracted from it, we have

$$157.6n - 1.811\gamma = 1.811$$

which divided by 1.811 becomes

$$\gamma - 87n + 1 = 0 \qquad (6)$$

As is seen, the slope term is eliminated, which is a check on the writer's observation as previously mentioned. Equation 6 gives directly the relation between the Kutter and Bazin coefficients of roughness, and it is the same whether the original equations are given in the English or in the metric system. It is also obvious that the relation is in the form of a straight line, and it has been plotted in the accompanying diagram.

To show the close check between the coefficients as calculated by equation 6 and as generally used, the accompanying table has been computed. It gives the type of channel, the coefficient γ as recommended by Bazin for the various types of channel, the Kutter coefficient n as calculated by equation 6 and the latter as generally assumed.

ASSUMED AND CALCULATED COEFFICIENTS

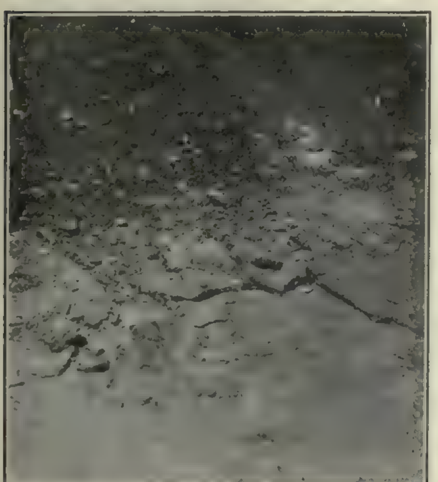
Type of channel	Bazin's γ	Kutter's n — As calculated by equation 6	Kutter's n — As generally assumed
Planed boards or smooth cement	0.06	0.0122	0.012
Well-laid brick	0.16	0.01335	0.013
Rubble masonry	0.46	0.0168	0.017
Firm gravel	0.80	0.0207	0.020
Excavated canals in good order	1.30	0.0265	0.025
Excavated canals in bad order	1.75	0.0316	0.030
Rivers	2.00 or more	0.0345	0.035 or more

The check between the assumed and calculated values is so close, and the relation between them so simple, that it appears quite possible that the second Bazin formula is nothing but an abbreviated form of the Kutter formula. Therefore in cases where the slope is so steep as to make the slope term in the Kutter formula negligible, the Bazin formula can be used with the same degree of accuracy as the Kutter formula, which also checks the writer's observations, as previously mentioned.

Pavement Damage Calls for Truck-Weight Restrictions

E. W. Stern Discusses Injury to Asphalt and Granite Block by New York Subway Construction Haulage

SO GREAT has been the damage to some of the best pavements in the Borough of Manhattan, New York City, by heavily loaded, steel-tired trailers hauled by motor trucks that the municipal authorities are considering measures for limiting the weight, size and speed of all vehicles using the city's streets. The situation was summed up last week by Eugene W. Stern, chief engineer of highways, Manhattan, in a paper presented before the American Society of Municipal Improvements, from which the following extracts are taken:



TRUCK AND TRAILER LOADED WITH SIX SKIPS OF SUBWAY ROCK
(LEFT) DAMAGE TO ASPHALT ON CONCRETE FOUNDATION
(RIGHT) DEPRESSIONS IN NEWLY LAID GRANITE PAVEMENT

15-TON LOADS

The chief offenders are contractors' outfits hauling rock from the subway excavation on Broadway. They consist of tractors and trailers, each carrying six large skips, weighing about 15 tons. The trailer wheels are 41 in. in diameter, with steel tires 8½ in. wide. The load per inch width of tire is about 1400 lb. The springs are very stiff, and this fact has unquestionably contributed to the destructive effect of the wheel loads of the trailer. The jarring effect of the loaded vehicle is such that people along the route traveled complain about excessive vibration in their buildings.

The route traversed has been along sheet asphalt and granite pavements, both on concrete foundations. These pavements are all substantially about four years old. They are considered among the city's best pavements, and have been laid in conformity with the latest specifications. Up to the time when the damage began to be done by the trailers no appreciable amount of wear had been noticed beyond what ordinarily might be expected on thoroughfares with as much traffic as have the streets mentioned.

The mischief has all been done in a very short space of time, about nine months, and has amounted to 5400 yd. of repairs on granite (equal to 32 per cent of the total area), costing \$6,000, and 1900 yd. of repairs on sheet asphalt (equal to 30 per cent of the total area), costing \$1,900. Prior to this time the average cost per year of maintenance on the granite was \$150; on the sheet asphalt, \$70.

The accompanying photographs show a loaded truck and the amount of damage that has been done to the pavements. On granite pavements the granite blocks have been literally crushed and ground into powder. In some cases the blocks are actually split. While the granite is not what might be called "hard," still it is of the quality that has been successfully used on the best types of pavements in New York. It was quarried at North Jay, Me., and Rockport, Mass.

On the sheet asphalt the destructive effect has been equally startling. In some places it has been ground to small bits; in other places the fiber of the wearing surface has been completely broken and cracked. It has also shoved in places and shows many depressions, waves and ruts.

In many cases the 6-in. concrete base has been shattered. In many other cases, however, where the wearing surface has been damaged, the foundation remains intact. The speed of these vehicles was about 6 miles per hour in the daytime, and at night it was considerably higher—12 and 14 miles per hour.

The question of restraining the contractor from hauling such excessive loads was submitted to the corporation counsel, and his answer was that as there was no ordinance restricting the loads on vehicles it would be very difficult to obtain any relief until suitable legislation was obtained.

RUBBER VS. STEEL TIRES

Practically no damage has been caused by motor vehicles in which all of the wheels are covered with rubber, beyond what is reasonable, although there are some types of heavily loaded trucks in use in the city. The first-class pavements show practically no additional expense for maintenance beyond a reasonable amount.

The manufacturers of motor vehicles have found by experience that about 750 lb. per inch width of tire is all the load the rubber tire will stand, and this load and the resiliency of the rubber and the adequate springs on motor vehicles, which good construction demands, seem to be the sav-

ing features in protecting the pavements against undue wear, even under heavy loads.

The trailer, however, comes in an entirely different class. Not being rigidly connected with the vehicle having the engine and the more or less delicate mechanism, it need not have the rubber tires, nor the easy springs to prevent damage to the tractor. Hence builders of these, who form a distinct class from the motor vehicle manufacturers, have allowed their fancy no restrictions in the designs of the trailers, their principal object, according to Mr. Stern, being to provide a vehicle having the greatest tonnage capacity at the least cost, without considering the destructive effect on the pavement caused by the excessive loads, narrow steel tires, small diameter of wheels, and inadequate springs.

It becomes evident, therefore, that immediate action must be taken to protect city pavements and country highways. Otherwise the taxpayers will be called upon to make very heavy payments to maintain their streets and highways, although these may have been constructed in a thoroughly first-class manner and in accordance with the latest ideas.

Regulations properly framed to protect the pavements against the destructive effects of excessive loading in vehicles should, Mr. Stern believes, take into account the following factors:

1. That the wearing or damaging effect of wheel loads on pavements is a function of (a) the load, (b) the diameter of the wheel, (c) the width of tire, (d) whether or not the tire is of a resilient material such as rubber, or of steel, (e) the kind of springs.

2. That speed has considerable to do with the damaging effect produced by heavy loads.

An investigation of the laws and ordinances governing the weights and loads of vehicles, etc., adopted by eight states and forty-nine cities in the United States and Europe, goes to show that only a few laws have been drafted in accordance with modern conditions. It is surprising that even to-day in this country certain communities require that the width of the tire should depend on the diameter of the axle, regardless of the loading. Others make no distinction in the regulations between a wheel large or small in diameter, while still others treat rubber and steel tired wheels the same.

Some of the most up-to-date ordinances are presented in the table.

WIDTH OF VEHICLES

Unless some limitation is placed upon the size of vehicles, the tendency will be to make them larger and larger, until they will become a nuisance and congest the highways. This is now becoming evident in New York, as well as in other cities. In order to provide reasonable standing room on each side of a street, and at the same time allow traffic to proceed in both directions, it becomes necessary to limit the width which vehicles take up.

Many of the New York streets have roadways only 30 ft. between curbs. It thus becomes evident that with the curb lines occupied, vehicles over 7 ft. in width do not allow for two to pass, even using the utmost care. While it is becoming necessary to widen roadways in Manhattan, it is very difficult to add more than 2 ft. to each side. A 30-ft. roadway is thus converted into a 34-ft. roadway. In this case a 7½-ft. width for a vehicle would be the limit.

REGULATIONS GOVERNING LOADING OF VEHICLES

CHICAGO, ILL.

Maximum weight of vehicle	15 tons
Maximum load on any one axle	12 tons
Maximum load on the wheel	6 tons
Maximum load per inch width of tire	1000 lb.
Maximum length	40 ft.
Maximum width	8 ft. 6 in.

Speed—Compatible with safety, but not to exceed 9 miles per hour; not to exceed 4 miles per hour when truck has defective tire which would cause injury to pavement. Motor trucks must have rubber tires. Trailers must have steel tires.

NEW YORK STATE

Maximum weight of vehicle	14 tons
Maximum load on any one axle	9 tons
Maximum load per inch width	800 lb.
Maximum width, 8 ft. 4 in., except traction engines, which may have a width of	9 ft. 2 in.

Speed—Under 4 tons, 15 miles per hour; over 6 tons, 6 miles per hour, with steel tires; over 12 tons, 12 miles per hour, with rubber tires.

STATE OF NEW JERSEY

Maximum weight of vehicle	12½ tons
Maximum load per inch width of tire	800 lb.

Speed—4 tons, 12 miles per hour, with iron tires; 6 tons, 8 miles per hour, with iron tires; 6 tons, 10 miles per hour, with rubber tires.

STATE OF PENNSYLVANIA

Maximum weight of vehicle	12 tons
Maximum load on any one axle	9 tons
Maximum load per inch width of tire	750 lb.
Maximum width, 7 ft. 6 in.; for buses in large cities	8 ft. 4 in.

STATE OF MASSACHUSETTS

Maximum weight of vehicle	14 tons
Maximum load per inch width of tire (except for hard pavements.)	800 lb.

Speed—4 tons, 15 miles per hour; 6 tons, 6 miles per hour, with iron or steel tires; 6 tons, 12 miles per hour, with rubber or similar tires.

OAKLAND, CAL.

Maximum weight of vehicle	14 tons
Maximum load per inch width of tire (except for hard pavements.)	800 lb.

Speed—4 tons, 6 miles per hour, with iron or steel tires; 4 tons, 12 miles per hour, with rubber tires.

ENGLAND

The English have much the most complete and scientific ordinances of any that Mr. Stern has examined:

Maximum weight of vehicle	12 tons
Maximum load on any one axle (for trailers, 4 tons.)	8 tons
Maximum weight of vehicle without load	5 tons
Combined weight of motor car and trailer	6½ tons

Weight on axle to be proportioned to diameter of wheel.

The load per inch width of tire (steel) shall be 840 lb. for wheels 3 ft. in diameter; and an additional allowance of 9⅓ lb. for every additional increase in diameter beyond 3 ft.; and for wheels less than 3 ft. in diameter, a deduction of 18⅔ lb. per inch width of tire for every inch less in diameter than 3 ft.

Vehicles for military service are limited as follows:

Weight of car (unladen)	6 tons
Weight of car (with trailer)	8 tons
Unit of registered axle weight with tires shod with cross bars	560 lb.
Maximum width. 90 in. for 3 tons; for trailer	90 in.

Speed—Dependent on axle weight for iron-tired vehicles, 6 tons, 12 miles per hour for rubber tires; over 6 tons, 8 miles per hour for rubber tires. Should car unladen weigh more than 3 tons, speed is limited to 8 miles per hour. If motor draws trailer, maximum speed is 5 miles per hour.

Joint Operation of Research Laboratory Planned

Portland Cement Association and Lewis Institute, Chicago, Agree to Co-operate on Investigations of Practical Value

WITH the purpose of broadening the scope of tests and insuring practical application of the results, the Structural Materials Research Laboratory of the Lewis Institute, Chicago, will be operated jointly by the institute and the Portland Cement Association, according to an agreement entered into on Sept. 1. There is thus assured in this country a plan which has been successfully used by Germany for many years, whereby an association of manufacturers makes provision for a scientific study of the uses of their product and its value to the general public. The Lewis Institute laboratory will be utilized in carrying out exhaustive research into the properties of concrete, reinforced concrete and aggregates, and the influence of various factors upon the manufacture and placing of concrete.

At present the laboratory occupies about 8000 sq. ft. of floor space, and contains equipment for making all the usual physical tests of concrete and concrete materials. As an adjunct there is a chemical laboratory for testing the impurities of natural sands. A considerable part of the work already undertaken has been carried out in co-operation with several committees of the American Society for Testing Materials. Committee C-9, for example, supplied funds for equipping and operating the chemical laboratory for the study of impurities in sands and related problems. Tests of reinforced-concrete fence posts have been made for a committee of the American Railway Engineering Association, and tests of concrete to determine the effect of time of mixing have been carried out for the National Conference on Concrete Road Building.

EXPERIMENTAL WORK IN PROGRESS

The scope of experimental work, either completed or in progress, is indicated by the following list: A comparison of results of tests of mortar and concrete, using twenty-three lots of cement, of interest also in showing the most satisfactory form of test piece; effect of fineness of grinding on the strength of mortar and concrete; a study of the impurities affecting the concrete-making qualities of natural sands; wear tests of concrete, with reference to use in roads; effect of variations in consistency on strength of concrete; a study of concrete aggregates to determine effect of size and grading and the relative value of different kinds of aggregate, and the use of mechanical sifters for determining fineness of cement. Tests are now being made at the rate of about 40,000 a year.

The laboratory work is under the immediate direction of Duff A. Abrams. The chemical investigations are in charge of Oscar E. Harder. Four assistants aid in the conduct of the investigations. The results of the research work thus far completed have been embodied in reports of technical committees of the various societies mentioned.

Recommends Waste Collection by Motor Trucks in Chicago

Waste collection by wards or small districts with motor trucks, at least experimentally, is the recent recommendation of the finance committee of the Chicago City Council. An investigation by the committee disclosed the fact that politics affected to a marked degree the conditions surrounding the collection and disposal of ashes and garbage. In many instances team owners were assessed from 50 cents to $1 per day per team, and withal the system tended to bring an inferior kind of service. The committee recommended, in addition to the motor truck proposition, a method insuring selection and continuance of teams on the basis of efficiency. Definite specifications for horses are 1400-lb. animals, 16 hands high, chunky, short bodies, full ribs, clean leg bones and a good-shaped foot. The council has approved the recommendation by a large vote.

Co-ordinated America Demands Participation of Engineers

Technical Men Should Take an Active Part in National and Local Politics—Mere Voting Not Enough

By THOMAS C. DESMOND
Consulting Engineer, New York City

ONE of the most difficult and important problems of America to-day is that of how properly to co-ordinate our democracy. We are trying out on this continent an experiment at democracy which has not yet been proved an enduring success. The definition of co-ordinate is: To bring into common action, movement or condition; to regulate and combine in harmonious action; to adjust, to harmonize. The effort of today should be to co-ordinate our whole national life so that America may be a truly great nation—a nation great in other ways than merely in regard to the extent of its natural resources; and the engineers of America have in them the power to help largely to bring this about. The American nation was founded on certain ideals of democracy. The great leader of America in the days of the Revolution, George Washington, was trained as an engineer in his youth, and the example which he gave of constructive public service should be an inspiration to all other engineers.

National Team Work Needed

We have here a democratic government and not a strongly centralized government. We have decided that our people shall not be controlled too directly by any governmental power. If therefore we are to accomplish collective results at all, we must find a substitute for that direct governmental power by developing in our people some sort of democratic spirit of team work. The many people of foreign birth in America, with their differing sympathies, help to make this difficult. But by some means we must get the mass of people of all sorts which we have here to pull together willingly for the common good. It is this that is meant when it is said that we must co-ordinate our democracy, and it is this problem that the engineers of America may well take part in helping to solve.

A great significant fact of the present war has been the realization of France and the other Allied Powers that if they are to have any hope of succeeding in the struggle they must develop a national efficiency to some degree approximating that of Germany. And so in France as well as in England and the other Allied countries we have seen an extraordinary development of national co-ordination. The previously discordant elements of French national life have been welded for the time at least into a harmonious whole, and it is France, a nation of one purpose, with its people co-ordinated and efficient, that now faces the world. The war has repaid something of its cost to France by its wonderful development of French character.

Those of us who still believe in the ideals of democracy as expressed by our forefathers in the founding of this nation will not want America to substitute German ideals. Nor does any one of us want this country to go through the terrible agonies of war for the indirect benefits which result from war. But the facts before us should set us all earnestly thinking. We should realize that whether we have any military dangers to fear or not we shall at any rate have to endure a world-wide industrial conflict after the war is over. The nations that will compete against us are those that are now being welded into unity by great necessity. It is well that we should be examining the state of our own country and helping in every possible way to keep it in a condition to withstand successfully any strains, any dangers, it may have to undergo.

Big Problems Involve Engineering

There are many reasons why, in working on national problems, the help of engineers will be especially effective. This is largely an engineering age and engineers are responsible for much of the complexity of modern life. The development of applied science, with its tremendous effects on the economics of production, has changed greatly the relations of people to each other and the relation of the government to the people.

The problem of transportation, for instance, with its important connection with the interests of all of our people, is essentially an engineering problem. Consider one means of transportation—the railroads of America—and think how vitally interested every one in America must be in the condition of these railroads. The railroads have become the very arteries of the country; they are almost indispensable. If we are ever to have a properly co-ordinated democracy in America it is evident that the relations of the railroads and the people must be on a sound and just basis. The engineers of America have been largely responsible for the building and operation of the railroads, as well as for other works of applied science, and America should utilize the help of the sane judgment and influence of these American engineers in keeping railroad conditions in accord with other elements of our national life.

Health Problems Important

With no sacrifice of individual liberty, except where that individual liberty menaces the public welfare, more attention should be paid to the health of our people. In this work our sanitary engineers can be of the greatest assistance. The marked lowering of the death rate that has come in many cities from proper engineering supervision of matters of water supply and sewage disposal is known to all. The beneficial results which follow proper engineering attention to matters of street cleaning, garbage disposal, etc., are also very important. Engineering studies of the housing conditions of our people, particularly in the tenement districts of the large cities, may also be productive of much good. We are a prodigal, reckless nation, reckless of the health and lives of our people even while we have the scientific means at hand to preserve them. Needless deaths and needless sickness certainly make for national inefficiency, and engineers can show very well the advantages of a coordinated America in helping to safeguard the public health.

Is a democratic form of government really unsuited to human nature as it now exists? Is a strongly centralized, autocratic government really a better form of government under which to live? To every American who still cherishes the democratic ideals for which his forefathers fought the answer must be "No" to both of these questions. But at the same time the obligation rests with the man who answers "No" to see to it that he does his part toward making our ideals of democracy practical. American men have always answered the call to national duty in times of war, and, if they can be brought to realize fully the need, they will answer the quieter calls to duty in times of peace.

It is urged that some kind of system of universal military training would be of great help in co-ordinating American life. It is suggested that a particular advantage of military training is the discipline it gives to the minds of young men, with a strengthening of their character. This is undoubtedly true, and a system of universal military training would certainly help greatly to co-ordinate America. One might call attention, in this connection, to the effect on engineers of the severe technical training which they undergo. Engineers must acquire in school and out of school a mental control and fixed standards of truth, or else they do not succeed very well as engineers. Engineers are not perfect as a class by any means, but they are generally men of strong character, and for this reason alone they can be effective forces for good in a democracy.

Naval Consulting Board's Work

The general question of military preparedness in America will not be touched on here, but it is desired to mention something of the well-known work for preparedness that has been done by that group of engineers which is called the Naval Consulting Board. This association of prominent engineers, with the assistance of many other engineers throughout the country, has been making inventories of all of the manufacturing establishments in the United States. The resources of each manufacturing establishment, the number and kinds of the different machines contained therein, have been noted with a view toward their use in making munitions in time of war. This kind of work, done by engineers, certainly represents real preparedness, and it is a great step toward national co-ordination. No individual liberties or privileges have been disturbed, no owner of any manufacturing plant has lost anything by the information he has given, but the country as a whole has been greatly benefited. It is an excellent instance of the kind of public service which engineers can render America.

The public has been made familiar of recent years with the extraordinary results of increase in efficiency of production which have attended the introduction by engineers of the principles of scientific management into many industries. In a few cases where cities have appointed city managers, engineers have been given these positions, and have done well in carrying out some of the principles of scientific management in the administration of city affairs. This is a good thing; efficient government in itself helps to co-ordinate American life. It is a tribute to engineers that they should be hired as capable city administrators. But if engineers are to be most effective for good government, they should be not merely governmental employees, but the men of power behind the government as well, the leaders of public opinion, and this implies that they should be active in city, state, and national politics.

This is indeed the fundamentally im-

portant work which engineers must do if they are to accomplish the best results in helping to co-ordinate our democracy—they must become more active in politics. The government of a democracy is the government of the people, and unless the people take an active interest in the shaping of that government the government will suffer, and with it the whole national life will suffer. There is no escape from the logic that a democracy can not be successful unless its best qualified citizens take an active interest in its welfare. And such an interest means more than merely voting at the polls on the days of general elections. It means that since in America we have the party system, engineers should, for the best results, be active in political party organizations in helping to choose good party candidates for office, good party programs of legislation, and doing other general political party work.

Engineers and Politics

The interest of engineers in politics should not be merely a temporary thing, kept up during some particular campaign. It should be a lifelong interest, kept up as a matter of duty. By activity in politics, and particularly activity in political party organizations, engineers will be able to make their beliefs effective in a powerful way. They will be able to affect the currents of public opinion at the source. With more good men active in party organizations, other good men will consent to stand as candidates for public office. We shall get back more of that fine spirit in American life which deems it a high honor to serve the State. And a popular respect for government, brought about by the kind of democratic government that can be respected, will do much to help co-ordinate America.

It has been said several times in this article that it would be well for us to have a better co-ordination of our national life. The dangers which may result from unco-ordinated, disintegrated national conditions are very real. It is unpleasant, and probably unnecessary, to point out that there have been other experiments at democracy in the world's history before, and they have failed. There have been other rich nations, and they have been destroyed. What it is wanted to emphasize now is the wonderful possibilities of this nation if it holds true to and makes more effective the democratic ideals of its founders. In the realization of these possibilities engineers can play an important part.

Cost of New Jersey's Roads Increased by Traffic and Difficult Construction

Special road problems in New Jersey are encountered owing to the presence of marshes, to a relatively congested population, and to the location of that state between New York and Philadelphia. Because of the heavy traffic it has been necessary to construct more substantial, and therefore more costly, roads than in many of the other states. This cost has been increased by developing a number of the roads from turnpikes built in the early days along straight lines without regard to grade. The necessity for carrying highways over marshes and tidal inlets has also contributed to the cost. The approximate construction cost of roads in New Jersey up to 1914 has just been estimated by the U. S. Department of Agriculture as $140,000,000.

Sun Shipbuilding Plant Planned for Rapid Production of Special Standard Steamers

Main Building of H-Shaped Plan, with Mechanical Equipment for Direct Movement of Materials, Provided at 80-Acre Site on Delaware River

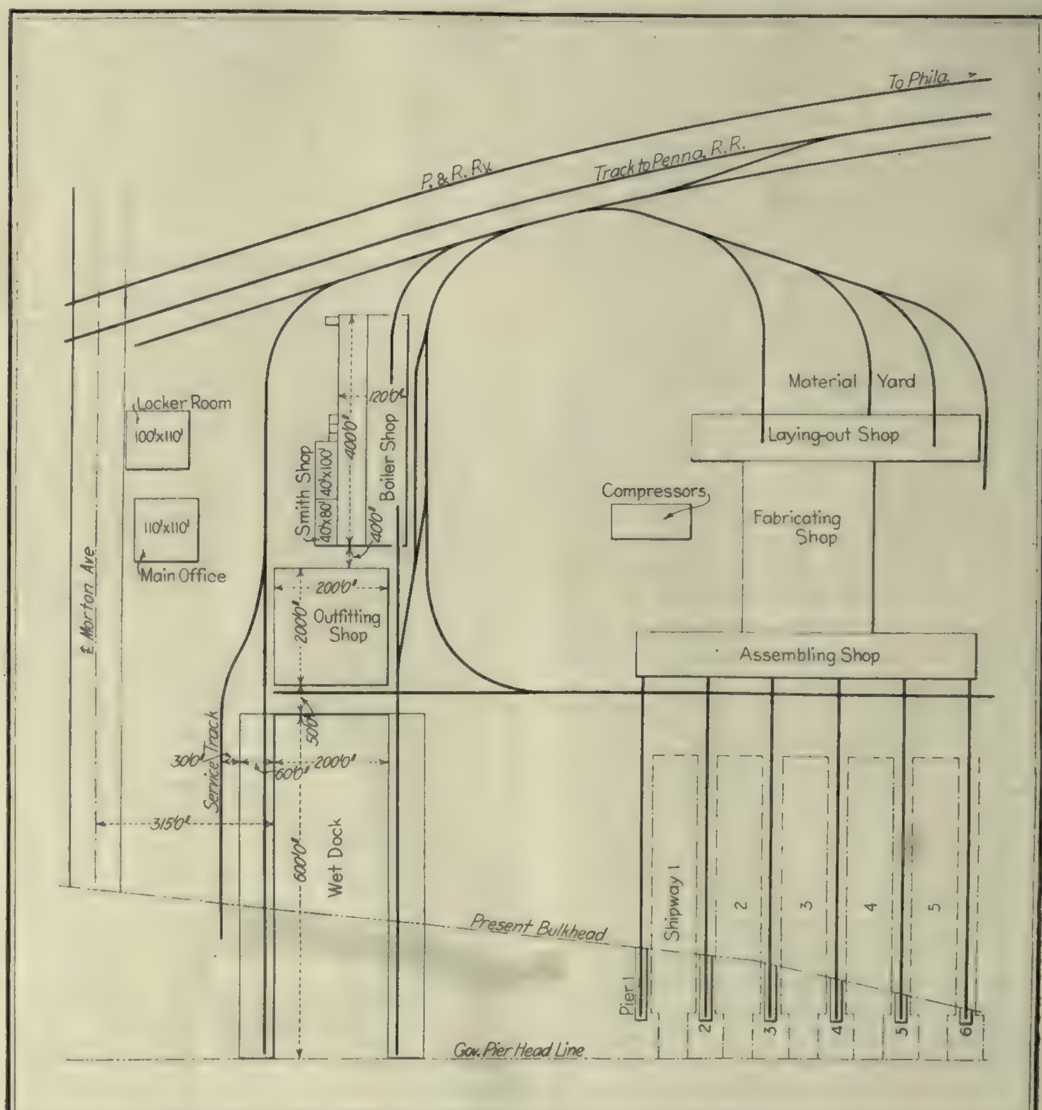
After extensive study of shipbuilding establishments in Europe, the main building of the Sun Shipbuilding Company's new plant on the Delaware River at Chester, Pa., has been designed as a large H in plan in order to insure the most effective and direct movement of the materials from the stock yard where received by rail on spur tracks connecting with the Pennsylvania and the Philadelphia & Reading railroads to the finished steamer in the river. The cross-bar of the H is the wide fabricating shop equipped with electrically operated rollers instead of cranes to provide continuous movement of the material. Next to the stock yard on the north is the two-story part of the building, the layout shop in the first floor and the mold loft in the second floor. At the other end of the fabricating shop, next to the river, is the assembling shop, a one-story building, with a high crane runway for handling large sections of the hulls or ship framework. Crane runways nearly 100 ft. high and spanning 125 ft. then transfer the fabricated parts to the five reinforced-concrete shipways where the hulls are assembled preparatory to launching. After launching, the ships are placed in a 200 x 600 ft. wet dock near which the boiler shop and the outfitting shop are located.

Three standard types of freight ships will be built, with the idea of insuring rapid production, hence effective layout and handling facilities are especially necessary. It is expected that at least fifteen standard 10,000-ton steamers per year can be fabricated, and with improved organization a possible capacity of twenty steamers per year is contemplated. This means that about 5000 tons of steel must be taken into the plant and fabricated into a ship each month.

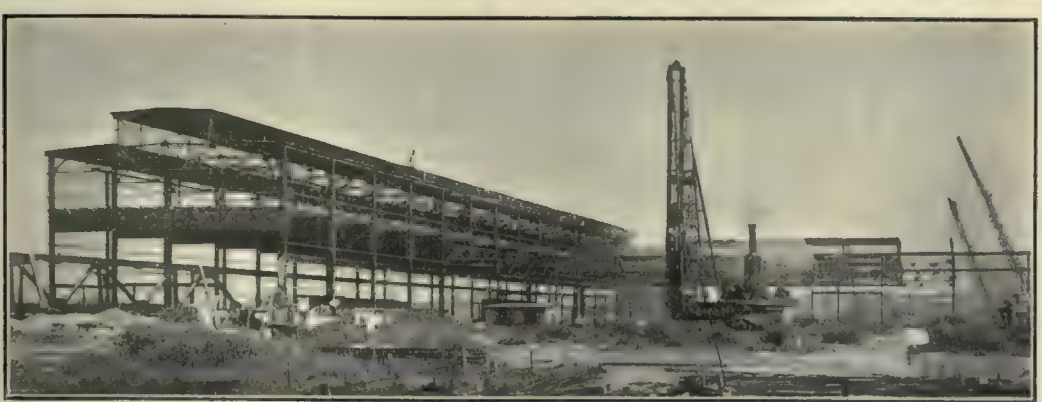
General Layout of Plant

The Philadelphia & Reading Railway tracks bound the 80-acre site on the north, while the Pennsylvania Railroad will construct a spur crossing over the Reading and connecting to the tracks indicated on the plan. The material transported to the plant is delivered to the material yard, the boiler shop, the wet dock or the assembling shop and shipways, as desired.

The laying-out shop, the north side of the H, is 80 x 500 ft. in plan, two stories high, the first floor being used for the layout shop and the second floor for the mold loft. As seen in one of the photographs, the main building is a steel-frame structure of Bethlehem H-columns, with flat roof and monitors. Ample light, so essential in a



TRACK SYSTEM AND BUILDING LAYOUT TO FACILITATE MOVEMENT OF MATERIALS



LAYING-OUT SHOP ON LEFT CONNECTS WITH FABRICATING SHOP IN CENTER

building of this type, is provided by steel sash in side walls and monitors. The fabricating shop, 300 x 225 ft. in plan, connects the parallel end buildings. Long-span triangular trusses in the sides of the latter carry the roof and crane loads to allow columns to be omitted and thus insure free passage between the parts of the building. By omitting the interior columns in every other bay and carrying the roof framing on longitudinal trusses in the fabricating shop, or cross-bar of the H, the desired larger working spaces were obtained. The south side of the H, nearer the river, is the assembly shop, 80 x 600 ft. in plan, where parts of large size can be handled and thence transferred to the shipways. Electric traveling cranes serve both the laying-out and the assembling shop.

REINFORCED-CONCRETE SHIPWAYS IN VARIOUS STAGES OF CONSTRUCTION—MAIN BUILDINGS IN BACKGROUND

The shipways are constructed of reinforced-concrete columns and beams with concrete pile foundations at the inshore end and of timber deck and piles at the river end. After launching down these ways the ships are equipped in the adjacent wet dock, which accommodates two vessels, with room for a third at the outer end.

The boiler shop, 120 x 430 ft. in plan, and the outfitting shop are located near the wet dock and connected by track facilities to both sides of the wet dock, as indicated on the plan. The company has bought the engine-building plant of Robert Wetherill & Company, Inc., just across the railroad on the north, from which engines will be transported by railroad to the ships. Electrical power is to be used throughout, and a powerhouse with four 2500-ft. air compressors is located near the fabricating shop.

The total cost of the plant is estimated at $4,000,000. Construction of the concrete-pile foundation walls and concrete piers, which were found necessary in the soft soil encountered, began on June 22, and the erection of the steel work started June 30. The buildings are rapidly approaching completion, and it is expected that by November the plant will begin active operations. The Raymond Concrete Pile Company, of New York City, designed the foundations and the shipways, and the Belmont Iron Works, of Philadelphia, and Lewis H. Shoemaker & Company, of New York City, designed, fabricated and erected the steelwork of all the buildings and runways. The foregoing information was furnished by J. N. Pew, Jr., vice-president of the Sun Shipbuilding Company, of which J. Howard Pew is president.

APPEARANCE OF MAIN BUILDINGS ON SEPT. 25—ASSEMBLY SHOP ON RIGHT

How Should Abandoned Property Be Valued?

Of Three Classes, That Eliminated Because of Obsolescence or Inadequacy Should Be Included in Reproduction Cost

By R. B. SHEPARD, Jr.
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ABANDONED property is one of the subjects in valuation work which offers large possibilities, and about which, nevertheless, comparatively little has been said. There are several classes of such property. In the writer's estimation the class which represents plant eliminated because of obsolescence or inadequacy in the course of the development of the road must, in fairness to the railroad, be embraced in reproduction cost new as a development expense.

ORDERS 2 AND 10

On May 12, 1914, the Interstate Commerce Commission issued its second order to the carriers under authority conveyed by the Valuation Act. This order commanded that each carrier file with the commission on or before Feb. 1, 1915, "complete and detailed schedules of all fixed physical property which it has abandoned prior to June 30, 1914, together with a complete and detailed statement of its claims with respect thereto." The order prescribed that the schedules be classified in accordance with the Interstate Commerce Commission investment accounts, and called for certain other information, data, plans, and the like. Later, on Dec. 23, 1915, the commission issued Order 10, modifying Order 2, so as to require the carriers to file the schedules, claims, etc., "within thirty days after the date fixed by the commission, as that as of which the carrier's property shall be valued."

It is manifestly impracticable, if not altogether impossible, to comply literally with the requirements of these valuation orders, because of the absence of records giving the details specified, and because of the physical changes wrought by time and the elements in property long unused precluding the accurate ascertainment of original construction quantities from field measurements. Further, the carriers might not be justified in expending the large sums which such field investigations would entail without having some understanding of the use to which the data would be put when obtained, and of their place in the general valuation scheme. No positive light has thus far been shed on these important questions by the

Division of Valuation, though there have been certain elucidating negative statements. For example, it was thought by the carriers that the cost of abandoned property might be included in the general statement of "original cost to date," but it now appears that the Division of Valuation construes the act to require the original cost of only those units of property in service on the date as of which the valuation is made.

In the interest of a clearer understanding of the economic principles involved, and for the purpose of bringing out sharply the vital interest of the carriers in just and reasonable application of those principles, it might not be amiss to present a short review of the usual history of abandoned property and an analysis of the consideration which led to its abandonment. It might also be remarked in passing that, while the economists and the engineering profession have a certain interest, more or less academic, in the problems arising as the valuation progresses, the very frame and structure of the railroad body is affected, and each question is susceptible of such determination as to cause a further drain on its very life blood.

Three General Classes

Abandoned property may be broadly divided into three general classes:

1. Temporary structures or roadways built to facilitate construction of the permanent railroad, as run-around lines at tunnels, at heavy cuts, at big bridges, etc. This class of abandoned property, when pointed out by the carrier, will probably be included in the estimate of cost to reproduce, and can therefore be omitted from this discussion.

2. Property abandoned because of exhaustion of source of revenue. This class of abandonment is significant in connection with the total sum of capital expenditure made by the carrier during its career, but the cost of such property probably has been, or should have been, charged to profit and loss, closing the carrier's accounts with respect thereto. Any claims which the railroads might equitably present for this class of abandonment are dependent on what artificial economic conditions were produced by arbitrary governmental action affecting individual cases. No general rule can be formulated.

3. Property abandoned because of obsolescence or inadequacy, or in the course of development of the railroad. It is this class which constitutes the great volume of abandoned property, and it is the treatment this class is to receive that is a matter of concern to the carriers. The most important item is abandoned line, and the considerations leading to the abandonment of line in the course of development are to be the subjects of this discussion. The same reasoning governs in practically all voluntary abandonments, so one analysis will suffice.

When Improvements Are Justified

Let us suppose a line of railroad built into an undeveloped country. The standards of location and construction must, of necessity, be low in order to keep the cost within limits commensurate with available business. In the course of time the country develops, new industries spring up along the line of road, and the volume of traffic offering so increases as to tax the original facilities. The management begins to consider the advisability of extensive improvements, and the engineer is asked to investigate and report upon the feasibility of reducing grades and curvature, and of otherwise improving the line and the probable cost. In his report the engineer gives his estimates of the total cost of the improvements and of the probable saving in operating expenses to result therefrom. If the yearly saving makes a favorable showing as a return upon the total estimated cost, the improvements stand a good chance of being authorized, but it is the total cost that enters into the calculation, and not the excess cost of the new line over the cost of the portion replaced.

Under conditions heretofore prevalent, the conservative carriers have welcomed the rule to charge the cost of the abandoned portion of the property to operating expenses, as it practically enabled them to build up the railroad partially out of earnings, strengthening the value of their securities, enhancing their credit and furnishing a reserve strength highly desirable. If, however, the capitalization is to be made a basis for regulating revenue, or for condemnation, an entirely new condition arises, under which it is neither advisable from the carrier's standpoint, nor economically just to require this charge. The stockholders actually do make the payments represented by the charges to operation, just as truly as if they were openly assessed, and unless they are allowed to recoup through greater returns on their nominal investment, they are permanently at a loss. It has been argued that once an amount is charged to operation the stockholders have no further interest therein, the public footing the bill; but this reasoning is fallacious, in that no increase in rates is authorized to equalize such charges, while a smaller sum is available for dividends or surplus during the years of extensive reconstruction involving large operation charges on account of abandoned line.

Example

As an illustration suppose a road capitalized at $10,000,000 is earning 6 per cent, or $600,000 per year. Improvements to cost $2,000,000 would reduce operating expenses and increase earnings in the net sum of $120,000 per year, or 6 per cent. If money could be borrowed at 5 per cent there would result an increase of $20,000 a year in the funds available for surplus or dividends, and the work would probably be authorized, regardless of the required charge of, say, $500,000 to operating expenses on account of line abandoned. If the earnings were not affected by regulation the stockholders would not object to paying this sum out of earnings, and correspondingly reducing the issue of securities, for they would be reimbursed in the larger sum of $45,000 available for the purposes noted. The total returns would still be $720,000 a year, but the capitalization would nominally be $11,500,000 earning 6.26 per cent, instead of $12,000,000 earning 6 per cent.

If, however, the road were told it could earn only 6 per cent on the nominal capitalization of $11,500,000, or $690,000 a year, the situation would be decidedly altered. The stockholders would be forced to forego dividends to the amount of $500,000, or actually to invest this sum in addition to the borrowed $1,500,000, on which they could receive only $90,000 a year, or 4.5 per cent, which is less than the cost of money in the market. They would certainly decline to authorize the improvements.

The lesson is that the $500,000 representing property abandoned in the reconstruction of the line on higher standards is an integral part of the cost of the final road, and as such should enter into the statement of such cost. It was manifestly proper to adopt original standards on a parity with the traffic requirements, and it would have been folly to construct the modern road before it was economically justified. To have done so would have placed intolerable burdens on both the shippers and the railroad, and probably would have involved the carrier in bankruptcy.

Under the current theory of valuation, the cost of reproduction of the identical property existing on the date as of which the valuation is made, must be determined, and to this added amounts corresponding to other values attaching to the business. It has been held in numerous instances that the cost of developing the property and the business must be included in the final statement of value. It seems that the cost of property abandoned in the course of development is an entirely appropriate item for inclusion in the "development expense" column.

Water Kept on Concrete Road by Additional Dike

Longitudinal Obstruction Insures Crown as Well as Sides Being Covered While Acquiring Strength

THE ORIGINAL method of diking roads in California has been improved by adding a longitudinal dike near the edge of the concrete, as shown in the picture. This prevents unnecessary loss of water and gives double assurance that the

ADDITIONAL LONGITUDINAL DIKE INSURES THAT CONCRETE WILL BE COVERED AT CROWN

concrete will be covered at the crown of the pavement as well as at the sides while it is acquiring strength and hardness. The added dike is thought to make good results more certain. Even where water is obtainable for use in this manner it is desirable to prevent unnecessary loss. This is particularly true in hot climates, where evaporation is rapid and where scarcity of water more often prevails.

Atlantic Highway Almost Completed

First to be completed of the big border-to-border routes will be the Atlantic Highway, according to figures recently compiled by the American Automobile Association. East of Portland, Me., and from Quebec, Canada, to Miami, Fla., there are now less than 100 miles of unfinished highways.

Engineer Reports on Corrosion of 350-Mile Australian Steel Pipe Line 12 Years Old

Greatest Deterioration Noted Where Conduit Is Buried in Earth—Damage Small When Above Ground—Maintenance Costs Given Since Year 1902

FOR the maintenance and repair of the 351½ miles of 30-in. steel lock-bar pipe which delivers water from the Helena River to Coolgardie and Kalgoorlie in Western Australia approximately $250,000 was spent during the year 1914-15, according to the latest annual report of P. V. O'Brien, engineer for the Goldfields areas of the Water Supply, Sewerage and Drainage Department of Western Australia. The report, issued recently, and reproduced at length below, is devoted largely to a discussion of external and internal corrosion of the pipe metal and to the condition of the asphaltic coating. It appears that the greatest deterioration has occurred where the pipe has been buried in the ground, while sections lying above the surface show comparatively slight damage.

The daring pipe line and pumping project, described in the Engineering Record of Feb. 24, 1900, page 178, and May 21, 1910, page 671, was completed in 1902. After having been in service a few years the pipe showed signs of serious corrosion. The steel of this conduit was manufactured in Australia from material supplied from England. The thickness of the plates is ¼ in. for all pipes under pressure up to 390 ft. head and 5/16 in. thick for pressures above that amount. The material employed was open-hearth basic steel. When completed and tested the pipes were heated to 300 deg. Fahr. and immersed in a mixture of coal tar and Trinidad asphalt. Over the outside coating sand was sprinkled to make the material resistant to the sun's heat.

Maintenance Costs

Mr. O'Brien presents the following figures on the cost of maintenance since the pipe line was completed in 1902:

Table 1—Cost of Maintenance of 30-Inch Steel Main 351½ Miles Long

Year	Cost	Year	Cost
1902-3 } 1903-4 }	$83,500	1909-10	$83,000
1904-5	37,600	1910-11	61,200
1905-6	38,000	1911-12	83,000
1906-7	68,700	1912-13	111,000
1907-8	96,600	1913-14	192,600
1908-9	74,500	1914-15	248,000

During the year covered by the report extensive works were carried out in unearthing and recoating pipes in the country where external corrosion was bad. The total amount expended on this work was about $154,000.

The coating applied originally on the exterior of the pipes, Mr. O'Brien states, was found to be in good condition where the pipes were above ground and generally in a more or less perished condition where they were laid underground. The condition of the steel plate where the pipes have always been above ground was, like the coating, excellent. Where underground, the pipes were, on the whole, in good condition, although there were very few places quite free from slight corrosion.

The corrosion on the exterior of the pipes took three distinct forms—rusting, pitting and scaling. In ironstone gravel through the hills and elsewhere and in sand on some of the sand plains the pipes, Mr. O'Brien reports, were in very good condition—practically free from pitting and scaling, although freely covered with spots of rust under the decayed coating. This rusting was very slight, it is said, and has not appreciably damaged the pipes. The remainder of the pipe line is in clay and loamy country, more or less impregnated with salt and, of course, generally damp.

In this country there was widespread but slight rusting as in the gravel and sand, and in addition, many instances where pitting and scaling have occurred. The pitting and scaling were found generally on the bottoms of the pipes only, the top halves being, almost throughout the whole length of the main, in a uniformly excellent condition. The occurrence of pitting is due to a combination of several factors, in the absence of any one of which there can be no pitting, and is therefore very irregular.

Scaling Around Leaking Joints

Scaling commonly occurs around leaking joints, and in salt (morrel gum) country. When once started it requires only moisture to eat itself rapidly into the steel. It is, according to Mr. O'Brien, the most insidious and dangerous type of corrosion, and requires most careful attention to detect and repair. Perforations through the pipes have occurred from pittings since 1905, but it is only during the last two or three years that the scaling corrosion has made itself apparent. The combination of factors that gives rise to pitting breaks down in time by the elimination of one of the factors, and the pitting stops. It is probable that only a few of the holes now occurring from external corrosion are due entirely to "pitting," although the corrosion in all other cases originated in the shape of "pits," and afterward proceeded by "scaling." A perforation arising from pitting alone is generally small in area and closely surrounded by steel of the full original thickness of the plate, and therefore easy to repair, while a perforation occurring after scaling has started is generally much larger in area and surrounded by thin metal with an irregular surface, making repairs much more difficult. The number of holes that have occurred from external corrosion are shown in Table 2.

Table 2—Holes Due to External Corrosion

Financial Year.	No. of Holes.	Financial Year.	No. of Holes.
1904-5	2	1910-11	131
1905-6	27	1911-12	124
1906-7	54	1912-13	774
1907-8	55	1913-14	966
1908-9	91	1914-15	2,078
1909-10	177		

A large number of the holes that occurred in the year 1914-15 broke out while the pipes were being scraped after being unearthed and would not otherwise have appeared so soon.

Both pitting and scaling have been found to occur most frequently in certain classes of country, but while "pitting" is limited in the extent to which it can occur, there is no limit to "scaling," and it is only a question of time when, in the absence of preventive measures, the whole main would become affected and destroyed by scaling.

Repairs

The method adopted for dealing with external corrosion consists of uncovering the pipes wherever they are found to be badly pitted and continuing the opening up in both directions till they are found to be in good condition. In this way all those parts of the main in the vicinity of places where corrosion is known to be bad have been opened up, and in addition, other portions which were likely to be similarly bad have been opened up during the past year. The length opened up and left open for the financial year 1914-15 was 36½ miles, making a total of 80 miles uncovered at the close of the year. It is proposed to open up about 16 miles during the year 1915-16. Judging by the condition of the pipes that have been opened up during the past year, it is anticipated that the work of dealing with the external corrosion of the pipes can be satisfactorily dealt with for some years in the same manner as hitherto, and at no greater cost. Although almost the whole of the coating on the pipes where they are underground is more or less perished, and has been so for many years, the condition of the steel plates is, apart from the pitting and scaling already referred to, almost uniformly good. There is therefore nothing to indicate the advisability of the wholesale opening up of the pipes in order to repair the coating at the present time. The development of scaling will probably proceed slowly as in the past, and by unearthing the pipes at the same rate as this development, the main will be maintained without any material depreciation at a minimum cost and the expenditure will be spread over a number of years.

Friction and Carrying Capacity

The usual friction tests were carried out during the year. The most striking feature in this connection is that east of No. 4 pumping station there is not one section of the main that shows any increase in friction during the past twelve months. From No. 5 pumping station to Kalgoorlie there has been no appreciable change for the last four or five years, and any such changes as have occurred are in the direction of an improvement. The section from No. 4 pumping station to No. 5 pumping station showed a gradual increase in friction up to July, 1914, but appears now to have reached its maximum friction in the same way as those sections to the east of it, and is likely therefore to show very little change for the next few years.

The section from No. 3 pumping station to No. 4 pumping station shows a slight increase in friction during the past year, but it too will probably soon, if it has not already done so, reach its maximum friction without getting appreciably worse than it is now. The section from Northam to Cunderdin has shown gradual improvement during the past two years, and from Baker's Hill to Northam there has been very little change during the same period.

From No. 2 pumping station to Baker's Hill the friction increased considerably during 1914, on account of the deposit of carbonate of lime. As stated in the last annual report this deposit was thick at Mundaring and diminished gradually to a film only at Merredin. In order to ascertain the amount of protection afforded by this

deposit, the lime treatment was stopped in January. Since then the water has dissolved some of the deposit and thus materially improved the carrying capacity of the sections from No. 1 pumping station to Baker's Hill, which is now very little less than it was in January, 1914. The tests for alkalinity of the water show that since the lime treatment was stopped the alkalinity at Kalgoorlie has been maintained at about the same degree as when the treatment was in use. Further improvement in the carrying capacity of the sections from No. 1 to Baker's Hill may thus be expected till such time as it is found advisable to recommence the lime treatment.

Interior of Main

The increase in friction that has taken place in the main has been due to the growth of nodules of rust, and between No. 1 pumping station and Northam also to the deposit of lime. The nodules of rust owe their origin to the corrosion of the steel at spots where the bituminous coating has been damaged (cracked or perforated), and the water has thus come directly in contact with the steel. From inspections of the interior of the main, it would appear that along the greater part of the length of the main at least half of the area of each pipe is practically free from nodules and on the remaining half the nodules are scattered over the surface at rates varying from one or two to 30 or 40 per square foot. Of the remainder of the pipes some are entirely free from nodules, while others are almost completely covered with nodules touching one another. These conditions clearly account for the wide variations in the friction in different sections of the main.

Over the areas that are free from nodules, and also between the scattered nodules on other areas, that is, over more than three-quarters of the whole area of the interior of the main, there is no incrustation of rust, and the surface of the bituminous coating is as smooth and clean, save for a slight brown slimy deposit, as when the pipes were made. Although the coating on most of the interior of the pipes thus appears on the surface to be as good as ever, it is nevertheless perished to such an extent by the action of the water that it is porous and allows moisture to reach the steel everywhere except at a comparatively few places where the coating is over ⅛ in. thick. The perished coating is much softer than the original coating. It is also brittle, and when dry crumbles to a powder when pressed between the fingers. This coating varies greatly in thickness (having a wavy or ribbed surface) from 1/64 in. to ⅛ in. Where the coating is thin, it must have perished within a few years after the pipes were put into use, but there is, even in these cases, very little corrosion of the steel. Under the thicker coatings there is still less corrosion. The thinner coating is easily rubbed off the plate, while the thicker coating adheres firmly.

Corrosion Under Nodules

It is only under the nodules that any appreciable corrosion is found. Under each nodule there is a corresponding pit. The pits are frequently found ⅛ in. deep, but rarely deeper. The pitting on the interior of the main is due to the same combination of factors as on the exterior, and that pittings rarely exceed ⅛ in. deep is due to the fact that by the time this depth is reached, one of the essential factors is, in most cases, eliminated. Under some comparatively rare favorable conditions, however, pittings go on to greater depths before the elimination of the factor takes place. A few cases have thus occurred where the pittings have reached a depth of ¼ in. and caused leaks in the pipes and many more will occur in the future, but the conditions favorable to such deep pittings are fortunately not so common in the main as to constitute any serious danger to the maintenance of the main for some years.

For the most part the strength of the main is not appreciably reduced by the internal corrosion that has taken place. It is only at those places which show the greatest friction, and where the nodules are closely encrusted over the pipe that any material amount of metal has corroded away, and the strength of the pipe been reduced, but even in the worst case there is sufficient metal left to give ample strength for some years.

A feature of internal corrosion that is likely to lead to considerable expenditure in a few years is the thinning of pipe ends. Many cases have been found where material loss of metal has occurred from corrosion round the interior of pipe ends, and a few pipes have had to be removed on account of the pipe ends becoming so thin that it was impossible to calk the joints watertight. All joints that have so far failed in this way have been yarned joints. It is probable that all pipe ends at joints that require frequent calking will fail in the same way, but it is not likely that any serious trouble will arise from this cause for the next two or three years.

Lime Treatment

As already stated, the lime treatment of the water was continued till Jan. 6, when it was stopped in order to ascertain the degree of protection afforded by the deposit already in the pipe. The tests made since then are so far favorable.

Tests are being regularly carried out to determine the changes in the friction in the pipes and the corrosive quality of the water so that the lime treatment of the water may be recommenced as soon as the indications are such as to show it is advisable. When the lime treatment is recommenced it will be necessary to provide more extensive settling basins or filters to adequately free the water from all suspended matter after the addition of lime.

The total amount of corrosion on the exterior of the worst pipes hitherto found is small, and the strength of the pipes has not been greatly diminished by it. In the future, also, with moderate maintenance, there is not likely to be any material reduction in the strength of the pipes from external corrosion, nor is there likely to be any necessity to remove more than perhaps a few pipes on account of such corrosion.

With regard to internal corrosion, all that can be done is to use every practicable means to reduce the corrosive activity of the water to a minimum, till such time as the strength of the pipes is reduced to the safe limit and then to lift, clean, repair and relay the pipes. The maintenance of the main can be carried on for the next three or four years without having to resort to such extreme measures as removing any great number of pipes, but the insidious progress of general corrosion on certain sections of the main and the thinning of many of the pipe ends are inevitably bringing the time nearer when these measures must be resorted to. In the meantime, careful attention is required to minimize the corrosive quality of the water and to watch the progress of the corrosion that must go on, in order to determine the most economic time for relaying sections of the main. No great disadvantage accrues by delaying such work, as long as a reasonable margin of strength remains in the pipes, and the pipes can then be cleaned and repaired at comparatively small cost, and recoated so as to be fit for a further long period of service.

Card System Records Cost of Engineering

Full Data as to What Each Man Is Doing and Cost of Each Job Are Kept in Simple Manner at Boston Navy Yard

A CARD SYSTEM for recording the cost of drafting and engineering, both by man and by job, has been in successful use in the public-works department of the Boston Navy Yard for two years, and is described by Civil Engineer R. E. Backenhus, U. S. N., in the September *Bulletin of the Public Works of the Navy*. The entire record is kept on three types of cards.

The first card is the employee's card. Each employee is assigned a card for his time record for the month. At the top of the card is filled in his name and rate of pay per day. The card is ruled horizontally on each side for the 31 days of the longest months, these days being indicated down the left side of the card. Vertically the card is ruled into seven columns on each side to give space for fourteen jobs. Each job has a number, which is indicated at the top of one of the columns. The money charge against each job is entered in the proper columns against the proper days. In the samples shown by Mr. Backenhus days, half days and quarter days are indicated.

Prefixed to each amount is one of six symbols representing one of six parts into which the engineering work is divided, as follows: SL, surveys and layouts; P, plans; S, specifications; I, inspections; E, estimates; M, miscellaneous. At the bottom of each side of the form each of these six classifications is totaled separately and below all of the classifications is a grand total.

Job Cards

At the end of the month the costs are transferred to the proper column on individual job cards. At the top of the face of this card are blanks for indicating the job number, date issued, location and description of work. Below this the card is divided into nine spaces or compartments, three each way. The upper left-hand space is designated "Surveys and Layouts" and shows when they were ordered, to whom they were assigned, when they were completed and the total cost. Next on the right comes "Plans." Similar information is filled in as to them, and also the dates on which they went to the bureau and came back. In the upper right-hand corner, under the heading "Plans Made," come the file numbers of the plans and their dates. These three spaces are amply deep to allow the entry of a number of plans and also to show assignment of the work to several men.

At the left of the next row of spaces comes "Specifications." In this space are filled in the dates when the specifications were begun, completed, sent to bureau, received back from bureau and printed; also the

bureau serial number and the total cost. The center space, "Inspections," gives the contract number—which is the bureau serial number of the previous space—the names of the inspectors and the total cost. The right-hand space, "References," gives the computation-book number, the plan numbers and the number of the letter file.

The bottom row of compartments is not nearly so deep. In the left-hand space, under "Estimates," is filled in the name of the estimator and the total cost. The middle space records miscellaneous costs, and the right-hand space gives the date of completion of the job.

On the back of the card is a summary of charges against the job. For each month the charges against each of the six divisions of the work are carried vertically and those against men horizontally, with totals each way and a grand total in the lower right-hand corner. As it would not be possible to carry a complete summary of a large job on one side of such a card, a third set of card forms has been printed, with summaries on both sides.

Separate standing job numbers are given to general drafting-room jobs, such as photographic work, blueprinting, filing, cement testing and the like; also to time off for various reasons.

Advantages of System

Five advantages, as follows, are claimed for the system:

1. The total cost of plans, specifications, inspections, etc., for each job is given to date at the end of every month.
2. The completed records form a good basis for estimating the cost of engineering or drafting on smaller jobs.
3. The records give accurately the cost of inspection on contract work and give as well the distribution of this cost, which is of value on contracts that have extended beyond the contract time of completion.
4. The records give in detail the disposition of the time of each man. This is of value as a part of the man's record
5. The system shows each man just how he has been spending his time, and he can determine for himself whether it has been profitably expended or otherwise, and it has thus been an inducement to pay attention to this feature.

Brooklyn Marginal Railroad Dropped

Until the problems of the West Side freight improvement in New York City are settled nothing further, it is stated by the comptroller's office, will be done about the Brooklyn marginal railroad.

Country Roads Protected Cheaply from Scour

Tree Trunks, Piling, Brush and Stone Have Proved Effective and Economical Defense Against Streams

By GEORGE E. SCHAEFER
County Superintendent of Highways, Geneseo, N. Y.

COUNTRY HIGHWAYS of to-day are the outgrowth of old Indian trails. As the course of the original trail followed the line of least resistance, so to-day, and particularly in the region of mountain streams and tributaries of great velocity and fall, we still find many sections of road too close to waterways, and seriously susceptible to scour and wash.

A large mileage in such locations cannot be changed and must, of necessity, be as adequately safeguarded for traffic as the funds of the community will permit. The prevalence of rugged territory usually typifies a decreased population and therefore a correspondingly lessened assessed valuation of property and a minimum amount of highway funds. And furthermore, for a number of reasons these streams frequently change their courses, and where bank protection was necessary before, it becomes useless unless the stream returns to its former channel. Finally, for financial reasons and otherwise, the more expensive construction, such as concrete and steel sheeting, is eliminated and only cheap local materials utilized.

Tree Trunks Effective

Where the subsoil is of rock a good type of construction for bank protection and to prevent scour is of tree trunks or logs laid in horizontal layers parallel to the stream, with laterals running at right angles to them back into the roadway at distances of 5 or 6 ft. These are bolted or dovetailed to the stream logs, and are locked securely under the highway with deadmen or with dowels. A heavy fill of brush and stone is then placed back of the sheeting. This type is very economical where logs and rock are abundant.

In unstable soils good results have been obtained by driving piling along the bank, preferably staggered, and filling in between the piles with green brush and stone in alternate layers. The brush should not be thrown in haphazard, but placed evenly, and the more the better. It should skew with the stream—that is, be at an angle of about 45 deg. downstream. Care should be taken to procure green brush and have enough rock on top to hold it down.

Piling in straight lines sheeted with planking has not given as good results in this county as that staggered with brush and stone, for the reason that the planking cost is excessive and the earth back of the sheeting invariably washed out from underneath, with resultant caving in of the roadway. Where the velocity of the stream is very great, and large quantities of débris come down, it is sometimes necessary to wire piling together and also to wire it under the highway.

Willow Brush Best

Good bank protection can also be acquired with brush and stone alone, skewed downstream and placed in alternate layers as with piling. Willow brush should be used if possible, and large rock. In a great many cases the willow takes root, eventually forming a natural protection.

Another type giving good results is practically of corduroy construction, layers of logs bound together and lying at right angles to the stream, or better, pointing slightly downstream. These should also be interspersed with brush and well weighted down above the water line.

Baffle dams or water breaks of piles, brush and rock are also used at curves in the stream and just above weak spots in the bank. They jut out into the stream on a downstream skew to about the center, and by driving the water to the opposite side tend to protect the bank at the curve or at the weak spot.

Many roads in this section are protected in this manner, and at very low cost, due to the most of the materials being acquired gratis. If well built, they answer the same purpose as concrete or steel sheeting.

LOGS IN HORIZONTAL LAYERS AND BRUSH AND STONE MATS ARE EFFECTIVE AND ECONOMICAL

Prepared Blocks and Wedges Speed Up Track Leveling in Street

Prepared blocks and wedges were used instead of ordinary rough material in leveling track on the lines of the Northern Ohio Traction Company at Akron, Ohio, states the *Electric Railway Journal.* In the construction work the rails were laid on International twin steel ties embedded in concrete—the foundation for the paving brick. The special hardwood blocks and wedges employed, which were found to facilitate the leveling work materially, were made by the Steele-Alderfer Company, of Cuyahoga Falls, Ohio. The blocks were 6 x 8 x 8 in., while the wedges were 2 x 4 x 8 in., tapered on one side.

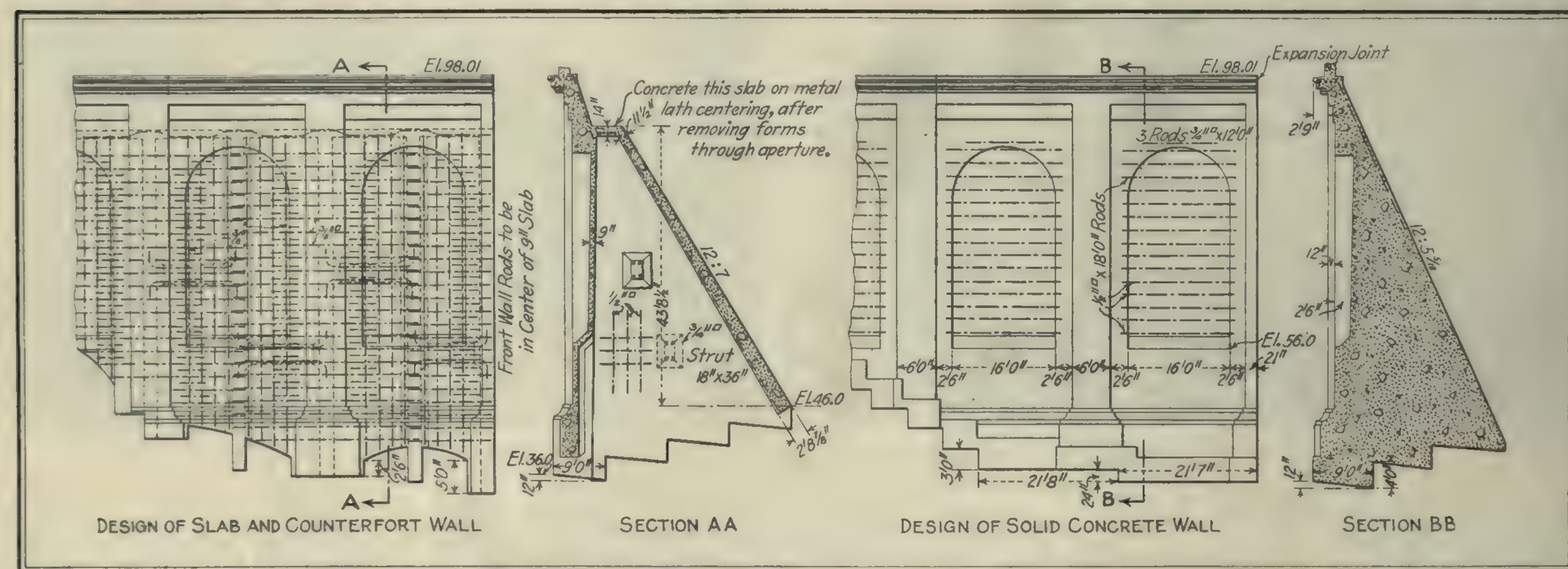
Design of Bensalem Avenue Bridge Governed by Architectural Requirements of Site

Contract Let for Important Arch Structure in Philadelphia to Contain Massive Pylons and High Retaining Walls—Alternate Designs Compared

By JONATHAN JONES
Assistant Engineer, Division of Bridges, Department of Public Works, Philadelphia

THE city of Philadelphia has recently awarded the contract for a concrete bridge which will rank next in that city to the Walnut Lane arch, which when constructed in 1908 was a pioneer in ribbed-arch construction in concrete. The new bridge is to carry Bensalem Avenue over Pennypack Creek and the Pennypack Park drives, and when completed will become a part of the transcontinental or Lincoln highway connecting Philadelphia and New York. On both banks of the stream, for several miles in each direction, the city has acquired the land for the development of what is destined to be one of the most important of its parks, and the architecture of the bridge has accordingly been considered of prime importance.

The general proportions of the structure were carefully studied in elevation and perspective, from viewpoints in the valley and on the roadway, and tested for reasonable economy before being finally determined upon. The resulting elevation presents three elements: (1) The principal bridge structure of three semicircular spans—a central span of 100 ft. clear width crossing the stream and two side spans of 60 ft. clear width, allowing for any desired development of park drives, footpaths, etc.; (2) the approach retaining walls extending practically across the valley, it being deemed inadvisable from the park standpoint to shorten the walls for economy, to intrude 1½ to 1 or similar slopes into the natural contours of the park and to sacrifice the old timber on the south approach; and (3) massive pylons separating the bridge structure from the retaining wall approach.



PROPOSED DESIGNS OF SOUTH RETAINING WALL—COUNTERFORT VERSUS GRAVITY TYPE

Design of Arch Spans

Solid spandrels for the arch spans were from the outset considered desirable to give a massive effect. These were designed as gravity sections of solid concrete, with a base width of 0.45 times the height, according to Philadelphia practice. Several different designs were worked up for comparative estimates, including designs which dispensed with the earth filling, thinned the spandrels to bearing walls and by interior piers or columns supported a roadway slab, and including designs which employed the earth filling but balanced the earth thrusts by means of transverse ties from one spandrel to the other. None of these schemes, however, showed any certain economy that would compensate for its complexity or for sacrificing the unlimited pipe and duct space afforded by the unobstructed earth-fill. If the bridge were less wide this result would not obtain; it is because the cost of the spandrel walls is spread over about 80 ft. of bridge width that they do not show up badly in cost per square foot.

The 60-ft. arches are of the solid-barrel type, but with a saving of material in the piers and abutments by the use of buttresses in the latter and cross-walls in the former. For the 100-ft. arch a small and problematical saving, certainly not $1,000, was estimated for a construction of six ribs with reinforced slabs spanning the spaces between them. At even an equal cost, however, this construction was preferred as to appearance, for it conveys the sense of direction of the principal span, while the smooth soffits of the side arches emphasize the transverse direction, which is the direction of park travel through them. A separate price was taken for the waterproofing of the extrados of all arches with asphalt mastic, and as a favorable price was received, this will be ordered.

Massive Pylons and Retaining Walls

The pylons flanking the arch structure have strong projections from the general surface of the bridge, and are built hollow, with a vertical slab in the rear transmitting the earth pressure to the side or buttress walls. Being hollow, the pylons lend themselves to a number of possible future uses—for storage rooms, comfort stations and other park purposes, perhaps a stairway from the upper to the lower level. Doorways and windows are therefore incorporated in the architectural treatment.

The high retaining walls possess possibly the greatest interest as regards both design and the conditions of the contract letting. Walls as high as 60 ft. at the highest point naturally promised considerable economy through the use of reinforced concrete rather than the gravity type, especially since access to the bridge site is not easy and the cost of hauling is adverse to the type of design that uses the greater quantity of material.

The question of design is, however, inseparable from the question of architecture and of surface finish. Concrete is regarded as an acceptable substitute for stone in the construction of bridges in Philadelphia only in so far as it can be given an acceptable texture and color, either by the scrubbed or Quimby finish, or by bush-hammering and chiseling. In either case, a desirable surface requires a facing mixture different from the body concrete, using a small aggregate of ¼ to ⅜ in., either of stone chips or pebbles. For the Bensalem Avenue bridge it was felt desirable to set against the green trees and meadows of the surrounding landscape a warm buff color, which has several times been obtained by the scrubbing method, using brown and yellow pebbles, locally procurable for the aggregate of the facing mixture. Previous experience with facing mixtures in high thin walls has shown that from 3 to 3½ ft. of thickness is absolutely necessary if the workman is to obtain a uniform and acceptable surface and prevent the backing mixture from working to the face in unsightly patches. This is particularly true when the reinforcement is at all heavy and near the face.

Alternate Designs of Walls

For the design in reinforced concrete of the usual slab, platform and counterfort type, it was therefore required that the slab should have a least thickness of 3 ft. 3 in. to allow proper manipulation of the facing. Under this restriction as to amount of material, and using reasonably higher unit prices to allow for the slower and more difficult placing and the probable working of the mixer at less than its capacity, the difference in cost of the reinforced wall was only slightly in its favor.

Further consideration led to a design in which the facing mixture was in general the only mixture in the face wall, so that this wall could be poured from above with no necessity for keeping it separated from any backing mixture. A thickness of 9 in. was adopted for this face wall, and it was of course excluded from any other duty than that of rendering the desired appearance. The earth pressure was to be resisted by a reinforced, inclined slab, back of and independent of the face wall, and carrying its strains by horizontal reinforcement to counterforts. The front faces of these counterforts would require facing, and were designed of ample dimensions for this purpose.

Such a design gives high toe pressures, as the width of base is the width only of the counterforts, the face wall being arched up so as to take no foundation pressure and hence develop no cracks. In the present instance, the presence of hard rock near the surface makes these toe pressures entirely permissible. The apparent advantage of such a wall is that the slab which actually resists the earth thrust can be built speedily in large sections, and with rough forms. If eventually leaks should develop at construction joints, they would be in joints parallel to the main reinforcement and would rust out only a rod or two adjacent to the joint, doing no great damage. Seepage through such joints would not reach the showing face because of the gap between.

ARCHITECT'S SKETCH INDICATES THE PRINCIPAL FEATURES OF NEW ARCH BRIDGE

COMPARISON OF COST ESTIMATES AND BIDS

Cost estimates indicated that such a wall would be considerably cheaper than the usual counterfort type, allowing for the additional forms and deducting for the reduction in earth fill. It promised to be several thousand dollars cheaper than a gravity wall of 0.45 base width, which was of course the criterion for stability used in the reinforced designs. It was felt, however, that such comparative estimates on so large a structure should be checked by the taking of actual bids, and therefore the gravity design was advertised in competition with the hollow design. Five bidders submitted proposals, and of these two favored the reinforced design, while the three others bid lower on the gravity type, one by as much as $21,000. Bids received at this particular time hardly establish any generalities, however, as the diversity of opinion among bidders is shown by the discrepancy of nearly 100 per cent between the high and low bids received. There was a difference of about 20 per cent between the lowest and second bid.

The contract was awarded to Day & Zimmermann of Philadelphia at an aggregate price of about $200,000. The contract includes such a diversity of items that it is impossible to compare this price directly with other bridge prices. It represents about $4.15 per square foot, including the fill in place, without paving. As the difference in bids on the retaining walls was small it has been decided to construct the gravity type.

This contract is under the direction of George E. Datesman, director, Department of Public Works, city of Philadelphia, and Chester E. Albright, chief engineer of the Bureau of Surveys. The writer, as assistant engineer in charge of the bridge division, is directly responsible for design and construction.

Describes Sheet-Pavement Problems in St. Louis

J. L. Laxton, Engineer of Bituminous Roadways, Tells Reasons for Potholes and How to Mend Service Cuts

CROWN, gradient, traffic, and extremes of temperature, in their effect on the maintenance of sheet pavements of St. Louis, were discussed in a paper recently presented to the St. Louis Engineers' Club by J. L. Laxton, engineer of bituminous roadways. The following notes are from this paper.

The crown of the roadway, being intended to dispose of surface water, it follows that the greater the crown the easier it will be to prevent small pockets of water from standing on the surface. It is inadvisable, however, to exceed a 6-in. crown on a standard-width roadway of 36 ft. owing to the tendency of vehicles to skid when the pavement is wet or has ice on it. This condition becomes aggravated on a pavement that has "dried out." These little pools of water are highly detrimental to the surface of sheet pavement because of the suction-pump action that takes place when the wheels of a rapidly moving vehicle pass through them, displacing the finer particles of the surface and creating a pothole through which water soon gains access to the concrete foundation and begins the work of destruction through disintegration of the asphalt.

The gradient of the street governs to a large extent the tendency of a ductile material to "shove" or form undulating waves transverse to the roadway. On a roadway having very little grade in it the tendency is for these waves to remain permanent or to become more aggravated. It is therefore necessary to remove such material and replace it with new. On a roadway having a material gradient there seems to be a greater tendency for these wavy places to iron out through the action of traffic. This opinion is based upon the fact that there is no trouble from "shoved" spots where there is an appreciable gradient. Maintenance costs are also lessened on a street having a gradient, since it assists in the removal of surface water, thus preventing the suction-pump action.

TRAFFIC NEEDED TO KNEAD THE PAVEMENT

Under traffic the surface is subjected to severe abrasion and mineral particles are exposed, loosened and swept away. This raveling process assists in the formation of potholes mentioned previously. To this extent traffic is detrimental, but it is highly beneficial through the kneading process, commonly referred to as "ironing," which keeps the pavement plastic. A sheet pavement with no traffic deteriorates about as fast as one subjected to heavy traffic. The lack of traffic assists the rotting action of water, street liquids, and escaping gas, because this condition helps the volatilization of the lighter oils, with a consequent hardening of the remaining bitumen. The pavement is thus rendered porous, and its ability to withstand the strains and stresses set up by expansion and contraction is reduced. In the course of time the pavement loses so much of its plasticity that it cracks during periods of low temperatures. Generally speaking, temperatures affect the various bitumens in much the same way.

MENDING HOLES

The method followed by the city in curing potholes is to remove the injured material with a square shoulder, going far enough back to get into good material; paint the edges of the cut with a cut back A. C. paint; place new material, tamp and roll. On repairs due to wear and tear this method is very efficient. The greatest difficulty experienced in St. Louis in making repairs is on service cuts, which are rarely tamped as they should be, and continue to shrink after the repair is made. An effort is made to let these cuts settle at least thirty days, but on prominent thoroughfares it is frequently found necessary to make the repair in less time. The department is also criticised for going back on a cut far enough to secure a shoulder on solid material. This is absolutely necessary in order to make the work as nearly permanent as possible. In other words, the criticism arises from the necessity of making the repair slightly larger than the neat lines of the cut.

The costs for repairs and maintenance of 2,056,228 yd. are approximately as follows: Maintenance per square yard per year, 9 cents, including straight burner resurfacing (plant mix) at 60 cents per square yard; straight patching wear and tear (plant mix), 81 cents per square yard, and straight flush coating on bitumen, 2½ cents per square yard.

Light Concrete Approaches Prevent Bumps at Bridges

Under the usual earth approaches at the ends of bridges Washington County, Oklahoma, has placed light concrete approaches 4 ft. long. The concrete slopes downward from the edge of the bridge floor at an angle of 45 deg. In case traffic and weather action remove the earth near the ends of the bridge floor the concrete still remains to shield the drivers of automobiles and other vehicles from the bumps that they would otherwise encounter. This precaution is said to eliminate such annoyance.

Safe Design Depends on Validity of Assumptions Underlying Theoretical Analysis

Professor W. M. Wilson, in Address Before Western Society of Engineers, Incidentally Points Out Lessons Taught by Second Quebec Bridge Disaster

THAT QUALITY of design is not proved because a structure has not failed, that good engineering is the best insurance against failure and wasted material is a tribute to ignorance, that higher safety factors should be used for small critical parts upon which the success of a whole structural operation may depend, that incorrect assumptions for theoretical analysis may cause serious failure, that secondary stresses (and the best frames to avoid such stresses) should be considered, and that tests are required to furnish more exact knowledge of the behavior of truss frames —all these points were given striking emphasis by W. M. Wilson, assistant professor of structural engineering, University of Illinois, in an address before the Western Society of Engineers on Oct. 9. The second Quebec Bridge disaster was cited as an example of the use of too low a factor of safety in a small part the failure of which would destroy the whole structure. The following short extracts have been taken from this address:

Criterion of Good Design

"The fact that a structure has not failed is not proof that it was properly designed. Structures are generally designed with a factor of safety of about 2, based upon the elastic limit. The fact that the structure has not failed is evidence only that all members have a factor of safety of at least 1, and there is no evidence to show that some members do not have an excess of material. If a design is good because the structure does not fail, the design of the ancients should be copied, whereas they are known to be so wasteful of material as to be prohibitive.

"For a design to be good it must be well balanced. Although a structure must be safe, it also should be economical. In stating that a structure must be well balanced I do not mean that the ratio of strength to stress necessarily shall be the same for all members. Many other factors besides strength must be considered. If the failure of a small part will destroy a whole structure, the factor of safety in the small part should be greater than the factor of safety for larger or less critical parts. This is illustrated by the second Quebec Bridge disaster.

"Because of saving in shop costs it is sometimes cheaper to build a member that is too large than it is to build a member that will just carry the load to which it is subjected. Because of the small amount of material involved it is often cheaper to use an excess of material than it is to make an exact analysis of the stresses. An increase in the live load may cause a much greater increase in the total stress in one member than in other members of the same structure; therefore if there is a possibility of an increase in the live load such a member should have a greater margin of safety in the original design than other members of the structure. Although it is good engineering to make some members of a structure larger than stress alone requires when there is a definite object to be attained, it is not good engineering to make a member unnecessarily large because of ignorance of its true function.

"Good engineering is the best insurance against failure; wasted material is a tribute to ignorance.

Designing Not Solely Mathematical

"It is not true, as the beginner is likely to believe, that the design of a structure is made up only of exact mathematical processes, and that the results are therefore infallible. In general, with known forces acting upon a structure the stresses are determined mathematically. The thing that has been entirely overlooked, however, is the fact that for every mathematical equation used assumptions have been made in deriving the equation, and these assumptions have been entirely neglected in applying the equation. The accuracy of the results depends not only upon the accuracy of the mathematical processes, but also upon the accuracy of the assumptions upon which the mathematical processes are based.

Incorrect Assumptions

"The assumptions which enter the design of a bridge and demand special attention on the part of the designer refer to the following: Secondary stresses, distribution of stress in a member, and distribution of stress in a connection.

"One of the fundamental assumptions in stress analysis is that connections are frictionless hinges. If a truss having frictionless hinges is deflected, the members meeting at a joint are free to rotate relative to each other and no bending stresses are produced in the members. If, however, the connections are rigid, when a truss is deflected the members are not free to rotate relative to each other, and bending stresses, known as secondary stresses, are produced. These secondary stresses can be determined mathematically. While all are willing to admit that, theoretically, secondary stresses exist, many—apparently because of the elaborateness of the calculations necessary for their determination—look upon them as something invented by the mathematician for the further torture of the soul of the engineer. The strain gage, however, has come to the support of the mathematician and secondary stresses are known to be a reality.

Secondary Stresses

"The calculation of secondary stresses is a long and tedious process, but like all long processes it shortens with repetition. The design of short and medium length spans has been standardized; and if the secondary stresses are computed in a few of each of the common types of trusses, may we not hope to establish empirical laws by means of which the secondary stresses in other trusses may be determined in a comparatively short time? Thus it would be possible to design all members with approximately the same factor of safety after secondary stresses have been included.

"The resulting more perfectly balanced design would be a sufficient reason for making an extended systematic study of secondary stresses in standard trusses. There are, however, other results to be obtained from such a study which are even more important. A more intimate knowledge of secondary stresses would result in the abandonment of types of trusses having high secondary stresses and the substitution for them of trusses having low secondary stresses. An illustration of this is to be found in the attempts to use the K type of truss of the Quebec Bridge for shorter spans. Moreover, being confronted with high secondary stresses, the engineer would exercise his ingenuity to devise details which would reduce the secondary stresses. This is illustrated by the recent use of pin connections between the floorbeams and trusses to reduce the secondary stresses in the vertical posts of trusses.

"It is the writer's opinion that for ordinary working loads the stress at the end of a member is not uniformly distributed over the section, and that the maximum unit stress is materially greater than the total stress divided by the area of the section. Furthermore, it is the opinion of the writer that ultimate failure of many members connected as they are in bridges will occur at a stress materially below the ultimate unit strength of the material multiplied by the area of the section of the member. Since the advent of the strain gage the first statement can be either verified or disproved by means of field tests of bridges under normal working conditions without a prohibitive expense. The second statement can be checked by tests to destruction.

Tests Necessary

"The important thing to be revealed by such tests is the efficiency of the different types of sections. If a member having one section can develop a stress of only 80 per cent of the product of area times unit strength of material, whereas if the member had a different type of section it could, because of the better type of connection possible, develop 90 per cent of this product, then, other things being equal, the latter type of member should be used. At present we have but little, if any, reliable data relative to the efficiency of connections for different types of members. We have many opinions, but few facts.

"The thickness required for gusset plates is another question that has no satisfactory answer. Some designers claim that a truss can be assembled with only 25 per cent for details; other designers use 50 per cent. The American Bridge Company states that its trusses run about 33 per cent details. As gusset plates comprise a large part of the details, the percentage of details depends largely on the thickness of the plates. The thickness of the plates cannot be computed except that the strength of the rivets in bearing should develop the strength of the rivets in shear. Usually the plates are thicker than is necessary to meet this requirement. The outstanding fact is that the weight of a truss can be materially altered by changing the thickness of the gusset plates, and we have no positive evidence determining the proper thickness. We have opinions, of course, but the man who assembles trusses on 25-per cent details is positive that any one using more than 25 per cent is wasting material, whereas the man who uses 50-per cent details is positive that any less than that endangers the structure.

"In general, in judging of the merits of a connection it is well to bear in mind that the main member is the major part and

the connection is the minor part, and that it is not good logic to jeopardize the major part to save a little on the minor part. Furthermore, if the life of a bridge is determined by the time it will wear as a machine it will be the connections that will wear instead of the main members. For this reason also the connections should be stronger than the members.

"The whole question of the strength of connections is a field ripe for experimental investigation."

Derrick Breaks and Drops Section of Boiler Stack

Twisting Moment on Head Produced by Eccentricity of Guy Connections Probable Cause of Failure

By HENRY BLOOD
Engineer, Bureau of Buildings, Portland, Ore.

CAUSED by the breaking of one leg of the A-frame, apparently due to excessive twisting moment, a derrick used in hoisting the top section of a steel boiler stack collapsed and dropped the 6700-lb. load a distance of 145 ft. to the roof of a two-story wing of the building. The accident occurred on Aug. 30, when the last section of an addition to the height of the Northwestern Electric Company's 10-ft. 6-in. stack on the Pittock Block, a 200 x 200 ft. reinforced-concrete office building eight stories high, was being placed in position. This addition of 50 ft. to the height of the stack was being made to abate the annoyance to tenants of a neighboring office building caused by the smoke.

DESCRIPTION OF DERRICK

The derrick had an A-frame composed of 14 x 14-in. Douglas-fir timbers, with a vertical height of 45 ft. and spread of 50 ft. It had no stiff legs, but was guyed to the roof with two sets of steel cables, making an angle of 60 or 70 deg. with each other, extending back about 50 ft. from the derrick, and fastened through holes cut in the roof slab around concrete girders. The base had a timber under each leg, connected by poorly made joints to a short girder built up from I-beams, with top and bottom plates, to form a seat for the boom. Back of this sill there were two diagonal timbers and a center strut 12 ft. long. The boom was a single stick of Douglas fir 106 ft. long, of 14 in. diameter at the top and 22 in. at the bottom. It worked on a vertical pin of 4⅛ in. diameter. Its weight with fittings was about 6600 lb.

The legs of the A-frame were connected at the top by two wide steel plates 4 ft. 9 in. long. The front plate was ⅜ in. and the back plate 5/16 in. thick. The lower corners of the back plate were cut off, so that they did not extend as far down the legs as the front plate. A large number of bolts, generally ¾ in., joined the plates and legs, some being below the back plate. A heavy forging with an eye in each end passed through the plates near the top. The center of the front eye was 2½ in. from the face of the plate; that of the back eye about 5 in. The boom guy, a six-part ¾-in. steel cable, was fastened by a link and clevis of 2¼-in. metal to the front eye. The backstays were attached by a horizontal pin and shackle. The running line from the boom guy passed through a block held by a U-bolt near the bottom of the front plate. A side guy ran from the end of the back shackle to the east wall to take the strain when hoisting from the street over the west wall. All cables and connections appeared amply strong for the loads. The superintendent stated that the derrick was designed to handle 36 tons at an elevation of 30 deg.

HOW FAILURE OCCURRED

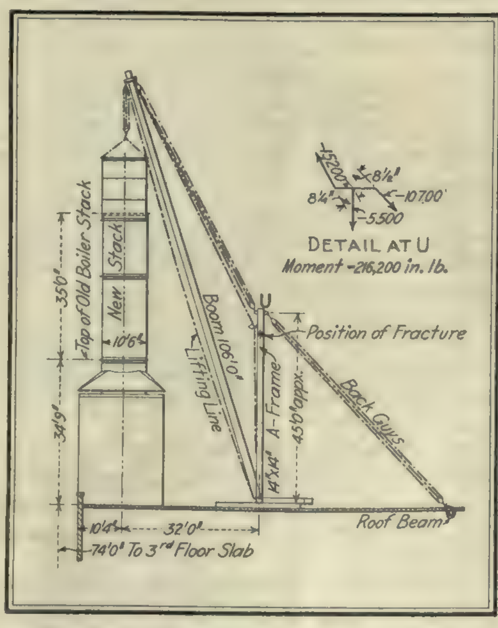
Two engineers of the Northwestern Electric Company were on the roof watching the work and observed the failure, which was caused by the west leg of the A-frame being twisted or torn off just below the top connection. The boom fell in a vertical plane toward the north, struck the fire wall, and broke off a few feet outside. The broken end, which was about 40 ft. long, fell close to the wall, the top end punching a hole through the wood roof about 25 ft. from the wall, and the broken end leaning against the wall at a window. The blocks swung violently against the wall, smashing windows at the fifth, sixth and seventh floors in the second row from the west corner. Several workmen and employees in two or three offices had narrow escapes.

The derrick kicked backward, not being fastened to the roof, struck a corner of the fire wall, and was turned toward the west. The base timber broke off near the east leg. No cable connections were broken. The accompanying photograph, taken the next morning, shows clearly the nature of the break and the position of the fallen derrick.

VIEW OF WRECKED DERRICK SHOWS THE BROKEN LEG OF A-FRAME

The broken timber was not entirely sound, but no real decay was visible. It was seriously weakened by the bolt holes. There were three ¾-in. holes in a transverse row and two more only 2½ in. from them at the point of failure. The wood broke through all five. There was an old crack or check about 2 in. from the outer face, extending for some distance along the fibers, which may have been caused by some previous strain. But even with these defects the stick was safe for a much larger direct load than existed at the time of failure.

In my opinion the break was due to a twisting moment on the derrick head produced by eccentricity of the guy connections. This was not nearly so large when the boom was at a moderate elevation as when it was in a high position. It was elevated at an angle of 70 or 72 deg. from the horizontal at the time of the failure. As indicated in the sketch, there would be considerable twisting in this position, which would cause tension in the front face of the legs. The connection of the boom lifting line to the bottom of the front plate increased this eccentric action, adding to the direct tensile stress in the leg.



BOOM AT HIGH ELEVATION JUST BEFORE ACCIDENT—TWISTING MOMENT COMPUTED

But the heaviest twisting moment could have occurred when the boom was swung to the west to hoist from the street. It was then nearly parallel to the front of the A-frame, and its guy formed with the side guy from the east wall a couple having a lever arm of 26 or 27 in. The leg may have been slightly cracked by this strain, and so weakened that when the boom was in its unusually high position it easily failed.

It is quite unlikely that there would have been a failure if the top connection had been designed to avoid eccentricity with the load in any position, and if the side guy had not been attached to the back shackle. This is a detail that should receive more careful consideration. Derricks, hoists, scaffolding, and other erection equipment should have proper design and inspection, as well as more permanent structures. They need not necessarily have the same factor of safety, but they should be sufficiently strong to avoid risk, and the details should not be weaker than the members they connect.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Lime and Cement vs. Cement

SIR: A little over a year ago I built for Broadacres Dairy Farms at Orangeburg, N. Y., two concrete silos, each 37 ft. high and 16 ft. in diameter, having 6-in. walls reinforced with ⅜-in. square twisted steel bars. Six-foot forms were used, the volume of concrete being about 1 yd. to the foot of height. The concrete was proportioned 1:2:4, the coarse aggregate being crusher-run field stone up to 1½ in., with the dust removed.

The concrete was hoisted in a tower and chuted from this to the forms. In the first silo no lime was used, and the concrete had to be mixed watery to flow into the narrow forms and around the reinforcement. In the second silo one shovel of hydrated lime was used to each two-bag batch, making the proportion of lime about 5 per cent of that of cement. With this the concrete was mixed to a cream-like consistency, and flowed readily from the chutes and around the steel, giving a good surface against the forms. By reason of the drier mix the forms could be removed considerably earlier, thus allowing a shift a day.

Without the lime I had difficulty in getting the forms tight enough to prevent leakage of the watery mortar, with the consequent honeycombed surface. The mortar would also separate, the mortar chuting quickly into the forms, with the separate stones of the aggregate tumbling slowly after. With the lime the concrete slid slowly into place, keeping its consistency throughout, and requiring little spading.

Recently the concrete of both silos was cut into in attaching a building to them, and I could not detect any difference in hardness of the concrete in them; but that of the silo in which the lime was used showed a more uniform distribution of the coarse aggregate.

In this case the cost of concrete materials was increased by the cost of the lime; but the foregoing appears to indicate that the lime could replace some of the cement without injury to the concrete, thus making the cost of materials the same or less, while reducing the cost of placing.

R. M. CREAMER.

Orangeburg, N. Y.

Prepared Mortar as a Cure for Present Carelessness

SIR: Experienced engineers know that a structure is not superior in strength to the material of which it is built, and that a wall can be no stronger than the mortar which binds its parts together. This then brings us to the question of failures of brick masonry that have been reported in your columns during the past few weeks due to more or less common poor but often expensive practices of some engaged in the contracting business.

I make particular reference to the abuses of such well-known standard materials of construction as Portland cement and lime. In your issue of Sept. 2, on page 294, is printed Sanford E. Thompson's report of the failure of the brick piers in a school building at Roxbury, Mass., in which a direct abuse of the materials just mentioned is given as one of the causes of the failure. On Aug. 28 last a five-story building collapsed in Marion Avenue between East 187th and 188th streets, New York City, killing two and injuring fifteen workmen. Several persons were arrested, charged with manslaughter, it being the opinion that the building was inefficiently constructed and could not stand. One bricklayer stated he had never seen such "rotten" cement. It is safe to say that the cement was up to the standard, but can the same be said of the mortar? On the other hand, it is safe to say that a most flagrant misuse and abuse of cement was committed.

In spite of the efforts to construct building codes to prevent occurrences of this kind, building departments to furnish inspection, etc., still these failures occur from time to time, and after the din of failure has subsided the verdict is "careless mixing or skinning the mortar."

There is nothing mysterious about Portland cement or lime as commonly used in building construction. Both of these materials are manufactured along highly scientific lines by reputable and responsible concerns to pass certain well-known and accepted specifications; and if the manufacturers' instructions are followed in using the materials, they can be depended upon to perform their particular functions. Specifications are written by engineers and architects with known results in mind, and the job is then turned over to the contractor for completion. Unfortunately, however, these standard materials are destined after shipment to be passed to the hands of many who either know nothing about the materials entering into building construction or do know but prefer to disregard all governing conditions to reap big profits upon concluding a contract.

This important subject of the misuse and abuse of Portland cement and lime offers the following solution as probably being the best method to avoid failures such as mentioned: The adoption of a prepared brick mortar, which would be delivered on the building site ready for mixing with water. Such a mortar would carry the following advantages:

1. The mortar would be delivered on the job by a reputable builders' supply concern in packages of convenient size for handling, each package marked with the name of the manufacturer.

2. The reputation of the builders' supply concern would protect the engineer or architect against receiving anything but a suitable mortar.

3. Proportions of cement, lime and sand would be accurately made by weight according to some formula known to give best results from both economic and structural viewpoints.

4. Mixing would be done mechanically for any given length of time to insure thorough distribution of all materials.

5. Every pound of mortar to be used in a building would be of the same identical proportions and would have received the same amount of mixing. Every package of mortar would be the same as the one previously used.

6. The mortar would be ideal for the purpose intended.

It will readily be seen that a prepared mortar such as mentioned would not only make reliable mortar joints but would automatically eliminate the loss of life and property, as cement and lime mortar properly proportioned, mixed and used does not fail.

As to the cost of a prepared mortar of this kind, it probably would not cost more than the mortar as it is mixed and used at present. A ton of prepared mortar would lay 2000 bricks with ordinary joints, and approximately exact quantities of mortar could be ordered for each job. There would be no waste materials. It is not infrequent to find a waste of from 10 to 15 per cent upon screening the sand, and there would be no unused piles of sand after completion of jobs. Taking these items into consideration, and others that enter into the preparation of mortar on the job, a prepared mortar should cost no more than when it is mixed on the job.

Prepared mortar of this kind has been in use in the city of Cleveland for the past two years, and it seems that no new materials introduced into any market could have had a more rapid development than prepared mortar. Engineers, architects and contractors have accepted it as standard practice with the satisfying knowledge that they are using a mortar that is safe, economical and produces "sure-thing" results.

No doubt engineers and architects in all other large cities would be quick to see all the advantages of a prepared mortar of this kind and would standardize it as is being done in Cleveland; and going further, it would probably only be a short time before the first-class cities would make it imperative, through their building codes, that a prepared mortar be used on every job of brick masonry.

HYDRATED LIME BUREAU,
Norman G. Hough, Manager.

Pittsburgh.

Inadequate Compression Members

SIR: A striking illustration of the results of using improperly designed compression members was recently noted by the writer in making an examination of an old steel highway bridge. The bridge in question is of the ordinary light construction still quite common in some sections of the country. It is a seven-panel, pin-connected Pratt truss, 125 ft. center to center of end pins, 22 ft. center to center of chords, and 17 ft. 10½ in. center to center of trusses. The vertical posts or compression members are all built of four 2 x 2 x 3/16-in. angles, laced.

With only one or two exceptions these posts were bowed or buckled to such an extent that the defect was quite noticeable from the roadway of the bridge. Such a defect, if occurring in only one or two members, might reasonably be assumed to be the result of injury to the piece during fabrication or erection, but such an assumption seems hardly reasonable when practically all of the members show the same defect.

It seems to the writer that the cause of the buckling is made quite clear by an examination of the properties of the post sec-

tion. The radius of gyration about the axis along the lacing is 0.98 in. and the distance between pin centers is 22 ft., making the value of l/r equal to 269. The column formulas usually specified cannot, of course, be applied for such a large ratio of length to radius of gyration, some of the straight-line formulas giving negative allowable stresses. The maximum computed dead-load stress in any post is less than 8000 lb., or 2800 lb. per square inch. The posts have buckled, as would be expected, in the direction of the least radius of gyration and parallel to the axis of the truss.

E. F. KELLEY,
Assistant Bridge Engineer, Iowa State Highway Commission.
Ames, Iowa.

Evidence Presented on Wear of Concrete Roads in Wayne County

SIR: The article (page 434) and editorial (page 427) in your issue of Oct. 7, on the resurfacing of concrete roads in Wayne County, Michigan, impose upon me a very disagreeable necessity. We have never exploited the deterioration and repair of Wayne County concrete roads. When, however, the Engineering Record states that "no concrete roads in Wayne County have as yet worn out" it seems desirable in the interests of truth to call your attention to the photographs inclosed herewith. You will note that these photos of Grand River Avenue were made in May of this year. They show the extensive repairs, amounting almost to reconstruction, that were then taking place. Gratiot Avenue, another Wayne County concrete pavement, was at the same time in a similar state of disintegration. Both roads had "worn out" to such an extent that in an automobile one could proceed over them only on low gear and at very slow speed.

In calling your attention to these facts, which I think completely disprove your statement that "no concrete roads in Wayne County have as yet worn out," I fully realize that it is possible to point to failures of every type of pavement. I hope, therefore, that I shall not be accused of exploiting the two Wayne County road failures here referred to. I merely wish to correct the statement made in your editorial note.

With reference to the article, as distinguished from the editorial note, it does not give the cost of the resurfacing of Grand River Avenue, which really amounted to building a new concrete road on top of the old one that had gone to pieces. Should I suggest that a better way of repairing the road would have been to utilize the old road as a concrete foundation for an asphalt macadam wearing surface my statement might be taken merely as that of an asphalt advocate. This much, however, is indisputable: The cost of providing a durable 2-in. asphalt-macadam wearing surface would have been very much less than the cost of building a new 3-in. concrete road on top of the old one. Since you have made reference to the cost of the work as done, you may consider it desirable to ascertain just what this cost was, including the repairs made to the old road and the subsequent resurfacing thereon.

D. T. PIERCE,
Executive Assistant, Barber Asphalt Paving Company.
Philadelphia.

CONCRETE ROAD CLOSED FOR REPAIRS

PATCHES MADE IN GRAND RIVER AVENUE CONCRETE ROAD OF WAYNE COUNTY SYSTEM IN MICHIGAN

DEFECT IN GRATIOT AVENUE WORK

Justice to the Contractor

SIR: In your issue of Sept. 9, page 331, J. L. Harrison of Manila has something to say concerning justice to contractors, and in the issue of Sept. 16, page 359, Albert M. Wolf also discusses the subject. Both of these gentlemen have the same idea that is causing contractors so much trouble, namely, that the engineer is right regardless.

To begin with I want to say something regarding the system now practised throughout the United States. When a young man graduates from an engineering school some engineer gives him a job as inspector. You can tell how much he knows by the salary he is paid, usually from $60 to $85 per month. His principal duty is to tell a superintendent (who is probably paid from $175 to $1,000 per month) how much he, the inspector, knows. This boy engineer (?) who has had no experience whatever tells this superintendent whether rivets are driven right, whether timber is good or bad, whether the concrete is being mixed properly, etc. He also gives the superintendent "pointers" on how to carry on the work.

It is the most unreasonable condition existing in any business in this country today. You engineers work on the theory that a man is an engineer when he graduates from an engineering school. He is no more an engineer than is a man a business man when he graduates from a business school. Whoever heard of taking a young man out of a business college and putting him in charge of a bank? Why not? He pursued a business course, with banking and bookkeeping, etc. It sounds foolish, but that is the condition you are forcing on the contractors.

Mr. Wolf lays particular emphasis on the engineering contractor who "carefully analyzes" every bid. I wish we could have secured Mr. Wolf's services to analyze carefully some of our bids this season and make ample allowance for a rainy season, labor shortage, and a scarcity of freight cars. These conditions soon convert a good contract into a losing one.

Mr. Wolf makes a startling statement when he says that the more experience a man has in inspection work the less he is worth to the owner. I think if Mr. Wolf will reconsider this statement he will withdraw it. For my part I know I would rather let an experienced tailor make me a suit of clothes than some graduate from a sewing school.

I want to call a few instances to your attention in which contractors have suffered at the hands of engineers. A few years ago I was working as an inspector under

an engineer who "carefully analyzes" things. The contractor was building a parapet wall about 3 ft. 6 in. high on the top of a concrete dam. In one place the wire across the forms broke and the weight of the concrete sprung the forms considerably at that point. The foreman removed part of the concrete and drew the form back as near to place as he could get it. It happened that the engineer was on the job that day (it was too cloudy for him to go fishing) and saw the whole accident. He told me to have the foreman remove that section (16 ft.) I got a level and checked the form and found that it was ¼ in. out of plumb in 3 ft. 6 in., and I refused to make him take it out for that slight difference. The engineer made him remove it, however, saying that anybody would know that that wire was not heavy enough to hold those forms. That same size wire had worked successfully, though, in some 2000 ft. of wall that had been built.

Last season, in laying concrete pavement, we came in contact with some engineering judgment that was quite expensive. The specifications called for a subgrade 5 in. below the top of the forms, to be rolled with a 10-ton roller. We graded the street and rolled it as per specifications, and when we came to laying the pavement the inspector fortified himself with a piece of chalkline and immediately found places where the grade was ¼ in. too high. Anyone who has ever been around construction work knows that dirt cannot be rolled any closer than ¼ in., and there was just as much of it ¼ in. too low as there was too high. I offered to take out any dirt willingly where the average of five readings across the road was less than 5 in. He pulled out the specifications and showed me where 5 in. was called for, and said nothing else would do, and we had to grade over 4 miles of road under such tyrannical inspection.

I know of another case that happened in one of the large cities on this coast that shows what the contractors are up against. In bidding on a job the contractor bid on new curb and on old curb torn up and replaced. There was only 3 ft. of the latter shown on the plans, so he put the same price down for both, as it would have been foolish to waste time trying to figure costs on such a small amount of work. During the course of construction the computers made an error in grade, and after the curbs were in they discovered that one block was a foot too high. They made the contractor tear out this curb and replace it for his price per foot because he bid on tearing out and replacing curb. I was estimating new work for the city at that time, and before bids were called for I protested against taking such an unfair advantage of a contractor; but the engineer in charge of this job thought that was a clever piece of engineering.

A year or so ago a Western state highway engineer, in his yearly report to the governor, showed a novel combination of engineering skill and high finance. In one county a certain amount was appropriated for road construction. The contract was let to a Seattle concern, and after the work was under way the engineer deemed it advisable to change the location, involving thousands of yards of extra excavation. In his report the engineer stated that under the original classification of excavation the county did not have enough money to complete the work, but by changing the classification there was still a balance of more than $1,000 in the road fund. I might say in connection with this that the contractor brought suit, which is still in the courts, for something over $60,000. Such a case as this should be punishable with a penitentiary sentence. Obtaining money by altering the classification of earthwork is not different from obtaining money by altering a set of books.

I could cite a hundred cases equally as ridiculous. As long as this feeling and condition exist there is going to be trouble between engineers and contractors. As long as you engineers start on a job with the feeling that the contractor is a crook you are going to cause yourselves trouble and cost the contractor money, and nobody will be benefited. We in the contracting game do not claim to know it all, but we hate to have some kid with a B.S. degree tell us how little we know. Experienced engineers and inspectors are all we ask for. A give-and-take proposition is fair for both sides, but the way it is at the present the contractors give and the engineers take. We do not care what the specifications are with a fair engineer. We bid on doing the work right, and that is all a fair and experienced engineer will ask of us.

Portland, Ore. J. T. CARMICHAEL.

[In justice to the "boy engineer" it should be noted that in three of the four examples cited by Mr. Carmichael the offenders appear to have been engineers of more mature years. Unquestionably "kid" inspectors with the B.S. degree do often outrage engineering common sense, but their complete elimination would hardly settle all difficulties between engineers and contractors.—EDITOR.]

Eccentric Loading on Columns

SIR: I have read with interest the article in your issue of Sept. 2 discussing "Eccentric Loading on Columns" and the comments in the issue of Sept. 30. The article has special reference to columns in mill buildings and gives equations for the moments and reactions on such columns where subjected to eccentric loads from traveling overhead cranes.

The assumptions made in working out the above are erroneous in the following particulars: It is assumed that the roof truss is so held at its opposite end that it prevents any horizontal movement at the top of the column, while as a matter of fact all that holds it is a column exactly like the one under consideration (except in some special cases) and which deflects exactly as much, due to the force R_t. The only condition under which there would be no deflection at top of column, where both columns are alike, would be that of the crane load at the center of the crane as in Fig. 1 herewith. As the load may be at either end of the crane the condition for any mathematical discussion should be as shown in Fig. 2. Under such conditions it is obvious that hinged ends at both ends of the columns would result in collapse.

As a great many columns carrying crane runways are constructed with a much smaller section above the girder seat than below, the moments of inertia of the two sections are quite different and should be considered in working out any table for use in design.

The article in question states that "it is better to avoid eccentricity than to make provision for it. When practicable, columns as in Fig. 4 should be used." The crane load in Fig. 4 is certainly eccentric, as the neutral axis is some distance from the edge of the column on which the girder rests, although the bending is much less than that in a thinner column carrying the crane girders on a bracket.

It should be borne in mind that a great many mill buildings are built with side bays that so hold the main columns that the conditions become too complex to allow a satisfactory analysis, and when the condition is further complicated by the addition of swinging jib cranes and the consideration of lateral impact from any of the crane loads, it devolves upon the designer to make a reasonable assumption as to what factors to ignore, and to use conservative unit stresses.

It would seem proper when the crane loads cause flexure which, if combined with the direct compression, does not cause tension in the anchor bolts, to regard the base of the column as fixed, but unless the roof truss is quite deep at the ends the top should not be so considered. A truss with

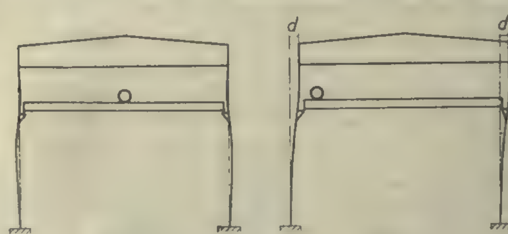


Fig. 1 Fig. 2

no end depth, as in Fig. 3 of your issue of Sept. 30, page 419, where the top and bottom chord members intersect about at the center of the columns, does not offer much resistance to flexure and cannot be regarded as "fixing" the end of the column. The large gusset plate simply transfers the moment to the individual members of the truss, which members are generally small as compared with the column section, and deflect too much under flexure to offer a restraining moment of any great amount.

HOWARD C. BAIRD,
Boller, Hodge & Baird, Consulting Engineers.
New York City.

Slide Rule for Number of Rivets

SIR: In looking through some old papers recently I came across a slide rule which I designed in 1907 which gives with very little effort the number of rivets required in riveted connections.

Believing that this may be of interest to some of your numerous readers I am inclosing herewith two of the rules made up in usable form, and two sets of instructions which I prepared for their use. If any of your readers are interested in this I will be glad to give them rules free of charge from the small lot that I have on hand.

W. WATTERS PAGON,
Baltimore. Consulting Engineer.

Shallow Brick Economical

King County, Washington, has recently laid 3 miles of a monolithic brick pavement 20 ft. wide on which brick 2¾ in. deep was used. These brick, laid on the cut side, cost $21.75 per 1000 and require only 36 to the square yard. The standard pavers, laying 41 to the square yard, cost in King County $28.75 per 1000. The estimated saving is about $5,000 per mile. The brick used are of the "vertical-fiber" type.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Heavy Smithing Job Done in Open on Bent Crusher Spindle

By H. S. CARPENTER
Cobleskill, N. Y.

BY PLACING it horizontally on two rails so that it could be rolled over at the right moment, and building a brick furnace around it, the writer recently straightened in the open the spindle of a No. 6 McCully gyratory crusher which had been bent just below the bell until the bottom bearing was 2⅝ in. off center. As may be seen from the photograph the spindle and bell were supported so that they could be rolled over on two light rails blocked up from the ground.

Around them there was built a furnace of firebrick and fireclay in the bottom of which was an air blast supplied through a hose from the compressor plant. The spindle was placed with the concave side of the bend down over the hottest part of the furnace. It was heated until it scaled a little more than half way around, when the furnace was quickly torn down and the spindle rolled over until the concave side was on top.

Four men working in relays, two at a time, then drove down on the top of the spindle with 14-lb. sledges while water was played on the under side of the bend with a hose. The wetting caused that side to contract, and straighten the bend. The sledging compressed the metal on the under side of the spindle so that it did not bend up again when cooling. The job was a complete success in straightening the spindle, which is now in service in the crusher, and up to the present time has shown no signs of weakness.

SPINDLE WAS HEATED ON INSIDE OF BEND, THEN ROLLED OVER AND STRAIGHTENED

Motor Truck with Flanged Wheels Draws Flat-Car Trailer

MOTOR TRUCKS equipped with steel flanged wheels for operating on rails have made it possible and practical for railroads and construction companies to salvage rails on abandoned spur lines and in construction camps where heretofore the cost of reclaiming the rails by other methods was exceedingly high. A recent test on the Chicago, Burlington & Quincy Railroad bespeaks the success of the trucks.

The Burlington decided to salvage the rails on the abandoned McLaughlin lumber and tie road connecting the station at Nahant, in the Black Hills of Montana, with the forests 35 miles to the west. The contract for the job was awarded to the Black Hills Transfer Company. A locomotive could not be used to haul the rails, because the forest reserve laws require oil burners, and only wood burners were available. Furthermore, the track had not been kept in repair, and the cost of putting it in shape to permit the use of a heavy locomotive would have been prohibitive.

The contractors finally decided to try out a motor truck. An order was placed with the White Company in Cleveland for a standard 1½-ton truck, which was shipped to the Burlington railroad shops at Havelock, Neb. There it was equipped with a set of steel wheels with flanges for operating on rails, reshipped to Nahant, Mont., and put to work.

During the first month the truck was in service it covered about 3300 miles, averaging 108 miles a day. By the use of a flat car as a trailer, 12 tons of rails were hauled into Nahant each trip. The truck made two round trips a day, climbing several grades as steep as 7 per cent on second and third gear and registering an economy record of better than 10 miles to a gallon of gasoline. After depositing its load at Nahant the truck made the 27-mile trip to the forests on fourth speed.

MOTOR TRUCK ON TRACK HAULS 12 TONS OF RAILS WITH FLAT CAR AS TRAILER

Cantilever Forms Save Tie Rods on Thick Lock Walls

THE cantilever type of wall forms developed at Panama has been cleverly adapted in the construction of walls up to 40 ft. and more in thickness for Lock 2 on the Welland Ship Canal. In the use of these forms, anchor bolts 18 in. long are embedded as each lift of concrete is placed. These bolts, on a line near the top of the lift, project through the concrete after the forms have been removed. Posts made of two 4 x 10-in. timbers laced together, and of sufficient length to reach from the top of the next lift to a point several feet below the line of anchor bolts, are then stood up and clamped against the concrete by these bolts. These posts, acting as cantilevers above the bolts, support the next lift of forms during concreting. On the work referred to, described at length on page 490 of this issue, these forms are used not only for the vertical face, but for the back face of the lock walls, which is offset in steps. This is accomplished by bracing the form slabs to the uprights with short horizontal posts, as is plainly shown in the accompanying photograph. For work where large

CANTILEVER WALL FORMS USED ON CANAL

batches of concrete are dumped from a bucket, as in this case, and where very long tie rods would be readily bent or broken, these forms are a great advantage.

Work on the Welland Ship Canal is under the direction of J. L. Weller, engineer in charge for the Department of Railways and Canals. Baldry, Yerburgh & Hutchinson are contractors for Section 2, on which the forms described are in use.

Deck Trusses Changed for 100-Foot Girders Between Trains

By A. HALL
Akron, Ohio

TWO deck girders, each weighing 80 tons and forming a span 103 ft. long, were recently set by the writer in 30 minutes each by shifting the track to one side, cutting off the caps of pony bents which supported it, lowering the girder to place and shifting the track back on top of it. The girders were set between trains in 30-minute intervals, arranged with the dispatcher, and the entire work was carried out without delaying a single train.

Falsework, of which ten bents were required, was first driven and capped below the bottom chord of the old deck truss to support it. Inside the truss, on top of this falsework, were erected pony bents which were capped to support the track itself. All the interior steel of the old bridge was then removed, leaving the two trusses standing alone.

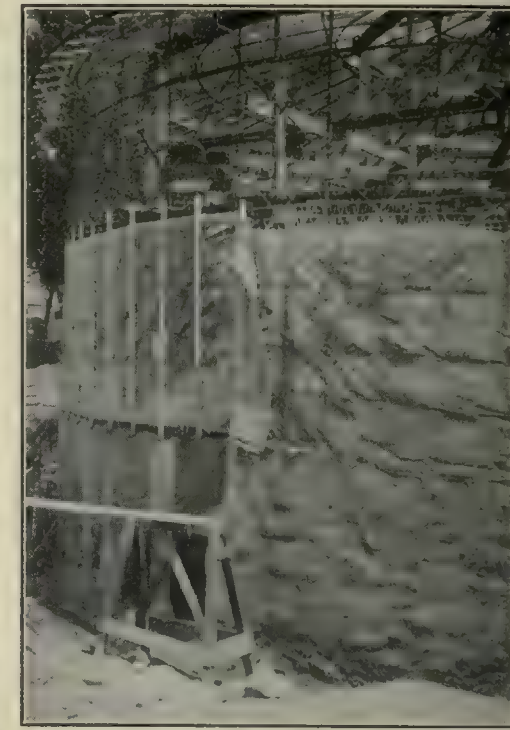
The only hoisting equipment available to set the new girders was a 15-ton Browning locomotive crane and a Lidgerwood hoist used in driving the falsework. Each girder had to be set just outside the rail under the ends of the ties, and the pony bents could not, of course, be made narrow enough to permit this. A heavy A-frame was set up at one end of the bridge and an eight-part wire rope fall, led to the hoist, was used to handle one end of the girders, while the other end was handled by the crane on a high boom. The girders were brought out on the span, on cars, picked up with this equipment and lowered on the pony bents outside the track directly over the outer line of posts. The caps of these bents on one side of the track were then sawed nearly through 3 ft. from the end between the girder and the track. In the 30-minute interval arranged for with the dispatcher this girder was again hooked by the falls and the crane, the caps were cut entirely through and the short ends under the girder turned around lengthways on the dowel pins holding them to the posts of the pony bents. Meanwhile the ties had been slid as far over to one side as possible, and jacks and blocking had been set on the pony bents under the track to raise it slightly until the girder could be placed. Turning the ends of the caps left a slot in which the girder could be lowered and swung over to place. As soon as it was set the ties were slipped back over it and the track lowered.

To set the girder on the other side, the ties were slid the other way over the first girder and that side of the track chained down to the truss on that side. We merely blocked or jacked this side, a little high, of course, to elevate the track enough for clearance of the entering girder. The remaining part of the pony bents which had supported the other side of the track up to this time were then knocked down on to the lower falsework after the second girder had been raised clear, and this girder was then lowered and set as the first one had been. The track was then unchained and replaced, and the bracing put in.

The entire work took some time, as the road was very busy and there was a severe penalty for delaying any trains. The crane had to be taken into a siding at least twenty-five times during the work. The bridge described is on the Louisville & Nashville Railroad in Kentucky.

Cement Gun Makes Monolithic Reservoir Without Forms

BY draping canvas over the framework of reinforcing, a concrete reservoir at Elmhurst, Ill., has been built with a cement gun without forms. When the first layer shot from the inside against the canvas secured to the outside has set, further building up of the layers by the gun is easily accomplished. The first reservoir of this type was constructed in 1912 at Cary, Ill., but experience since then has led to a number of improvements. Successful results



CANVAS MAKES BACKING FOR FIRST COAT

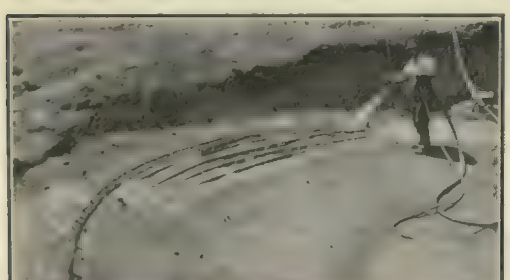
depend on the skill of the operator, for in the hands of inexperienced men defects are likely to occur which are not discovered until the reservoir is put in service.

A light structural-steel frame of angles and bars is erected with the required amount of spiraled reinforcing bars with hooked ends securely fastened to the frame. Over this reinforcement is placed a heavy triangular wire mesh, which serves as additional reinforcement, but chiefly to hold the concrete in place while setting. When the entire frame, reinforcing and wire mesh have been erected, heavy canvas ducking is stretched over the outside of the frame and upon this, from the interior, is applied with the cement gun about 1½ to 2 in. of 1 part cement to 3 parts clean coarse sand and gravel. When this coating has set a short time the canvas is removed and additional layers of dense concrete are applied from both the exterior and interior, building up the walls to the desired thickness. The root or cover is constructed in the same manner. On reservoirs about 20 x 30-ft. walls are made 6 in. thick and the roof 3 in.

One of the striking features of this method is the variety of cornices that can be built by an expert nozzle operator. These are struck off to true lines by means of a "sweep" and may be left either rough cast or finished to a troweled surface.

It is asserted that the costs are less than when using forms and that the dense concrete makes a waterproof reservoir.

The work at Elmhurst was carried out by the Dewey Cement Gun Company and the method has been developed by the company and Harry L. Emerson, consulting engineer, Chicago.



EVEN THE FOUNDATION IS SHOT IN

BUILDING UP FIRST COAT FOR INSIDE

PLEASING CORNICES MADE WITH SWEEPS

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Tumult Reigns as Municipal Improvements Convention Adopts Paving Specifications

Scenes of Wild Confusion Mark Defeat of Proposals to Accept Alternate Asphalt Specification and to Reject Bitulithic as Standard

Into the convention of the American Society of Municipal Improvements at Newark, N. J., last week, twin bombshells were thrown Thursday night. No detonation occurred, for the sputtering fuses were smothered in a blanket of parliamentary confusion. Nevertheless, the menace of the high explosives, in the form of an alternate asphalt specification and a rejection of Bitulithic—patented—as one of the society's "standards" created a near-panic, and sent members scurrying from convention hall to hotel lobby for reinforcements to resist the assault upon the positions won at Dayton and elsewhere in the campaigning of former years. The scene was one of wild confusion. Motions and amendments to motions, calls for adjournment, shouts of "You're out of order!" "Question!" and "Sit down!" and attempts to determine the will of the meeting, first, by a standing vote, second, by herding members into groups at opposite ends of the hall, and finally by roll call, lent to the meeting a color which is commonly associated with a political broil, rather than with the deliberations which would be expected of an engineering body in passing upon the merits of a technical question.

Action on Asphalt and Bitulithic

From the tangled mass of débris which represented the evening's proceedings it is not easy to construct a coherent statement of what really happened. Certain it is that the alternate asphalt specification was defeated, and that the proposal to reject Bitulithic pavement as one of the society's standards was "laid on the table." Excitement ran high, and into the proceedings was interjected every trick of parliamentary procedure which could becloud the issues under discussion. Things reached such a stage that very few of the members, apparently, seemed to know what they were voting on. As an instance of this, the chairman of the general committee on paving specifications, when his name was called, voted in favor of a resolution which he had been vigorously opposing for an hour or more, and, when a roar of laughter ensued, changed his vote.

The tranquil opening of the session on paving specifications on the night of Oct. 12 gave no hint of the storm which was soon to break. According to the program, the presentation of the committee reports on specifications was to take place after seven general papers on paving subjects had been offered. If this schedule had been followed the convention would have been ready to consider its paving specifications at about midnight. Nevertheless, President Macallum called for the first of these seven general papers, but E. A. Fisher interposed with a resolution, which was carried, calling for the omission of the general papers and the immediate consideration of the paving specification reports.

Alternate Specification Proposed

Prof. A. H. Blanchard reported for the subcommittee on broken stone and gravel roads. To his recommendations there appeared to be no objection. After the call for the report of the committee on asphalt by Francis P. Smith, chairman, there was a noticeable awakening of interest throughout the audience. Mr. Smith explained certain changes which the committee had made in the existing open specifications, the chief one involving a modification in the grading of sand. It was then that the sensation of the evening was sprung when Abraham Swan, engineering department, Trenton, N. J., advocated that the society adopt alternate specifications for asphalt—specifications which would differentiate the so-called refined and natural asphalts. These alternate specifications were prepared by Walter H. Flood. Mr. Swan contended that Trenton's experience with the society's open specifications had been unfortunate enough to justify the change he proposed. In this claim he was supported by Commissioner F. G. Simmons of Milwaukee, who said, with some heat: "We want a distinction between lake and oil asphalts." Then the full fury of a verbal tempest was released. Members sprang from their seats to hold whispered conferences with their fellows. The creation of an alternate asphalt specification was moved as an amendment to the subcommittee's report, which favored the existing blanket specification. With members darting to and fro in all parts of the room and standing in the aisles, a standing vote was called for under conditions which made an accurate count well-nigh impossible, and the alternate asphalt specification amendment was lost, according to the secretary's count, by the close margin of 46 to 44. Appeals for a recount were unheeded by President Macallum, the presiding officer.

Bituminous Discussion Reopened

This action closed the discussion on asphalt for the time being and Linn White, of Chicago, chairman, presented a report of the committee on bituminous paving, which was passed unanimously. It then developed, after the passage of the specification, that Bitulithic pavement, which had been sanctioned as a standard at the Dayton convention last year, was excluded from the specifications presented by this year's committee. Again the convention hall was in an uproar. After much confusion as to the correct parliamentary procedure to bring the matter again before the meeting, the question was again opened for discussion. It was claimed that Mr. White's report had not been fully understood by the general committee, which had proceeded on the assumption that Bitulithic pavement was retained in the newer specification. Motions and counter-motions then began to fly thick and fast. On several occasions, when the call for a vote was made, President Macallum was unable to state clearly upon what matter the meeting was voting. A motion to lay the whole matter on the table was lost by a vote of about 50 to 59, and then with nothing decided, a motion to adjourn was made by E. A. Kingsley and later withdrawn.

At this stage of the proceedings the scheme of counting, or attempting to count, standing votes was abandoned in favor of herding members for or against any motion to opposite ends of the convention hall, a move which, if possible, added to the general disorder of the meeting. The upshot of the whole matter was that in spite of protests by Mr. White and W. H. Connell, of Philadelphia, the Bitulithic specification was retained as a standard, its

(*Continued on page* 514)

Waterworks Technical Staff Gets Tactful Job

Illinois and Iowa Sections Discuss Insanitary Drinking Fountains and Hear a Lucid Statement About Commission Rule

That waterworks officials are now turning to the members of their technical staffs to handle complaints was brought out clearly in one of the papers presented to the Iowa section of the American Waterworks Association at the Davenport meeting Oct. 10. Startlingly insanitary conditions of modern so-called sanitary drinking fountains and a lucid statement of the present status of commission control of waterworks were features of the two-day meeting of the Iowa section, with which the Illinois section joined on the second day.

About 100 persons registered from the two states. The Iowa men elected the following officers: C. R. Henderson, chairman; S. L. Etnyre, vice-chairman; F. D. Lawlor and Philip Carlin, directors. The annual meeting of the Illinois section will be held in March.

Technical Staff Gets More Work

Earl T. Kirkpatrick, chemist and bacteriologist, Des Moines Water Company, told of his experience in handling complaints which are filed in the laboratory and plotted on a map to show graphically their distribution, as well as to aid in routing the order of the calls. The ground water in his city may, at dead ends, show iron color from crenothrix. The chemist explains to the consumers that the water is not bad hygienically. If it is colored enough to affect laundry work, a nearby hydrant is opened to flush out the main; otherwise nothing is done. For complaints of sediment a Whipple sediment test is made. Samples are always taken and the case followed until the consumer is convinced of the purity of the water. The results of less than a year's trial warrant a continuance of the practice. Confidence is engendered and there are fewer chronic "kicks" since the company has encouraged people to complain.

In discussion, Mr. Etnyre said his experience with complaints from new mains led him to believe that an oil leached out of the yarn. Paul Hansen spoke of a successful newspaper publicity explanation of the presence of a larval worm in the water at Champaign and Urbana. W. W. DeBerard, Western editor of the Engineering Record, stated that the Denver Union Water Company had recently turned over all complaints of the quality of the water to the technical staff with success. The consumers seemed more easily assured when confronted by a technical man, but the latter had to use much tact. One of the things always done was to drink a glass of the water in the presence of the householder.

Dry Lime Feeder

J. B. Thornell, chemist, Council Bluffs waterworks, in his paper on the treatment of the Missouri River water, described a dry lime feeder. A large iron hopper is filled with dry hydrated lime. In the bottom is a worm which pushes the lime into a smaller, funnel-shaped hopper below. A stream of water flows into the lower funnel, dissolving the lime and carrying it out through a 2-in. pipe to a weir between the first and second settling basins. A small electric motor drives the feeding device and is also attached to a small centrifugal pump which draws the water for dissolving the lime from one of the settling basins. By an arrangement of pulleys and gears the speed of the worm may be regulated as desired. About 30 gal. of water is used for each pound of lime. The large volume of water used is

one of the main factors in the success of the treatment, because it completely dissolves the lime, thereby preventing clogging of pipes and bringing about thorough mixing of the lime solution with the raw water before it receives the charge of alum solution.

Prof. J. H. Dunlap, Iowa City, has been examining sanitary drinking fountains and observing drinkers. One of thirty-nine fountains, he finds, is so arranged as to prevent people from getting their lips upon the surfaces. Bacteria, like a whirling ball in a garden fountain, dance up and down in the rising jet for long periods. Only a fountain that is protected and one in which the jet spurts clear of the supply opening will meet the requirements. The section appointed a committee to make further studies.

Leonard Metcalf, president of the national association, gave the address on commission control of properties. His paper, which is too long and the subject too intricate to abstract, is a most logical and convincing statement of the present status of affairs. Good service to the consumer and fair play to the waterworks was the burden of his talk.

A. E. Miller, a contractor of Des Moines, told of his experiences in France and Russia behind the lines with a modern trenching machine. Even though trenching machines represent the latest type of development for ordinary work they are not ideal for war purposes.

WATERWORKS MEN VISIT DAVENPORT PLANT—T. N. HOOPER, VICE-PRESIDENT, ALTHOUGH 83 YEARS OLD, INSISTED ON ACTING AS GUIDE FOR HIS GUESTS

They should be more largely experimented with, in Mr. Miller's opinion, mainly because the ideal trench is two series of short ditches connected by trenches at right angles to prevent an effective enfilading fire. Zigzag trenches 50 ft. from point to point and curved ones could be built and were considered satisfactory for the reserve line. The machines were found to be most suitable for preparing communication trenches. Twenty-two of them were tuned up with crews by Mr. Miller at Moscow for use back of the Russian front. In France the terrain was too congested to make the machines feasible.

Must Protect Banks Above and Below Weir at Hanlon Heading

Finding that the temporary rock weir and pile trestle being constructed across the Colorado River by the Imperial Irrigation District below the intake of its canal at Hanlon Heading is interrupting the regular flow of the river and thereby causing erosion of the Arizona shore, Major G. B. Pillsbury, Corps of Engineers, U. S. A., Los Angeles, has notified the district that steps must be taken immediately to protect the banks of the river above and below the weir. A spur track must be built from the railroad on the Yuma Irrigation District's levee and rock hauled and dumped along the banks for a distance of 800 ft. above and below the weir.

The weir was being constructed as an emergency measure to raise the water level at the intake and was to be removed Jan. 1, 1917. Efforts were made to check the scour by depositing rock and brush by hand. Major Pillsbury held that this would not be effective during a freshet.

Tumult Reigns as Municipal Improvements Convention Adopts Paving Specifications

(*Continued from page* 513)

chief proponents being Morris Sherrerd of Newark and E. A. Kingsley of San Antonio.

Engineering Record Sustained

In view of the Engineering Record's arraignment, in several recent editorials, of the procedure of the American Society of Municipal Improvements in making paving specifications, two significant admissions were made during the excited discussion. Mr. Kingsley said: "With these things being brought in at the last minute, no wonder we are subject to so much criticism from the engineering press." A particularly violent outbreak during the controversy moved Mr. Sherrerd to remark: "We have been severely criticised by the engineering papers for just this kind of procedure. We cannot afford to do this sort of thing."

When everybody was ready for the next order of business an interesting development occurred. Col. J. W. Howard called attention to the fact that the convention had neglected to pass the open specification recommended by its subcommittee, headed by Francis P. Smith. Then someone voted to reopen the entire discussion on the alternate asphalt specification, and by means of a roll call vote, consuming almost an hour's time, the alternate specification was defeated by a vote of 33 to 59. It was then about midnight and the meeting adjourned till the following morning.

At the morning session a wood-block specification, allowing the use of water-gas tar as well as coal-tar products, was passed.

The wild scenes of the night before had apparently had a sobering influence on the membership, for by a resolution of Prof. A. H. Blanchard authority was granted for the appointment of a committee to investigate and report upon changes in the constitution.

The brief session on the afternoon of Wednesday, Oct. 11, was devoted entirely to sewage treatment. A number of excellent papers were scheduled, among the authors being T. Chalkley Hatton, Harrison P. Eddy, George T. Hammond, George W. Fuller and others. As the room had to be vacated early for banquet preparations, the program was not finished and no opportunity for discussion was offered, although in the audience there were sanitary engineering experts of national prominence who had made the trip to Newark with this object specifically in mind. The discussion, however, was postponed till "promptly at 9 o'clock to-morrow morning." With a mere handful present at this later occasion the subject was speedily disposed of.

Next year the convention of the society will be held at New Orleans. The following officers were elected: President, N. S. Sprague, of Pittsburgh; first vice-president, E. R. Conant, Savannah, Ga.; second vice-president, G. H. Norton, of Buffalo; third vice-president, R. Keith Compton, of Baltimore; secretary, C. C. Brown, of Chicago; treasurer, F. J. Cellarius, of Dayton.

American Road Builders Convene November 3 in New York City

The annual meeting of the American Road Builders' Association will be opened at 2 p.m. Nov. 3, at the Automobile Club of America, New York City. Aside from a meeting of the board of directors and reports of officers and committees, the principal interest will center in the election of officers for the year 1916-1917. While this is now being conducted by means of a mail ballot, the polls will not close until 4 p.m. of the day of the meeting. The annual dinner will be held in the grill room of the Automobile Club, at which the result of the election will be announced.

Lake Washington Canal Will Be Opened About July 1, 1917

The Lake Washington Canal will be opened for traffic not later than July 1, 1917, if the Seattle bridge situation does not interfere with the remainder of the dredging operations. According to G. F. Nicholson, acting chief engineer of the Seattle Port Commission, the Fifteenth Avenue bridge at Salmon Bay is 85 per cent finished and will be completed by next April. The Fremont bridge is 90 per cent completed and is expected to be ready by Feb. 1, 1917. The Latona bridge across Lake Union is being delayed by reason of certain technical investigations concerning the foundations. However, if the work is carried on as per contract the Latona bridge would not be finished before Jan. 1, 1918, and would therefore seriously affect the date on which navigation may be inaugurated between Lake Union and Lake Washington.

The Lake Washington Canal Association met at the Seattle Chamber of Commerce Oct. 2 to confer with representatives of the Chamber of Commerce, the Municipal League, the Commercial Club and the Port Commission as to what action was advisable. A committee was appointed to confer with A. H. Dimock, city engineer, who is working on two plans to relieve the Latona bridge situation by providing drawspans in the present trestle. The canal association will further discuss the problem with Col. J. B. Cavanaugh, who has charge of the work.

Defense Board Named by President

President Wilson announced late last week the appointment of the members of the advisory commission to be associated with the Council of National Defense recently created by Congress. The appointees are: Daniel Willard, president of the Baltimore & Ohio Railroad; Samuel Gompers, president of the American Federation of Labor; Dr. Franklin H. Martin, of Chicago; Howard E. Coffin, of the Hudson Motor Car Company; Bernard Baruch, of New York City; Dr. Hollis Godfrey, president of Drexel Institute and consulting engineer, Philadelphia, and Julius Rosenwald, of Chicago.

The council will work to co-ordinate all forms of transportation and to develop means of meeting the military, industrial and commercial needs of the nation. It will also extend the industrial mobilization work of the committee on industrial preparedness of the Naval Consulting Board.

Inaugurate Highway and Engineering Administration Courses

The Bureau of Municipal Research, New York City, has added courses in municipal highway engineering and engineering administration to those offered by the training school for public service. Ernest P. Goodrich, consulting engineer to the Borough of Manhattan and to the board of estimate and apportionment of New York City, will have charge of instruction in engineering administration. Arthur H. Blanchard, professor of highway engineering, Columbia University, will instruct in municipal highway practice.

The Engineer

By DR. FRANK CRANE

The man of the future will be the engineer. He is the man who can *do* things; and is better than the man who *owns* things.

The millionaire is a temporary, passing, makeshift product of civilization. He is merely holding things together until the people get sense enough to do their own owning.

Some day little boys will read that the world once had millionaires and huge private wealth units, just as they will one day read and wonder that men once had kings.

But the official who will forever be indispensable is the engineer.

The time will come when the President of the United States will be chosen as the man who has the greatest talent and skill in organizing public works. There will be no more politics in his selection than there is now in choosing the master mechanic of a railway or factory.

When a nation goes to war nowadays, that is, when it becomes necessary to exert its supreme collective strength, nobody dreams of electing the most popular politician or the cleverest speechmaker to lead the armies. It is the man who can get the last ounce of efficiency out of men and metal that is wanted.

Some day the nation will realize that it is continually in a crisis, and that in peace as in war we need the highest order of efficiency and organization.

We need the engineer to arrange the transportation of people and goods from place to place, without waste, without competition, without graft, looking only to the public good.

We need the engineer to get meat, bread, and milk from farm to citizen, without the present inefficient tangle of trusts and middlemen working at cross purposes.

We need the engineer to turn the public enterprise toward building good roads and bridges, instead of enriching a few shrewd manipulators.

We need the engineer to manage a city as economically and smoothly as if it were a manufacturing plant.

We need the engineer to organize the farmers so that all can work together for each, and their products be marketed without being preyed upon at every step of the way from farm to household.

Wealth can be taken away from us. But the power to *do* things cannot be taken away.

The millionaires could go and not be missed. The engineers we cannot spare.

"What availeth all thy wealth?" said the ancient philosopher. "He that hath better iron than thou will come and take away all thy gold."

Says H. L. Gantt:

"The man who knows what to do and how to do it is pre-eminently the engineer. The new world which is being ushered in by the great struggle now taking place is one in which the engineer is destined to be the supreme power, for it is becoming clear that, in future, the man who *owns things* will not be as important a factor in the world as the man *who can do things*."

Engineering Society Activities

The San Francisco Association of Members of the American Society of Civil Engineers held a meeting last Tuesday, at which G. A. Elliott described the Calaveras hydraulic-fill earth dam. An inspection trip will be made to-day to the dam as guests of the Spring Valley Water Company.

The American Society of Civil Engineers will meet Nov. 1 to hear a paper by F. H. Peters, commissioner and chief engineer of irrigation of Canada, outlining a complete method for the classification of irrigable lands.

The Associated Engineering Societies of St. Louis conducted an inspection trip to the Chouteau Avenue viaduct last Saturday. The 80 x 1560-ft. structure of flat-slab construction eliminates a grade crossing on the tracks of the Missouri Pacific Railway. The bridge embraces a model subway and cost $200,000, exclusive of land and damages.

The Western Society of Engineers will celebrate ladies' night Oct. 30 at Chicago. Lantern slides showing mountain climbing will be thrown on the screen. D. W. Roper will do the talking. The next business meeting is scheduled for Nov. 6, at which A. S. Zinn, consulting engineer for the Republic of Panama, has prepared a paper on narrow-gage railway construction in Panama.

The Engineers' Club of Trenton, N. J., will meet Oct. 26 to hear Joseph A. Steinmetz, president of the Aero Club of Pennsylvania, discuss aerial warfare and terrestrial and submarine devices.

The Detroit Engineering Society will meet Friday evening, Nov. 3. Bela Nagy, chief engineer of the hydrated-lime bureau of the National Lime Manufacturers' Association, will discuss hydrated lime and its use in concrete and mortars.

What Engineers and Contractors Are Doing

ERWIN HARSCH has resigned as aid in the U. S. Coast and Geodetic Survey corps to become instructor in civil engineering at the University of Tennessee. Since graduation from the civil engineering department of George Washington University in 1915 he has been employed by the Survey on various kinds of hydrographic work.

LEONARD METCALF, consulting engineer, of Boston, has completed the work of directing the preparation of the inventory and the submission of the engineering evidence bearing upon the value of the property of the Spring Valley Water Company, in the fair suit (covering the period 1908-1915) before the federal court, which was intrusted to him by the company nearly three years ago. The hearings consumed 153 days, exclusive of the argument, which was begun Aug. 10 and completed Sept. 4, 1916. The evidence is now before the standing master in chancery of the federal court of the northern district of California for decision.

C. A. FITZMAURICE has resigned from the employ of the United Fireproofing Company to become superintendent for Lewis A. Miller, building contractor, of Meriden, Conn. He is at present directing the erection of a six-story concrete building in that city.

W. C. HIRN has secured a leave of absence as borough engineer of St. Marys, Pa., in order that he may take up special work in sanitary and municipal engineering at the University of Michigan.

H. W. HARTMANN, formerly instrumentman and inspector for K. C. Gaynor, consulting engineer, of Sioux City, Iowa, is now junior engineer in the Illinois highway department with office at Peoria. Mr. Hartmann has been associated with K. C. Gaynor since graduation from the University of Iowa.

ELMER G. FULLER, for the past two years junior civil engineer in the Chicago office of the Division of Valuation of the Interstate Commerce Commission, has resigned. He is now a member of the sales force of the General Fireproofing Company, with headquarters at Youngstown, Ohio. Mr. Fuller was graduated from the University of Michigan in 1911.

J. L. PARSONS, formerly county engineer of Humboldt County, Iowa, succeeds G. P. Smith as county engineer at Fort Dodge. Mr. Parsons received his education in civil engineering at Cornell College and from the American School of Correspondence. After spending about a year with different railroads, he was appointed assistant city engineer of Pierre, S. D. Since July, 1908, Mr. Parsons has engaged in private practice at Humboldt, Iowa, paying particular attention to county drainage work.

G. P. SMITH has resigned as county engineer at Fort Dodge, Iowa, to take the position of drainage engineer of Redwood County, Minnesota, with headquarters at Redwood Falls.

JAMES G. WRAY has resigned as chief engineer of the central group of the Bell telephone companies to become associated with Hagenah & Erickson, public utility engineers, of Chicago.

W. W. VAN EVERY has resigned as city engineer of Sault Ste. Marie, Ontario, to become general manager of the city water and light department.

ALBERT JEWELL, formerly operating chemist of the filtration plant at Toledo, Ohio, is now assistant sanitary engineer of the Kansas board of health. He was graduated from the University of Michigan this year.

JOHN H. BRINGHURST, a graduate of the University of Michigan, class of 1910, has resigned as instructor in civil engineering at his alma mater to join the engineering department of Johns Hopkins University.

O. M. MCNEIL, who during the last five years has been employed by the American Bridge Company, the Dominion Bridge Company and the A. J. Smith Construction Company, has been appointed instructor in civil engineering at the University of Michigan. Mr. McNeil was graduated from the civil engineering department of the University of Colorado in 1911.

PERRY A. FELLOWS recently resigned as general superintendent for the Winnsboro Granite Corporation to become instructor in civil engineering at the University of Michigan. Since graduation from that institution in 1906 he was engaged on railroad work until his association with the Winnsboro corporation.

EARL DENNY, a 1914 graduate of the University of Missouri, will become county surveyor and highway engineer, with office at Liberty, Mo., on Jan. 1, 1917.

PROF. F. H. NEWELL, of the University of Illinois, and formerly director of the U. S. Reclamation Service, will address the Chicago Association of Commerce Oct. 25 on "Drainage in Illinois." Only about once a year are engineers invited to address this noonday meeting of 400 to 500 business men.

GEORGE ALLAN KYLE, consulting engineer, of Portland, Ore., and specialist in railroad engineering, has been chosen by the American International Corporation as the engineer to have charge of the 1100 miles of railroad to be built in China by the Siems-Carey Railway & Canal Company. As noted in the Oct. 7 issue, the work is being financed by the American International Corporation, the officers of which have selected Mr. Kyle to direct the work, the estimated cost of which runs into the millions. The recent approval by the Chinese Government of Mr. Kyle's appointment concludes the preliminary arrangements and the engineer expects to sail early in November. Mr. Kyle was born in Tobasco, Ohio, in 1857. A business course and a short period of instruction in civil engineering preceded his first engineering job in 1876 as rodman. The following six years were spent on railroad construction in Iowa, the last one as locating engineer for the South Dubuque & North Western Railway. The next year found Mr. Kyle division engineer in charge of the location and construction of 30 miles of railroad for the Cincinnati & Eastern Railway. He returned to Iowa in 1884 and until 1886 directed location and construction in that state and Illinois for the Chicago Great Western Railroad. For the next few years Mr. Kyle was engaged on railway location in the Dakotas for private companies and on the re-

vision of the main line of the Union Pacific Railway in Wyoming. He spent the next four years with the Northern Pacific Railway in the Northwest, a year in the employ of the Baltimore & Ohio South Western and in 1895 became associated with the Summer & Jack Gold Mining Company, Limited. His duties with that organization took Mr. Kyle to South Africa, where he had charge of surface improvements and the development of deep-level mines. Upon his return to the United States in 1899 he again entered the employ of the Northern Pacific in charge of location and construction. Railway construction in Canada drew his attention in 1902 and for two years he was associated with the Grand Trunk Pacific Railway, with headquarters at Winnipeg. During 1904 he did special work for the Northern Pacific, and for the following two years was engineer of surveys and consulting engineer on construction for the Alaska Central Railway. He returned to the States in 1907 to become assistant chief engineer of the Chicago, Milwaukee & St. Paul Railway on the Pacific Coast extension, and two years later was appointed chief engineer of the Oregon Trunk Railway. When he resigned in 1910 to engage in private practice he was vice-president and general manager of the latter road. Mr. Kyle is now in New York City preparing for his new work in China.

American Engineer Employed by Chinese Government to Direct New Railroad Construction

Photo by Paul Thompson

GEORGE A. KYLE

SAMUEL MORREELL, JR., Oscar F. Gayton, Frank C. Van Etten and Robert F. Gayton announce that they have become associated under the firm name of Utilities Engineering Company, with offices in the Webster Building, Chicago. They will continue their individual practices of engineering as applied to the preparation of plans, specifications, reports and valuations of water and electric utilities, sanitary and civic improvements.

NATHAN C. JOHNSON, consulting concrete engineer, of New York City, who reported on the causes and the extent of the failure at the new Cleveland water filtration plant, has been further retained to make designs for the reconstruction.

WALTER W. WEIR, senior drainage engineer, office of public roads and engineering, U. S. Department of Agriculture, was recently at Reno, Nev., where the possibilities of draining the Truckee meadows, which cover an area of approximately 10,000 acres, was considered. Mr. Weir made the investigation in conjunction with F. L. Bixby, government irrigation engineer, and J. G. Scrugham, of the University of Nevada.

Obituary Notes

LAWRENCE M. THACHER, for the last ten years in the engineering department of the Georgia Railway & Power Company, died recently at Atlanta, Ga. Mr. Thacher was a native of Yarmouth, Mass. He was graduated from the Massachusetts Institute of Technology in 1886. For fourteen years he had been engaged in engineering in the South—for a time at Little Rock and then at Birmingham—before going to Atlanta. He was president of the Atlanta section of the Engineering Association of the South.

RALPH TOLLES NORTON, railroad contractor, died in New York City, Oct. 9. Mr. Norton had been engaged on numerous large construction contracts, having been associated with the Carter Construction Company, the F. M. Ferguson Contracting Company and the Degnon Contracting Company. At the time of his death he was a member of the firm of Norton, Head & Denneen, New York City, which recently completed the contract for the construction of the Mill Creek joint district sewer in St. Louis, involving an expenditure of nearly $3,500,000.

ROBERT SWAN, director of the department of public works of Pittsburgh, died last Saturday at his home in that city at the age of 57. Mr. Swan was born in 1859 in the old city of Allegheny. After graduation in 1877 from the Western University of Pennsylvania, now the University of Pittsburgh, he was for several years associated with his father, John Swan, a contractor, who built a large part of the Baltimore & Ohio Railroad through Western Pennsylvania. That was followed by his appointment as city engineer of Allegheny, and later as a member of the engineer corps of the Baltimore & Ohio Railroad. He had risen to the position of assistant engineer of the Pittsburgh division at the time of his resignation to become associated with the T. A. Gillespie Company, of New York and Pittsburgh. For about seventeen years Mr. Swan was in that company's employ, during which time he participated in the carrying of the Catskill Aqueduct under the Hudson River at West Point, the construction of the filtration plant at Aspinwall and work on the New York State canals. In January, 1914, he resigned as vice-president and general manager of the T. A. Gillespie Company to become director of the department of public works of Pittsburgh.

Director of Public Works of Pittsburgh Died Last Saturday

ROBERT SWAN

VIRGIL GAY BOGUE, consulting engineer, of New York City, died Oct. 14 on a steamer as he was returning from Mexico. Mr. Bogue was born July 20, 1846, at Norfolk, Va. After being educated at the school of Gen. William H. Russell of New Haven, Conn., he entered Rensselaer Polytechnic Institute, from which he was graduated in 1868. A year with the engineering corps of Prospect Park, Brooklyn, N. Y., was followed by a trip to South America. For several years he was engaged on railway construction in Peru, later being made manager of the Trujillo Railways. When active hostilities broke out between Peru and Chile Mr. Bogue returned to the United States. From 1880 to 1886 he directed surveys and construction for the Northern Pacific Railroad across Idaho and Washington to the Pacific Coast. The following five years he spent with the Union Pacific system as its chief engineer. Since 1891 Mr. Bogue maintained offices in New York City. He was a member of the commission appointed by President Harrison to investigate methods for improving the Columbia River. As consulting engineer to the Governor of New Zealand for three years he directed the selection of a route for the proposed railway across the South Island and recommended the tunnels now in use on that railroad. In addition to being consulting engineer to the department of public works of New York City, Mr. Bogue was a member of the commission appointed by Mayor Strong to determine the feasibility of operating surface cars on Brooklyn Bridge. His advice was asked when a report was being prepared on the cost of a tunnel under the East River, New York City. He was consulting engineer to the Western Maryland and vice-president and chief engineer of the Western Pacific railroads, and also associated with the Canadian Pacific Railway. Mr. Bogue also made numerous reports on roads in foreign countries. At the time of his death he was a member of the board of direction of the American Society of Civil Engineers and a member of many other professional and social organizations.

Well-Known Consulting Engineer and Director of American Society Is Dead

VIRGIL GAY BOGUE

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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Federation of Planning Boards

LAST YEAR there was formed in Massachusetts an organization that should prove of great benefit to the towns and cities of the state. It is known as the Massachusetts Federation of Planning Boards, and its function is to help the town-planning bodies of the individual communities. It has now started to put forth a series of bulletins which aim to stimulate the local boards to greater activity and efficiency. The federation is seeking to discover conditions which hamper the effectiveness of the local boards. As these conditions are disclosed it is proposed to formulate additional legislation which will enable the town-planning work of the state to reach the maximum effectiveness. The personnel of the executive board of the federation is such as to guarantee the success of the efforts. Other states could well profit by following the Massachusetts lead, not only as to the fundamental town-planning act but in the organization of a state federation of planning boards.

Barge-Canal Operation

WITH the early completion of the New York State Barge Canal in sight, as explained in the leading article in this issue, new problems present themselves for solution. Construction work is now about 90 per cent finished, and in fact several sections of the various routes have been open for navigation during the past year. It is apparent therefore that the thoughts of barge-canal officials are now being diverted from the well-worn channels of construction to the newer ones of operation and maintenance. The improved waterway linking the Great Lakes with tidewater at New York harbor represents an investment of something like $155,000,000. How is this great sum to be made to pay dividends? What is needed first is a business-getting agency—some bureau whose function would be to disseminate information concerning the advantages, facilities and other features relating to the barge-canal system. Facts of this sort should be of immediate interest to merchants, manufacturers, shippers and others, not only of New York State but of other sections of the country indirectly served by the barge canal. With these ideas in mind, State Engineer Williams has proposed the creation of a traffic bureau. It is only by means of such a bureau that the full benefit of the canal can be quickly realized when construction is completed. In spite of the fact that New York State has spent a vast sum of money on this project, the people, as a whole, have very hazy notions regarding it. It is time now to begin a campaign exploiting the value of the canal as a freight-shipping medium. Certainly a private corporation in charge of a public utility, almost completed, would have its agents in the field soliciting business. As a matter of fact, a number of interesting traffic developments, involving the use of the barge canal by large private interests, are already in the formative stage. Without doubt others will soon follow. Everything points to the need of a traffic bureau such as Mr. Williams has proposed, and there should be no delay in its organization.

Help from the Outside

THE TRUTH is out. A clear-visioned attorney at law from a hamlet in Minnesota has seen through the "smoke" raised by the Engineering Record in accounting for the Quebec Bridge accident—through both the "voluminous language" published by this journal regarding castings and a futile attempt by private letter to justify its position. One look at the photograph of the falling span showed the attorney at law that "all there was to it was that the span was not strong enough to support itself, and that it, therefore, broke down and fell into the river." In the letter referred to, the Engineering Record had tried to say that the crumpling of the span took place only after the failure of the casting, when the trusses had been subjected to stresses for which they had never been designed. But the learned counsel pointed out that "the span was 640 ft. long and of good, liberal width," and that any margin of safety that would not stand a settling of 4 ft. at one corner—one foot in 160 or one inch in 13 ft.—"must have been calculated with parsimonious frugality." And as a clincher he noted that the trusses "crumpled up something like 540 ft. from where your imagination leads you to suggest that the casting failed." On only one other point the Engineering Record would seek enlightenment: What had the "good, liberal width" to do with it?

Engineering Harpies

ALL PROFESSIONS are preyed upon by unscrupulous individuals who use their knowledge of some phase of the technique to make the lure plausible. The swindlers who have given engineers positions in questionable promotion companies but insisted on their investing $500 or $1,000 have not been heard from for some little time. It is to be hoped that the Federal authorities can keep them sufficiently under surveillance to prevent further operations. About a year ago a number of railroad and construction engineers in Chicago deposited money for expenses with W. D. Middaugh, a supposed agent of the Norton-Griffiths Company of London, which, it was asserted, had a contract to build the Wallaroo, Moonta & Northern Railway in Australia. Horace Nugent, the local British consul, has recently made public the results of an investigation which indicate that the contracting firm never heard of Middaugh and that there is no such railway in Australia as the Wallaroo, Moonta & Northern Railway Company. It is the practice of one of the newer engineering societies in Chicago to investigate such schemes as soon as suspicion points to them. Many engineers have thus been saved money they could ill afford to lose. More work of this kind could be done by engineering societies with profit to the profession as a whole. It is surprising to learn how little watching is necessary to make the "sucker business" unprofitable.

Adopt the Budget Principle

IN last week's issue of the Engineering Record, page 488, criticism was directed at the overloaded convention program of the American Society of Municipal Improvements at Newark, N. J. The session on sewage treatment was particularly disappointing, due primarily to mismanagement in allotting insufficient time to this prominent feature of the program. Several excellent papers were omitted entirely, others had to be condensed to a point where their full effect was lost and, most unfortunate of all, no discussion was possible on the afternoon the papers were delivered, in spite of the fact that an unusually large number of prominent sanitary engineers had journeyed to the meeting for the specific purpose of asking questions and making comments from the floor. The case illustrates forcibly the necessity of applying to convention-program arrangements the methods commonly followed in budget-making. In other words, let there be made, beforehand, a fairly definite mold by which the convention proceedings may be shaped. There is nothing complex about this scheme. It is a simple matter to learn, in advance, how much time is available at each session. By determining the length of the various papers to be delivered it is also possible to estimate accurately how many minutes the reading of each one will consume. If papers are not received in advance, a definite time limit should be placed upon them, depending on their importance. Then let some man with an appreciation of relative values make up a program which can be rigidly followed. The right kind of man will quickly sense the big things and give to them the prominence they deserve. He should also be able to make a very shrewd estimate as to a proper allowance of time for discussion. In fact, individual discussion might have a definite time limit put upon it, so as to give everyone with any-

thing to say an opportunity of being heard.

Efficient convention management really resolves itself into nothing more than intelligent advance planning. Foresight of this sort was entirely lacking at the recent Municipal Improvements convention in Newark. In the fiasco of the sewage-treatment session there is an important lesson for other engineering organizations which hold conventions. It is not enough merely to secure a number of good technical papers and a number of good technical men to discuss them. The engineering society's responsibility goes farther than this. It must insure for authors and auditors alike fair treatment. If present practice is followed much longer, it will soon be difficult to convince engineers that it is worth while to prepare papers for engineering conventions.

Creditable Work of the California Highway Commission

IN the past seven years California has expended $18,000,000 on highways. How great an asset this expenditure has produced and how greatly it has improved the future prospects of the state can be realized only by those who have seen something of the splendid highway system that has been built. Among engineers the California highway system has become well known because of the great mileage of oiled-surface concrete pavement, constructed with very limited funds. The chief reason for the notable success is that engineering ability and efficient management have gone hand in hand in carrying on the work. Furthermore, the commission has been notably free from political influence, and complex questions in the choice of routes have been settled with a fairmindedness that has won the people's confidence.

The act which provided the first state funds for the work stated that "the highways constructed or acquired under the provision of this act shall be permanent in character . . ." And thus the commission undertook its work with an impossible assignment before it. The concrete-base highways have proved a success and the maintenance charges have been very low. Nevertheless, maintenance must be provided for, and it is to be remembered that there will be a very considerable mileage of the completed system which will not be hard surfaced and on which there must be a generous allowance for repair and upkeep.

The commission has built up an organization which the state highway engineer controls as chief executive. Judging it solely by results, it is one of the most effective in the country. It is therefore important that its integrity should be preserved.

There is much work to be done. Long gaps must be filled before the greatest benefits of the trunk-route system can be realized. The state is about to vote on a proposed $15,000,000 bond issue, of which $12,000,000 would be used to fill in these gaps and $3,000,000 would be applied (on a county-aid co-operative basis) to the building of eight additional highways or extensions of the original system, the desirability of which has become apparent in the past two or three years. It is not conceivable that there could be anything but a hearty approval of this issue, especially since California has available such an efficient road-building organization.

Change in New York's Subway Personnel

AMONG the friends of Alfred Craven the announcement, in the news columns of this issue, of his retirement as chief engineer of the New York Public Service Commission, which is building the city's new subway system, will cause deep and widespread regret. It is true that Mr. Craven is not a young man, as young men are judged in these days—he celebrated his seventieth birthday last month. Nevertheless, the completion of the new subway system is only a year or so away, and those who have followed him in his arduous task of directing the country's biggest engineering job cannot help wishing that the pilot who had steered the course of the commission's engineering work thus far could have brought his ship safely into port. Mr. Craven felt, however, that the time had come to surrender the wheel to other hands. He remains with the commission as consulting engineer.

This is the situation so far as Mr. Craven is concerned. Now comes the question as to his successor. When a change of personnel involving large engineering responsibilities and, incidentally, a salary of $20,000 is made, it is natural to expect from the appointing power—in this case the New York Public Service Commission—a rather complete statement of the facts in the case. Otherwise suspicion is aroused, particularly since the commission was once before under fire in connection with the retirement of its chief engineer.

The brief statement of Mr. Craven's retirement in the New York daily papers last week was accompanied by the announcement that Daniel L. Turner, deputy engineer of subway construction, had been named acting chief engineer. No mention whatever was made of Robert Ridgway, engineer of subway construction, second in command to the chief engineer, and, in the regular course of promotion, the logical successor to the position left vacant by Mr. Craven's retirement. What does the Public Service Commission mean by a tactless announcement of this sort? Is the engineering profession to infer that the logical successor to the office of chief engineer of the country's largest construction project has been deliberately passed by in favor of his former subordinate—with no reason given for such action—or is it to assume that the post of chief engineer may still be considered as open and that the man to fill it ultimately is the one who for years past, in Mr. Craven's absence, has been officially designated as acting chief engineer? These are pertinent questions. In justice to the men concerned and to the profession at large, which stands squarely upon a platform of promotion by merit, they should be answered.

Actions of this sort, unaccompanied by explanations, inevitably result in disrupting the efficiency of any organization. A comparison of the professional records of the present engineer of subway construction and his deputy—the newly appointed acting chief engineer—gives no clue as to the reasons for the commission's action. Among his fellow-engineers Mr. Ridgway enjoys an enviable reputation both as a construction man and as an engineering executive of large capacity. His steady rise in responsibility on work of the old Aqueduct Commission, on the Rapid Transit Commission, which built the present subway system, on the Catskill Aqueduct, where he occupied the important post of department engineer, and on the Public Service Commission, where, as engineer of subway construction, he has been second in command to the chief engineer, is a definite tribute to his worth. In fact, when the city of Chicago wanted advice on the solution of its rapid-transit problem recently it selected Robert Ridgway as one member of its advisory commission—the other two members being men of such national prominence as William Barclay Parsons and Bion J. Arnold. And yet the Public Service Commission, from all outward signs, at least, has passed him by in filling the chief executive position in its engineering department.

A man of Mr. Ridgway's standing cannot be disregarded, as would a minor subordinate, without full explanation. The position of chief engineer is still vacant. Does the commission intend to appoint to this post the man who is the logical candidate for it? If not, why not?

Women's Vote and the Engineer

UNLESS the Women's City Club of Chicago were assured that the expenditure of a proposed $2,000,000 bond issue for increasing the garbage-disposal facilities of the city would be placed in the hands of competent engineers, the members were determined to oppose it. Mary McDowell was spokeswoman of the club, and when Miss McDowell is against a measure in Chicago, even case-hardened politicians pay attention. The following quotation from Miss McDowell's statement indicates what the entry of women into politics may mean to the engineer:

"We will not stand for a bond issue unless there is a competent engineering expert at the head of the waste bureau. The disposal of garbage and other waste is a matter of sanitation, and for sanitation we need an engineer. We will not stand for putting the disposal of the city's wastes into politics. Under such conditions we will go out and do our utmost to defeat the bond issue when submitted to the voters. If there is a competent engineering expert at the head of the bureau, we will support the issue. We will go out and speak for it and do all we can. But we won't stand for putting the disposal of wastes into politics."

The aldermen apparently saw the futility of attempting to oppose the women. The efficiency staff was instructed to formulate a program with the proposed issue halved, while the commissioner of public works

promised to comply with the women's request as to the engineering appointment.

There seems to be no reason why local engineering societies should not also take a hand in such a proceeding. If Miss McDowell and nine other women can lop off $1,000,000 at least temporarily (for the $2,000,000 issue was finally agreed upon) from a proposed bond issue unless engineers are put in charge of the work, the engineers ought to be somewhat more than slightly interested.

Heartwood Specification Needed to Get Best-Grade Timber

THE lack of a heart specification in the Southern Pine Association's select structural grade of timber has given a certain false sense of security to those engineers who have not looked into the specifications carefully and who do not know exactly what they may expect to get. When the word "longleaf" was eliminated from the specification of the American Railway Association the clauses covering different conditions with 75 to 85 per cent heart were still retained, so that the specification was not emasculated, and, with the exception of a very small percentage, longleaf timber only could qualify. Close-grained sapwood, it is generally admitted, may have the same strength as heartwood, but few persons contend that it has the same durability (see the Engineering Record of Aug. 29, 1914, page 255). Hence, to get the highest grade of material, which the engineer believes he is asking for, a heartwood clause should be included in the select structural grade specification, which already takes care of density or the strength factor.

Timbers cut from good longleaf and grading up to the select structural specification are bound to show 80 per cent or more heart. The timber grows that way and the longleaf manufacturer is forced to furnish heart timbers whether the buyer is paying extra for them or not. Consequently it is apparent that if the botanical distinction is to be avoided, a heart specification must be added to the select structural grade if that grade is to continue to pose as the highest grade of Southern pine timber.

The Southern Pine Association has made great progress in defining grades, but there is still room for improvement. The American Society for Testing Materials is the sponsor for the select structural grade, and that body is the one to improve the specification if further confusion is to be avoided. As it now stands the specifications of this organization ignore the important difference between longleaf and the two other principal Southern pines. Longleaf is distinguished for its lack of sapwood to as marked a degree as the others are distinguished for the abundance of it.

More and more engineers and architects must study the conditions under which the various grades are to be used. Where strength without long life is the desideratum, shortleaf, which has the strength, should be used, conserving the higher type for those uses where durability, as well as strength, is essential.

How Shall Motor Trucks Be Regulated to Conserve Highways?

AS a measure of protection for its highways the State of New Jersey is planning legislation to control the weight, size and speed of commercial motor vehicles. The initial stage in this movement was reached recently when a special committee, appointed by William L. Dill, state commissioner of motor vehicles, submitted a tentative draft of rules and regulations, which is given on page 536. It is to be noted that these requirements are not final. Further hearings are scheduled in order to secure the benefit of a full discussion of their merits or defects before adoption. Present indications are that a number of changes will be made.

The New Jersey situation is one of more than local interest. The signs are unmistakable that it will soon be faced in most of the states. Into the solution of this problem enter two of the greatest factors of public welfare—good roads and transportation—both involving millions in past investments and millions more in future expenditures. Upon what common ground of understanding can the road builder and the motor truck manufacturer and operator work to best advantage? We must have good roads, we must have motor trucks; this our legislators must keep in mind. To attempt to rule the truck off the road by drastic restrictions would be as futile as to demand from engineers unduly expensive types of road construction for carrying any kind of unreasonable traffic which the whim of truck designers might impose upon them.

The menace of hasty, ill-considered legislation on this question is so serious that bodies with law-making functions and highway engineers called in in an advisory capacity should weigh carefully all arguments before final action is taken. The value of such procedure is well illustrated in the case of New Jersey's proposed rules. The motor-truck interests have raised serious objections to legislation embodying these requirements. Many of these protests appear to be well founded. Others are obviously colored by partisan judgment. Nevertheless, they should prove useful to highway engineers.

The case of the motor-truck manufacturers, as developed by members of the Motor Truck Club of America and their attorney, Charles G. Bond, at a meeting in New York last week can be summarized as follows:

Sections 2 and 8 of the proposed rules (see page 536) prohibit the use of metal tires on both trucks and trailers. In the case of the trailers this restriction is held to be unjust. Trailer wheels merely roll over the road—there is no tractive effort applied, as in the case of the drive-wheels of a truck. Operated at suitably low speed and with the weight distributed by a broad tire, it is held that steel-tired trailers would produce no unreasonable wear on the road surface. If the trailer must be equipped with rubber tires, the motor truck men say, why should not the same restriction be applied to horse-drawn vehicles?

In the case of Section 5, calling for sealed governors on trucks to limit speed, a very interesting situation develops. Electric trucks, it was argued, are never equipped with governors. The passage of a bill calling for them, therefore, would exclude electric trucks from the state roads. Surely no such result was in the minds of the committee when this clause of the report was drafted. As for the gasoline-driven trucks, some are built with governors and some without. Section 5, if passed, would consequently necessitate radical changes in motor design on the part of some manufacturers, or else would stop the sale of their products in New Jersey. On the governor question the motor-truck men themselves are decidedly at variance. One member, for example, said: "The state of the industry has not produced a governor which will stand up under motor-truck service." It was further advanced against the governor that it would prevent a truck when light from operating at a higher speed than when loaded. On return trips, running light, every truck would lose valuable time.

Moreover, the rules take no cognizance of the character of the roads in limiting motor-truck speeds and weights. Should the same restrictions hold for water-bound macadam as for grouted granite block?

Exception was also taken to Section 7, limiting the overall length of trucks to 23 ft. 6 in. It developed that one of the large motor-truck manufacturers is producing a standard vehicle somewhat longer than 26 ft. Its function is to carry light, but bulky loads. No serious road damage could be expected from a motor vehicle thus used, but the New Jersey rules, in their present form, make no exception to the 23-ft. 6-in. length.

Opposition developed also to Section 8, allowing only one trailer per truck. The argument was advanced that a string of trailers, instead of increasing traffic congestion, would actually decrease it by reducing the spacing between vehicles. The proposed limitation to one trailer apparently was conceived with operation around curves in mind.

The table of limiting wheel loadings and speeds was ultra-conservative, in the opinion of the motor-truck men. In Massachusetts an 800-lb. load per inch of tire width is allowed, and the opinion was expressed that 1000 lb. per inch should not be considered excessive.

There was some debate regarding the question of anti-skidding devices. Any regulatory legislation, it was contended, should make provision for the development of inventive genius.

This is the motor-truck man's side of the case. With all of his arguments the highway engineer and the state road official, upon whom the responsibility of road maintenance rests, will not agree. Nevertheless, the only way that workable laws can be produced is to have all available experience and points of view at hand. Enough has been said to indicate that some of the provisions of the New Jersey schedule need revision. The draft and its modification should be carefully studied by highway engineers.

This journal will be glad to receive comments on the motor-truck situation as it exists in other localities.

MOVABLE DAM AT SCOTIA—GATES AND WICKETS MAY BE SWUNG CLEAR OF THE STREAM BY ELECTRIC WINCHES ON BRIDGE, THUS PREVENTING FLOODS

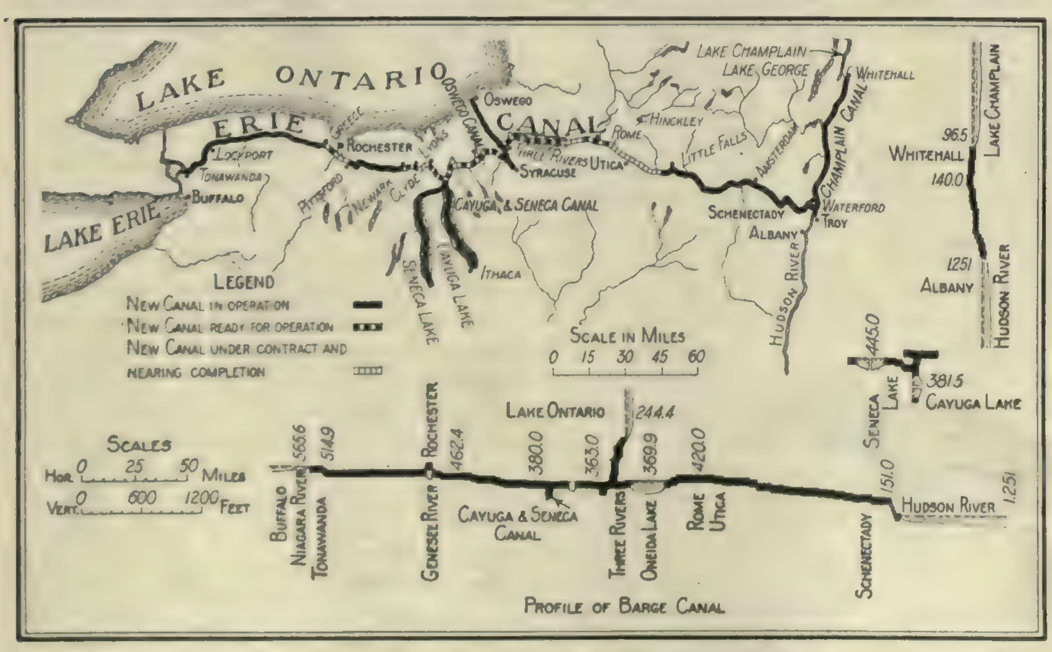
New York Barge Canal Is in Partial Operation

Construction 90 Per Cent Finished—83 Miles of Eastern Section and 97 Miles of Western Section of Erie Route Now in Use for Navigation—Mechanism for Lock Gates, Valves and Movable Dams in Working Order

WITH only about 10 per cent of actual construction work remaining to be completed New York State's Barge Canal, the $155,000,000 inland waterway linking the Great Lakes at Buffalo with tidewater in New York Harbor, is rapidly reaching the transition stage which marks the passing of the constructor, the principal figure on the work for the past decade, and the advent of the operator and the shipper of freight. To-day's chief problems on the Barge Canal cannot be stated in terms of excavation or concrete yardage. They deal with new factors—organization of an operating force, manipulation of lock gates and valves, movable dams, maintenance of water levels and regulation of feeder reservoirs, generation of electric power for operating and lighting purposes and the creation of terminals and freight-handling facilities at the principal cities and towns along the route from Buffalo east to New York City.

During the past season about 83 miles of the Erie section of the canal at the eastern end was finished and opened for navigation. Other sections of the route westward to Buffalo, from Newark to Pittsford and from South Greece to Tonawanda, about 97 miles, were completed and in use this year. The only points which prevent the full use of the Erie route are the unfinished work at the mouth of Tonawanda Creek, the section south of Rochester, the section from Lyons to Clyde and 4 miles from Utica to Sterling Creek. The present status of the work leads Frank M. Williams, state engineer and surveyor, to predict that the Barge Canal will be in full operation in 1918. He says that during the last year his department has solved the last big engineering problems—the Rochester and Syracuse harbors, the Irondequoit crossing, the Tonawanda movable bridges, the twenty disputed railroad crossings and the Clyde River location, which has permitted placing under contract work long undetermined.

To the Engineering Record's representative, who covered many miles of the Barge Canal work by motorboat and automobile a few weeks ago, in company with William B. Landreth, deputy state engineer; George D. Williams, eastern division engineer, and H. E. Brainard, bridge designer, an opportunity was afforded of inspecting the finished work on the eastern division, watching the locks fill and empty, seeing the gates of the movable dams rise clear of the river, and examining the hydroelectric plants which furnish power for the canal-operating mechanism and lighting. The outstanding impression created by this trip is that as a feat of engineering construction the Barge Canal work will soon be history. So much of it is completed that its annals are ready for a new chapter—on operation.



PLAN AND PROFILE OF NEW YORK BARGE CANAL, SHOWING PORTIONS OF COMPLETED WATERWAY

FOUR CANALS IN SYSTEM

The New York Barge Canal system, as shown on the accompanying map, consists of four parts—a main channel and three branches. The main channel, or the Erie Canal, 339 miles long, connects the Hudson River at Waterford with the Niagara River at Tonawanda. The first spur line branches off from the main channel at its eastern end and extends to Lake Champlain, a distance of 61 miles. The second spur leaves the main route at Three Rivers, extending northward to Oswego and Lake Ontario, a distance of 24 miles. The third spur, known as the Cayuga and Seneca Canal, 93 miles long, including Cayuga and Seneca lakes, leaves the main line at Montezuma and proceeds south, forking into two branches which tap Seneca Lake and Cayuga Lake respectively. In general the Barge Canal project is largely a river canalization, for 72 per cent of the length of the entire system is in river or lake channels. The length of the state's waterway system of Barge Canal dimensions—a 12-ft. depth of water and a minimum bottom width of 75 ft.—is 800 miles. Of this total about 440 miles involved construction of some type, the remaining 360 miles being in lakes or rivers which did not call for improvement.

A few statistics will give an idea of the

magnitude of the task of operating the New York State Barge Canal. There are, on all four canals, 57 locks, each with a width of 45 ft. and an available length of 310 ft.; the lifts vary from 6 to 40½ ft. Thirty-two hydroelectric power stations, eleven gasoline-electric power stations and three substations supply all the power for operating and lighting the 57 locks. Forty dams, some of them movable and others fixed, are needed in the Barge Canal operation. Terminal facilities are required at about 50 cities and towns along the route.

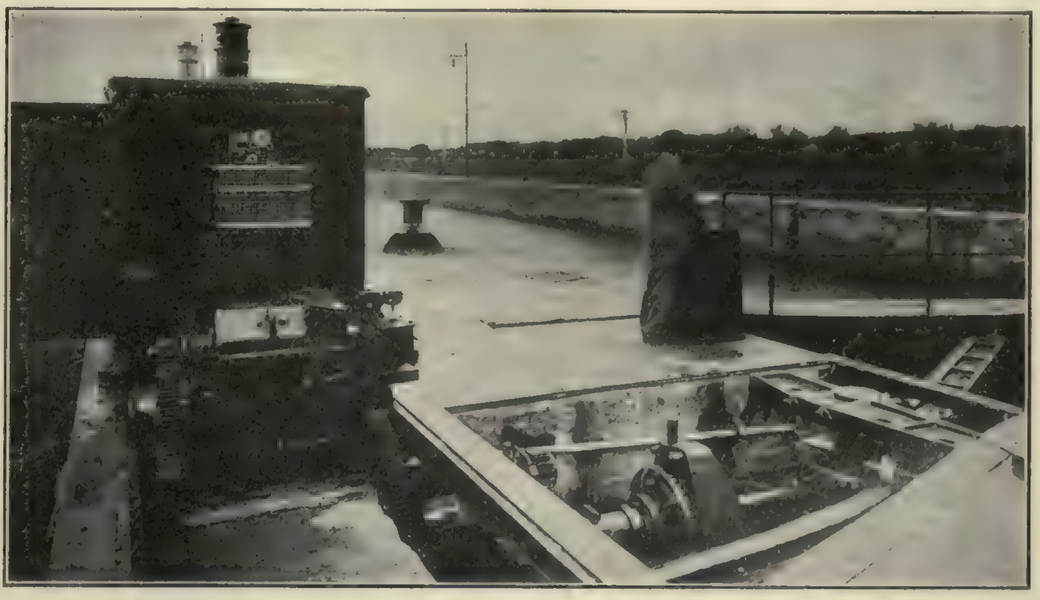
Lock Design

The lock design and operation have been practically standardized throughout the length of the Barge Canal, and while the following notes deal specifically with the flight of five locks at Waterford they apply, in a general way, to structures of the same type at other locations. The locks are of concrete construction, with an available length, for boats, of 310 ft. and a width of 45 ft. The depth of water over the sills is 12 ft.

The filling and emptying is effected by culverts in the side walls. From these culverts transverse connections are made at intervals to ports opening into the lock chambers at the bottom of the walls. The filling and emptying culverts vary in size, for with the locks of high lift a large volume of water must be admitted or discharged quickly to economize on the time of boats locking through. The culvert dimensions are 5 x 7 ft. for locks of 12-ft. lifts or less, 6 x 8 ft. for lifts between 12 and 23 ft., and 7 x 9 ft. when the lift exceeds 23 ft. Connected with the 5 x 7-ft. culverts are 16 ports, 8 on either side, while this number is increased to 22 for the 6 x 8-ft. culverts and to 28 for the 7 x 9-ft. size. The ports have been made both by embedding cast-iron pipes in the concrete and by leaving rectangular openings in the walls, the latter being the more recent method. The area of opening in either case is about 7½ sq. ft. In some of the locks there is another culvert through one of the side walls, a feature of the hydroelectric stations for operating and lighting the locks.

The gates of the Barge Canal locks are, for the most part, of the mitering-girder type, carrying the principal load as beams. They are built of steel, with single skin-plates, but have white-oak quoin and toe posts. The quoin posts swing on cast-steel pivots set in the concrete and are held at the top by an adjustable anchorage. The bearing is against cast-iron quoin plates bolted into the side walls.

Electrical power is used exclusively for all the mechanical operations at the locks, although each gate and valve is provided with hand-operating control to be used in the event of a breakdown of the power system. The lock gates are actuated by steel spars, carrying racks which mesh with gear trains from motors. Heavy coil springs are provided to absorb shocks in opening and closing. At the beginning and end of its travel the movement of each gate is slower than in the middle of the arc, this speed variation being provided for by resistance thrown in and cut out automatically in the motor circuit. Limit switches automatically stop the travel of the gate at the open and closed positions by shutting off the electric power.



LOCK GATE MECHANISM IS ALL OPERATED BY ELECTRIC POWER

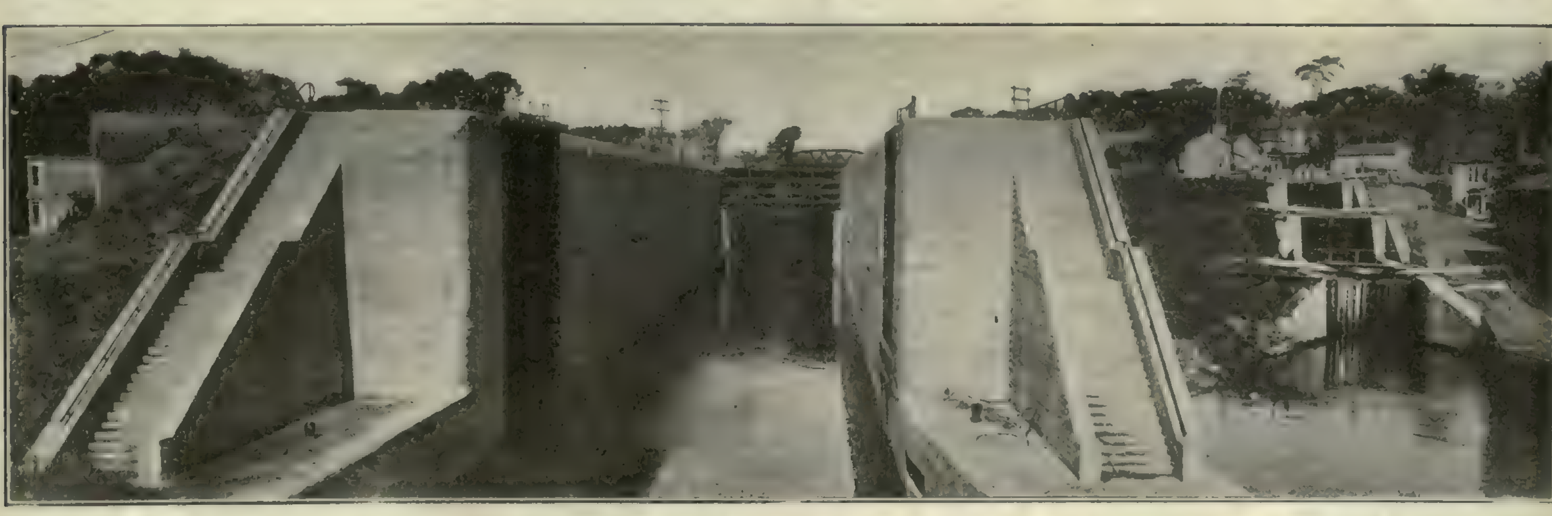
The gates, as well as the lock valves, are controlled from operating stands in duplicate, one on either side of the lock at both ends, making four in all. Thus the mechanism may be operated from whichever side of the lock proves to be the most convenient. Each operating stand is equipped with a master switch for the separate control of each of the two gate motors, valve motors and buffer beam motors. There is also a device for simultaneously locking all switches by a single key. A safety coupling, designed to release or break down whenever the load transmitted to the machinery exceeds a prescribed limit, is provided on one of the shafts. It consists essentially of two flanges connected by shear pins of Tobin bronze, the diameter of the shank on each pin being only ¼ in. Any overload, such as an attempt to open the lower gates with the lock filled, will immediately break these pins without damaging the rest of the operating equipment. In the event of failure of power or damage to the motor it is possible to disconnect the motor and operate the gates by hand by means of sweeps, which have been so designed that only two men are required for their operation.

Signal Lights

For the benefit of both operators and boatmen signal lights are installed to indicate the position of the gates. A green light flashes when the gate is entirely open, while a red signal is displayed when the gates are in any other position. These signal lamps are visible from either end of the lock in daytime or at night.

The operation of the culvert valves is similar to that of the lock gates, and is done from the same operating stand. The valves regulating the flow of water in these culverts are suspended on two chains which pass over chain wheels near the top of the valve wells to cast-iron counterweights. The chain wheels are mounted on a shaft rotated by a motor operating through a train of gears designed to raise or lower the valves at a speed of about 6 ft. per minute. The motors of the 5 x 7-ft. and the 6 x 8-ft. valves are rated at 3 hp., while those operating the 7 x 9-ft. valves are rated at 7 hp.

The scheme of master switches that is used for the lock gates is employed also for the valves. The signal lights, however, give more detailed information. There is a set of four lamps for each valve, three white and one blue. When all lights are out the



OLD ABANDONED CANAL STRUCTURES, AT RIGHT, DWARFED BY ONE OF THE WATERFORD LOCKS NEAR THE EASTERN END OF THE BARGE CANAL SYSTEM

valve is completely closed. One white light signifies that the valve is one-third open; two white lights, two-thirds open, and three white lights, full open. A blue light indicates that the valve is closed. It will be noted that the colors of the valve lights, white and blue, are different from those for the gates, red and green, so that there can be no confusion regarding the signals.

Lock 2, the lower of the five locks at Waterford, has a lift of $34\frac{1}{2}$ ft., and its filling and emptying requires the handling of about 3,900,000 gal. of water. A demonstration of the operation of this lock showed that the gates were closed in 35 seconds. The filling of the lock required about 6 minutes and emptying about 5 minutes.

Electric Capstans

Electric capstans, one at each end of each lock, are provided to control the movement of boats along the approach wall and to tow them into and out of the lock chamber. A 20-hp. motor operates each capstan at a speed of about 60 ft. per minute with a pull of 8000 lb. The operation of these capstans is controlled by foot switches placed flush with the top of the lock walls. The capstan motors are of the mill type and of specially rugged design. They are placed in watertight cast-iron housings for protection against intermittent wetting by surges in the lock or by other causes. The other motors, for operating the gates and valves, also are of the mill type, and their armature and field windings have been designed to be fireproof and waterproof.

As a measure of protection for the lock gates buffer beams are provided. Prior to any locking operation they are swung out across the channel and maintain this position until everything is in readiness for the boat to proceed. The buffer beams can be used as an emergency device if it should ever be necessary to make repairs to the lock gate. Below them, in the bottom of the channel, are sills into which needles may be lowered and supported at the top by the buffer beams, thus forming a cofferdam.

Hydroelectric Plants

At the Waterford locks operating power employed at each of the five lifts is supplied from a central plant at the Crescent dam, about 3 miles distant from the lower lock. At the other locks of the Barge Canal system, however, small individual hydroelectric plants are installed. They are operated by water from the canal and are equipped with duplicate vertical shaft turbines, which, in all but a few cases, are directly connected to 50-kw. vertical shaft generators supplying current at 250 volts. Where power is furnished to another lock not more than 2 miles distant booster sets are installed in the power station. At some of the movable dams, however, where there is probability of floods during certain seasons the hydroelectric stations are replaced by gasoline-electric outfits, with duplicate generators placed well above flood level. These gasoline-electric generators supply direct current at 250 volts, each unit being designed to furnish power for operating the locks and the adjacent movable dams and also for lighting purposes.

Prize for Best Lock

The operating force on the Barge Canal has been organized on the basis of three 8-hour shifts daily. At each lock there are one operator and one helper on each shift. Groups of locks are under the general supervision of lock superintendents, who live in the vicinity and can be reached quickly in an emergency.

For the purpose of increasing efficiency and creating a friendly rivalry among the operating employees Major-General W. W. Wotherspoon, state superintendent of public works, who is in charge of the operation of the Barge Canal, offers each year a prize to the crew of the lock which attains the highest standard both as to the condition of the operating machinery and the appearance of the structure and grounds. The prize consists of a small increase of salary to each man on the lock, as well as the distinction of erecting and maintaining a sign proclaiming it as the "Prize Lock." The plan, General Wotherspoon reports, has proved most successful. The men entered the competition with much enthusiasm. Not only were the mechanical parts carefully kept in perfect condition, but the rugged banks of the canal left by the contractors were leveled off and beautified. Unsightly plots of land were sodded and shrubs and flowers planted. The débris incidental to a long period of contract operations soon disappeared and at all the new locks a new order of things was soon manifest.

The Operating Force

That the operation of the Barge Canal system is a matter of men as well as machinery is exemplified by a recent statement of General Wotherspoon's, in which he points out that efficient operation is possible only if the men have some guarantee of tenure of office as a reward for efficiency and experience. Early last year the State Civil Service Commission was consulted, with the result that examinations were devised for the positions to be filled on the new locks, and the holding of these examinations was widely advertised. The results obtained were most satisfactory to the Barge Canal officials. The new locks are now manned by young men, skilled in various mechanical trades, and in addition to the safe and proper operation of the lock machinery they are able to make repairs needed without additional cost to the state. General Wotherspoon believes that at the present time the lock organization, man for man, is equal in ability to any similar force in the employ of a great business enterprise.

Although the operating machinery, like all similar apparatus, is of a somewhat complicated nature and is subject to disarrangement, not a single detention to navigation occurred last year at any of the locks. On the contrary, the time of passage through the new structures proved to be shorter than that necessary for passage through the old locks, although the present structures are several times larger.

Movable Dams

At certain places in existing streams used for the Barge Canal channel it is necessary to maintain water levels by means of dams of a type which can be moved out of the path of the stream during floods. If stationary dams were used at these sites the flood waters would be backed up, causing them to overflow the stream banks and inundate the surrounding territory. A representative dam of the movable type is the one at Scotia, near Schenectady. This structure has abutments, piers and a steel superstructure like an ordinary bridge, but from the downstream side hang steel frames resting against shoes in concrete sills that stretch across the stream between abutments and piers. The upright frames are 15 ft. apart and upon them run Boule gates, which are 30 ft. wide and are placed in two tiers.

These gates may be raised by chains from electric winches running on tracks on the bridge floor. After the gates are up the chain winches are employed to swing the steel frames upward to a horizontal position, such action being possible because of the hinge-like joint made by the use of a pin connection. Thus the river may be entirely freed of any obstruction in the form of a dam when a flood threatens. The electric winches receive power over a trolley wire extending to the gasoline-electric stations near the lock. It is the general practice to raise all the movable dams when the canal is put out of operation in the fall and at such other times as conditions warrant.

If there should be a break in the canal at a lock or at other points great damage would be done by the rush of water unless meas-

THE DELTA DAM IMPOUNDS WATER USED AS A FEEDER SUPPLY TO MAINTAIN CANAL LEVELS

ures were adopted to prevent such a contingency. At various points along the channel are located guard gates. These are massive steel barriers hung from a bridge structure spanning the channel and may be raised or lowered electrically to prevent any sudden emptying of the canal. Just above the Waterford lock, for example, are two guard gates about 1370 ft. apart. At present the upper guard gate is operated for the passage of each boat. The normal position of the lower gate is up, but it is lowered several times a week to insure its perfect operation. The upper gate is never opened unless both gates of the first lock below are closed. This operation obviously creates a protective barrier behind the boat which has just passed it, so that if the barge should become unmanageable and crash into the lock gate the only water lost from the canal would be that below the guard gate.

WATER LEVELS IN CANAL

The maintenance of the proper water level in the Barge Canal on the Erie section is simplified somewhat by the fact that the route utilizes existing watercourses to a large extent, and the natural flow of these streams, supplemented by large storage reservoirs built therefor, is sufficient for maintaining the requisite depth and for performing lockages and incidental operations. Many of the old canal reservoirs and feeders are retained for the new channel.

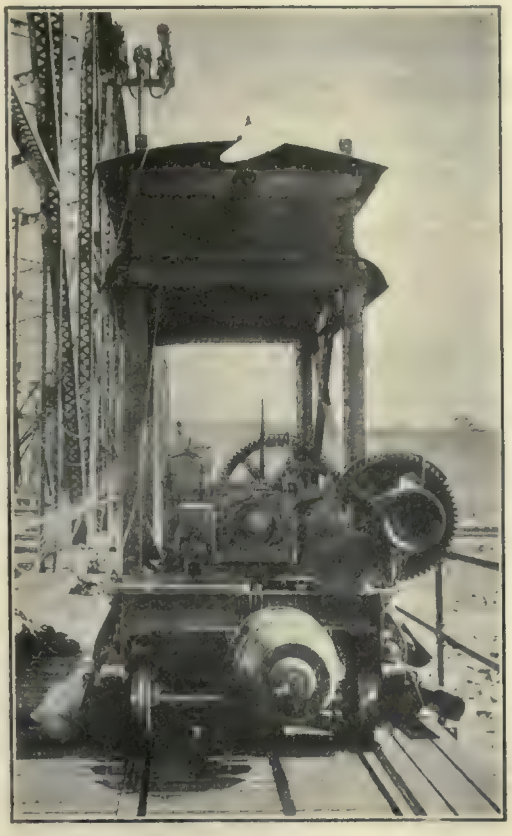
The summit level at Rome is the critical point in the canal water supply. From this point there is a continuous descent easterly to the Hudson River and westerly to the Oneida and Seneca rivers at Three River Point. West of this locality the canal ascends continuously to the Niagara River, which serves as an adequate feeder for the western section of the canal.

The Rome summit required the construction of two large reservoirs, the Delta on the Mohawk River and the Hinckley on East Canada Creek. The Delta dam, 1100 ft. long and 100 ft. in maximum height above rock, is capable of storing two and three-quarter billion cubic feet of water from a watershed of 137 square miles. The Hinckley dam, an earth structure 3700 ft. long (earth 3200 ft., masonry 500 ft.) with a maximum height of masonry of 82 ft., will store almost three and one-half billion cubic feet from a watershed of 372 square miles. This structure was completed and put into operation last fall.

As to the type of boat which the future will develop for the New York Barge Canal traffic last year's annual report of the state superintendent of public works makes this statement:

"Considering only the matter of passage of boats through the canal and without going into the subject of economical handling it would seem that the largest boat which should be used in the immediate future should not exceed 150 ft. in length and 20 to 22 ft. in width. With these dimensions a fleet of four such craft could be passed through a lock at one time, and one of the boats being equipped with power a speedy passage through the waterway would be assured. The length referred to is probably out of proportion to the proposed width, but such dimensions are given as the maximum which should be planned for at present. With such lengths no difficulty would be experienced in negotiating the various bends in the excavated prism."

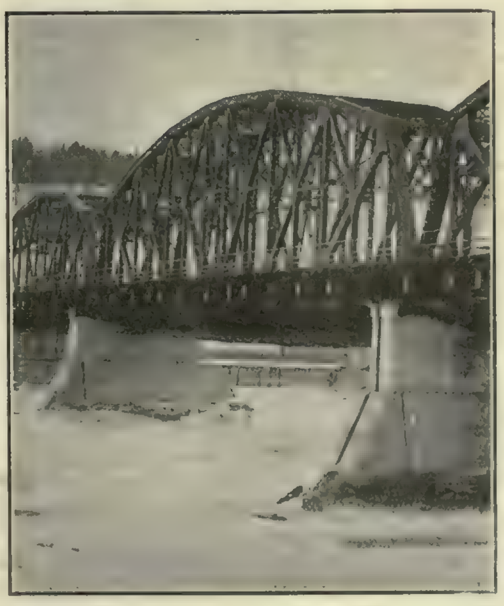
State Engineer Williams, however, believes that a considerable traffic will develop on boats built to navigate the Great Lakes as well as the canals, in which case their dimensions would be 300 ft. long by 44 ft. wide.



ELECTRIC WINCH WHICH RAISES AND LOWERS GATES OF MOVABLE DAMS

WILL SAVE FOUR DAYS

The completion of the improved canal will reduce to a considerable extent the time of passage of boats from the lakes to tidewater, and will minimize the points at which breaks, resulting in interruption to navigation, may occur. On the unimproved canal the time of passage from Lake Erie to the Hudson River of a boat propelled by animal power was estimated at ten days, and for a boat using its own motive power eight days. The average rate of speed attained by such boats ranges from 2 to 4 miles per hour. When the improvement project has been completed a greater speed may be permitted on stretches where the present canal prism has been enlarged, while on the rivers and lakes utilized as part of the route the speed to be attained will be limited only by the extent of the motive power. Since the latter condition will prevail on more than half the new route it is predicted that the time of a single trip may be reduced at least four days.



WICKETS OF MOVABLE DAMS ARE RAISED DURING WINTER

CANAL TRAFFIC

The improved New York Barge Canal system is designed for a normal seasonal traffic of 10,000,000 tons of freight. Last year's traffic over the old routes amountd to 1,858,114 tons, as compared with 2,080,850 tons in 1914. The value of shipments in 1915, however, exceeded those of 1914 by $2,332,679. With the completion of all the improvement work and the opening of the new Barge Canal throughout its entire length a marked increase in freight shipments is anticipated.

One of the most pressing needs at present, according to State Engineer Williams, is the creation of a traffic bureau to secure business for the completed canal. It is felt that the ways and means by which the Barge Canal system may be of service to the commerce of a large section of this country are but little known, despite the fact that New York State has spent millions of dollars on this work which will soon be available for use throughout its entire improved length. It would be the duty of such a bureau as Mr. Williams has in mind to disseminate information concerning the canal and go after the business of shippers of freight in the same way as do all of the railroad corporations.

ENGINEERING PERSONNEL

The construction of the New York State Barge Canal has been under the supervision of Frank M. Williams, state engineer and surveyor. William B. Landreth is deputy state engineer and D. B. LaDu is special deputy state engineer. On the three divisions of the New York State Barge Canal—eastern, middle and western—the division engineers in charge are respectively George D. Williams, Guy Moulton and F. P. Williams.

The operation of the Barge Canal system is under the direction of Major-General W. W. Wotherspoon, state superintendent of public works.

Operating Costs at Los Angeles Asphalt Plant

At the end of the first year of operation, the municipal asphalt plant at Los Angeles has saved the city $29,242, according to a report recently compiled by the city engineer. During the period between April 17, 1915, and March 30, 1916, the total output of the plant was 278,860 cu. ft. of asphalt, and for this period the books show the following figures:

Contractors' bid on 278,860 cu. ft. at 25c.		$69,715.00
Operative cost of plant	$35,606.63	
Maintenance of plant	1,992.93	
Interest, administration and depreciation	2,872.46	
Total cost		40,472.02
		$29,242.98
Plant cost to March 30, 1916	$7,773.89	
Plant equipment to March 30, 1916	420.87	8,194.76
Less depreciation charged in cost		566.99
Cost of plant less depreciation		$7,627.77
City paid for asphalt prior to operation of plant, per cu. ft.	$0.25	
Average unit cost on asphalt output	.1451	
Net profit per cu. ft. on output		$0.1049

Will Electric Welding Supplant Riveting in Fabricating Structural Steel?

Rapid Progress in Practical Application of the Spot Weld Suggests Possible Economy for Joints of Steel Frames

By G. C. HINCKLEY

Resident Engineer, Keokuk and Hamilton Bridge, Keokuk, Iowa

A DECADE ago the art of welding iron by means of the oxygen-acetylene flame was unknown. Electric welding is of still more recent origin. It is only within the past few years that these methods have emerged from the experimental to their present state of demonstrated practicability and rapidly broadening application in the metal trades. Welding concerns, confining their operations chiefly to repair work, have been successfully established in many of our larger cities. Lap-welded steel pipe and welded boilers and tanks have taken their places on our market in competition with the riveted articles.

Electric Welding Commercial Success

Electric welding has been demonstrated a commercial success in the manufacture of sheet-metal goods, automobile frames, steel window sash, frames for concrete reinforcement, etc. Its progress is marked particularly by a rapid and pronounced tendency toward the welding of increasingly heavy sections and the perfection of larger welding units, as recently evidenced by the introduction and successful operation of an electric spot welder with a capacity equal to a butt weld of 7 sq. in. sectional area for the field-welding of connection plates across the ends of street-railway rails. There is nothing to indicate that the ultimate limit of capacity has been approximated in this machine, the probability being rather that such a limit will be controlled only by the amount of electricity economically available in any instance.

The remarkable progress in the practical application of these new methods has so far outstripped their literature and published data that the subject is marked by a dearth of definite information, resulting in a general lack of knowledge concerning the methods themselves and of appreciation of their possibilities. Lacking such detailed information, and in the absence of specific experiments and tests, it is of course impossible accurately to predict the future of these methods, especially in their possible application to new fields of industry. Nevertheless, when we consider in a broad sense their present status of efficiency and rapid growth, together with the pronounced modern tendency toward the electrification of shop processes and the universal adoption of labor-saving devices, it is logical to assume that, unless unforeseen obstacles are encountered, the electric-welding process promises within the next few years to supplant 90 per cent of the riveting in all our fabricated iron and steel products. In the shop fabrication of structural steel such an innovation would be nothing short of revolutionary in its character and attended by enormous advantages, some of the more important of which it is now proposed to point out and discuss in a general way.

A Typical Connection

In the first place, let us assume that the tendency will be so to design welded connections that the welds themselves will be in shear whenever possible, much as is the current practice in riveted joints. Consider a typical connection, a girder web splice, for instance, consisting of the usual pair of splice-plates with double rows of rivets, the splice being subject to the usual tension, compression and shearing stress, and then conceive of the rivets being replaced by a sufficient number of spot welds between the splice plates and the web. The great advantage of the welded splice, both in efficiency and economy, is immediately apparent, inasmuch as it involves no reduction of sectional area in the web or splice plates for rivet holes. It has been repeatedly demonstrated that the riveted splice cannot exceed about 80 per cent efficiency; the welded connection, on the contrary, may be made 100 per cent efficient, or more, depending on the total area of the spot welds, which may be grouped as closely as desired, or even joined together to produce a single large welded area. While these advantages pertain particularly to tension joints, they are nevertheless applicable in a degree to all points where rivets are now used.

It will thus be seen that the substitution of welding for riveting would result in an ultimate saving of metal in each fabricated member, roughly measured by the difference between the present so-called "gross" and "net" sections, together with a considerable saving in the weight of details, while the opportunity for a better distribution of metal in the design of sections would doubtless result in additional economy. Eventually certain modifications in the rolled shapes themselves could be expected to result in very important saving of metal, inasmuch as the elimination of rivets would permit a more efficient distribution of metal in a great many shapes, in whose design the effective section has heretofore been subjected to the necessity for providing proper riveting facilities.

Comparing Costs

Anything approaching an accurate comparison of shop costs between welding and riveting is of course impracticable for want of the proper welding data. Yet it is evident that, in the first place, welding would do away with the necessity for punching and reaming rivet holes, with the attendant rehandling of material in the shop, and would doubtless also eliminate fully 75 per cent of the template-making and laying-out work. The cost of manufacturing, heating and driving rivets would be replaced by that of operating the welding machine and also a sandblast for cleaning the surfaces to be welded. In view of these facts it must be conceded that, if the introduction of the welding process should prove feasible, it would result in an immense saving of shop labor, and that the elimination of the punching, reaming and laying-out operations would leave a wide margin to cover any possible increased cost of the welding operation itself over that of driving rivets. In the light of results now obtaining in the welding of smaller work, there is reason for the expectation that the total shop cost of fabrication by welding could be brought considerably below that of the present methods.

Comparing, from a mechanical standpoint, the welded and riveted types of connection, it is at once obvious that the advantage lies with the weld, in which the stress coming upon the joint is immediately and simultaneously assumed by each spot weld, the amounts carried by the individual spots depending of course on their relative areas and positions in the group; whereas in the riveted connection the application of stress acts first to overcome friction between the plates consequent upon the initial tension in the rivets, after which the rivets take stress one by one, depending, among other things, on their varying fits in the holes. Under such action, and when subject to any considerable vibration or stress reversal, a riveted joint will loosen more or less in time, resulting in a gradual loss of efficiency and an increasing tendency toward crystallization and deterioration from rust and wear.

It will be contended that the nature of a welded connection involves lack of uniformity in the quality and strength of the welds which must be met by an increased factor of safety. However, the validity of such an objection is subject to question. Inasmuch as the welding process would seem to involve no more uncertainty of uniformity than that of making and rolling the steel itself, if welding were subjected to the same systematic inspection and testing as now obtains in the steel mills, the results would be dependable in a similar degree. There is no apparent reason why the electric-welding process may not be conducted with absolutely uniform results, for once the necessary pressure, amount of current and time of application have been determined for any given thickness of plates these may readily be maintained constant throughout repeated operations.

Field Connections—Tests Necessary

While there is nothing in the process to prevent the continued use of the riveted field connections, the same prospect of successful welding obtains in the field as in shop work, the contractor's air-compressor plant and riveters being supplanted by a generator plant (where electric power is not at hand) and a portable electric welder, which for ordinary work should be no more cumbersome than the "bull machine" now employed for field-riveting on larger jobs. It may prove advantageous in certain field connections to employ some modification of the oxyacetylene process.

Comparative tests of welded and riveted connections on identical members are needed to verify the foregoing contentions regarding their relative efficiencies. Investigations should be conducted to determine whether the heating due to the welding process will have any injurious effect upon the steel, with a view particularly toward ascertaining the maximum thickness of metal practicable to be welded under existing conditions and the best method of increasing this thickness. A series of tests using very thin filler plates of pure iron or other substance between the plates to be welded might be productive of interesting and valuable results. Experimental work to furnish approximate data on the costs of welding structural steel is of course imperative. It is suggested that much of the experimental work could be satisfactorily accomplished by universities and technical institutes and by some of the larger structural shops.

Men Cheaper Than Machines on Trunk-Line Railway Construction in China

Bridge Caissons Sunk Without Derricks—Chinese Engineers and Contractors Show Ability with Only One Caucasian to Each Fifteen Miles of Line

By E. PARK
Formerly Assistant Engineer, Chinese Government Railways

WHEN earth embankment can be placed by man power at a cost of 3½ cents per yard it is evident that there is little use for excavating machinery in Chinese railway construction, even if that machinery cost no more in China than it does at the point of manufacture. Accordingly, in building the Canton-Hankau Railway, which in point of population served will be one of the most important trunk lines in the world, mechanical equipment is used only where absolutely necessary, as on bridge work. On one of the larger bridges, which was included in the section built under the direction of the writer, four caisson piers were sunk with air locks which contained their own hoisting engines, and the air compressors and boilers required for this work were the only plant used on the entire section.

CONCESSION ONCE HELD BY AMERICANS

This road, which will form the southern half of a line connecting Canton and Hongkong with Peking, and, through the Trans-Siberian Railway, with Europe, traverses a densely populated and fertile section of South Central China, reputed to be rich in minerals. Although its construction was first proposed by Sir McDonald Stevenson, and has occupied a prominent position in every subsequent scheme for a Chinese railway system, the road is yet far from complete. From 1898 to 1905 a concession for building it was held by an American concern, which, however, scarcely made a start on the actual construction. The northern section of this line, on which the writer was employed, was put under construction in 1912 for the Chinese government by British interests for a distance of 600 miles south from the Yangtze River through the provinces of Hupeh and Hunan. The latter province alone has, under conservative estimate, a population of 22,000,000, giving an average of more than 200 persons to the square mile. The entire outside commerce of this province is now carried on the Yangtze River, a stream more difficult to navigate than the Ohio River, which it considerably exceeds both in size and in extreme range between high and low water.

SMALL MUCK LOCK SAVES AIR

WORK INTERRUPTED BY EUROPEAN WAR

Following an energetic start on the construction of these 600 miles, the work was interrupted for almost two years, or until the spring of 1914, by the Chinese revolution. Work was then resumed, but financial difficulties consequent on the outbreak of the European war made it necessary to confine construction to the 300-mile stretch from Hankau to Changsha. This part of the line is expected to be in operation in 1917, and tracklaying at both ends and at Yochow has been started.

The southern end of the railroad from Canton north for a distance of 200 miles has been completed and put in operation by the Chinese government itself. The entire work is in charge of an organization headed by a managing director, who is a Chinese. On the portion of the line being constructed by the British the engineering chief, the auditor, the chief accountant and all the engineers in superior charge are foreigners. A Caucasian engineer is in charge of each subdivision of about 15 miles, and is the only white man on his section. His Chinese assistants, some of whom are highly educated, are for the most part very valuable and reliable. Overseers, foremen, timekeepers and the like are supposed to speak some English, and many of them have a good command of the language acquired at mission schools.

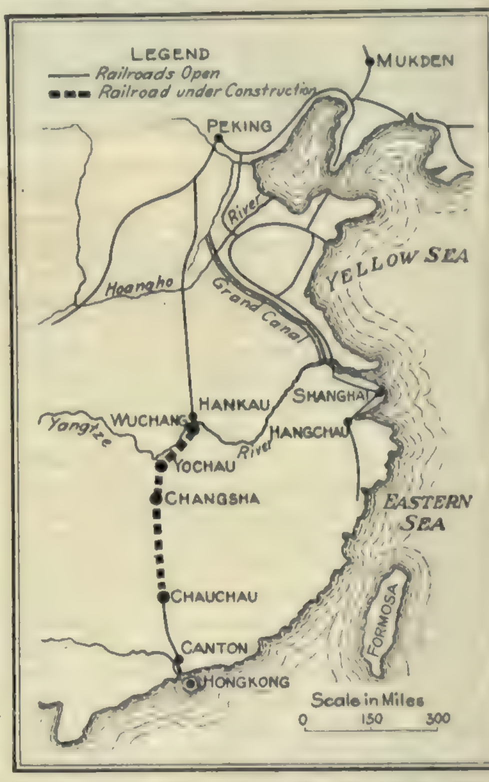
CEMENT AND RAILS MANUFACTURED IN CHINA

Two important construction materials do not have to be imported. The rails used are rolled at the Hanyang Iron Works near Hankau. The cement required is supplied partly by the mill at Tangshan and partly by the Hupeh Cement Works on the Yangtze River. The ties used are of Japanese oak, but Oregon fir has been employed very largely for structural timber. An inferior fir cut in China, where very little standing timber remains, is also used for construction purposes.

Most of the grading is done by contract for a base price of about 27 cents (Mexican money) per 100 cu. ft. for earth transported from borrow pit to fill until the height of fill exceeds 10 ft. This is equivalent to about 3½ cents per cubic yard in American money. The earth is carried in small baskets by coolies for hauls averaging 1000 ft. Payments are based on measurement in the borrow pit or in the fill, 15 per cent for shrinkage being deducted in the latter case. For ordinary grading about 500 men per mile are employed. They live in mat sheds that are moved along as the work progresses. Living on rice and vegetables, the coolies can feed themselves well on their pay of 12 to 15 cents gold per day.

HSIEN-NING BRIDGE

Fifty miles below Hankau the line crosses a tributary of the Yangtze River at Hsien-ning on a bridge for which four pneumatic caisson piers were required. The work was carried out in winter, as the surrounding territory, including most of the town itself, is flooded in summertime. The two abutments were built on 30-ft. piles of Chinese fir driven down till their tops reached low-water level. A 1-ton hammer operated by hand labor with a winch was used for driving. Two of the caissons were started in pits dug in dry land, and the other two on islands made by hand filling in the river. The working chambers, made of steel plate with semicircular ends and straight sides, were 34 x 13 ft. over all, with an inside height of 7 ft. and a total height from the cutting edge to the top of the outside shell of 8 ft. Each caisson had two air shafts 3 ft. in diameter, the shafting used being in 8-ft. lengths. The air locks, of a type common in Europe but unknown in the United States, have three compartments with a hoisting engine built into them. The drum is located at the top of the center compartment, the shaft extends through a stuffing box to the outside and the steam cylinder is fastened to the side of the lock. The center compartment over the shaft, which is always "in," is flanked on each side by a compartment for locking in and out, one used for muck and the other by the men. The main air line is direct-connected to the side of the lock. Muck is hoisted in buckets and dumped into a funnel riveted to the bottom of the muck compartment, which is a small lock itself, and from which the muck drops to a platform or into baskets. Coolie transportation was so cheap that the material excavated from these caissons was carried back and put in the approach fills.



DOTTED LINE INDICATES RAILWAY BEING BUILT BY BRITISH

CONCRETING WORKING CHAMBER THROUGH SMALL TOP LOCKS—TRIPODS HANDLE MAIN LOCKS

Shafting was put on by hand during sinking, the lock being suspended during the change by heavy tackle from a tripod of 12 x 12-in. timbers, the legs of which rested on the ground clear of the caisson. One of these tripods was erected over each lock at the start of sinking, and remained in place until the locks were finally removed.

An air plant consisting of four boilers and two single-stage straight line compressors of British manufacture was installed on each side of the river, so that two piers could be sunk at the same time. In addition to this plant, a small boiler was set up at each caisson for the lock hoist.

Sinking was carried on day and night with a gang of sixteen men in each caisson. Ten men were required in the working chamber and three in each air lock, besides the hoisting engineers, who worked on top of the locks. The piers were sunk through gravel and clay to boulder clay, about 40 ft. below water level. One of the piers rests on limestone. The concrete was carried up 8 ft. at a time, and only one set of forms was used for each pier. Sinking was suspended until each lift of concrete set, but was usually resumed before the forms were removed. These forms were made of 3 x 6-in. plank 8 ft. long, which were held together at top and bottom by an outside band of steel rail, flange turned in against the plank and secured to them with ordinary track spikes. The curved ends were made by cold-bending two lengths of rail to a quarter circle and fastening them together and to the straight rails at each side with ordinary fish plates. The rail arrangement is not shown in the photograph, which was taken early in the work, but proved much more satisfactory than the first method tried of fastening the plank with U-bolts to flat straps. The upper and lower lines of rail were spaced and held together by ¾-in. bolts incased in bamboo.

All the concrete was, of course, mixed by hand. It was lowered to place inside the form in baskets, no dumping being permitted. The working chambers were concreted through small locks attached to a top door in the center compartment, thus permitting the concrete to be locked through in a short time and dropped clear to the bottom of the caisson. One of these working chambers which the Chinese desired to finish to avoid working overtime on a holiday was concreted in this way in 12 hours.

CHEAPER IN CHINA TO CART DIRT IN BASKETS THAN TO USE MODERN EXCAVATING MACHINERY

CHINESE CONTRACTOR DOES SINKING

The actual sinking was done by a Chinese contractor, Chang-Fung Tsai. For $15, Mexican money, per vertical foot he supplied labor for running the air plants, excavating and hoisting the muck. The erection of the working chambers, changing of the shafting, concreting and disposing of the muck were done by day labor. The railroad supplied all stores, such as coal, oil, kerosene, candles and even cowhide for making shoes for the workmen.

The engineer in chief on the construction work in charge of British interests on this railroad was A. G. Cox. The engineer of the first district, including Hsien-ning, was A. G. Roberts, while the writer was in charge of the sixth subdivision, including the bridge work described, as assistant engineer.

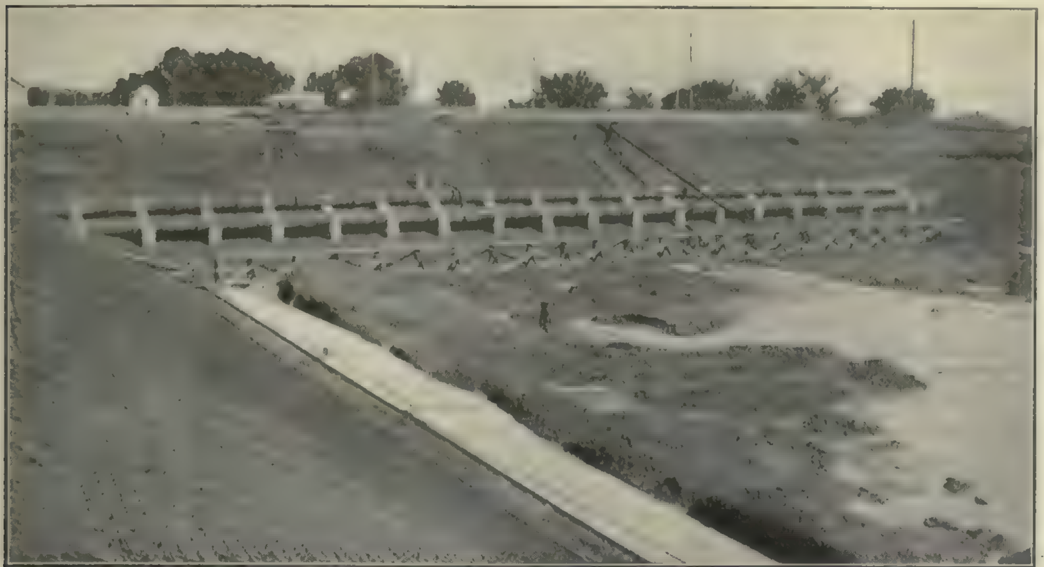
Auto Truck Helps Double Oiled-Street Mileage

87 Miles of Roadway in St. Louis Have Been Oiled During the Past Summer at a Cost of $313 per Mile

EIGHTY-SEVEN MILES of roadway in St. Louis have been oiled the past summer at a cost of $313 per mile. This is double last year's record, and, according to a statement made by J. L. Laxton, engineer of bituminous roadways, in a recent paper presented to the St. Louis Engineers' Club, is due to the addition of a 1000-gal. autotruck oiler to the former equipment of eight 500-gal. converted sprinkling wagons and one combination tank and boiler for heating. The cost is considered low, however, for quite a number of miles were added at the close of the season that received only one or two applications. For extra-wide streets, like the Kingshighway, the cost is $450 per mile.

The method of oiling that has been found to give good results is to apply first ⅛ gal. of light oil at a temperature of 125 deg. Fahr. It penetrates quickly owing to its volatile nature. Several days later, the time depending on the climatic conditions and rapidity of penetration, ¼ gal. of heavy oil is applied under a pressure of 20 lb. The light oil thoroughly impregnates all dust particles on the roadway, rendering them too heavy for flight. It also acts as a lubricant for the heavy oil, thus enabling it to penetrate quickly, and obviating the necessity of covering with sand or other material. The roadway is waterproof, and there is no criticism from citizens such as comes from the usual uncovered oil road.

Extreme care must be exercised. Too much oil, particularly heavy oil, acts as a lubricant, and assists the creeping of the macadam under the action of traffic. Ordinarily, three applications of the heavy oil at the proper intervals will maintain the roadway in good condition during a season.



FAR SLOPE POURED FROM CHUTES ON TRUSSED RUNWAY OVER TWO 36-INCH PIPE LINES
Material on floor has been trimmed from slopes ready for removal by hydraulic method.

Water Basin for City of Omaha Constructed by Day Labor, Using New Special Devices

Formed Ties for Steel Reinforcement Effect Economy—Daily Records of Concrete Materials Are Basis for Proportioning

By HOMER V. KNOUSE
Construction Engineer, Metropolitan Water District, Omaha, Neb.

SINCE the purchase in 1912 of the plant of the Omaha Water Company by the city of Omaha practically all concrete work has been done by day labor. The act of the Nebraska legislature which created the Metropolitan Water District of Omaha was so drawn as to give the management of the plant to a bipartisan board of directors, which was to select as general manager a "civil and hydraulic engineer." This act provided for a plan of organization that definitely removed the water department from local politics and made possible a policy of operation along the most markedly advanced economic lines. A closely co-ordinated organization under the direct and unhampered supervision of the general manager, a policy of competitive purchasing of supplies and construction material and the prompt payment of bills, and the employment of all classes of labor on an efficiency basis have made possible the operation of the plant and the construction of more than $1,000,000 worth of improvements.

OMAHA'S WATER SUPPLY

The city of Omaha obtains its water supply from the Missouri River, the intakes, settling basins and pumping station being located at the adjoining town of Florence, about 6 miles upstream from the business district of Omaha. The turbidity of this stream varies from 30 parts per 1,000,000 during the winter months to a maximum of 12,000 parts per 1,000,000 during the early summer. The clarifying treatment consists of coagulation and sedimentation, and except during a short period in the early part of the spring months at the time of the break up of the ice in the river it has been possible to obtain a satisfactory quality of water. During this period, however, it was not always possible to keep the water at the high standard desired, and at other times the amount of coagulant necessary was so great as to make the cost of treatment excessive.

To overcome these two undesirable conditions Basin 6 was proposed, which, together with additions to and changes in the supply lines and weirs, would provide at all times a satisfactory quality of water at a greatly reduced cost. The basin was filled in November, 1915, and placed in operation in the spring of 1916 for use during the breaking up of the river, and results to date make it appear beyond a doubt that it is fully meeting the requirements imposed upon it.

EXCAVATION AND EMBANKMENT

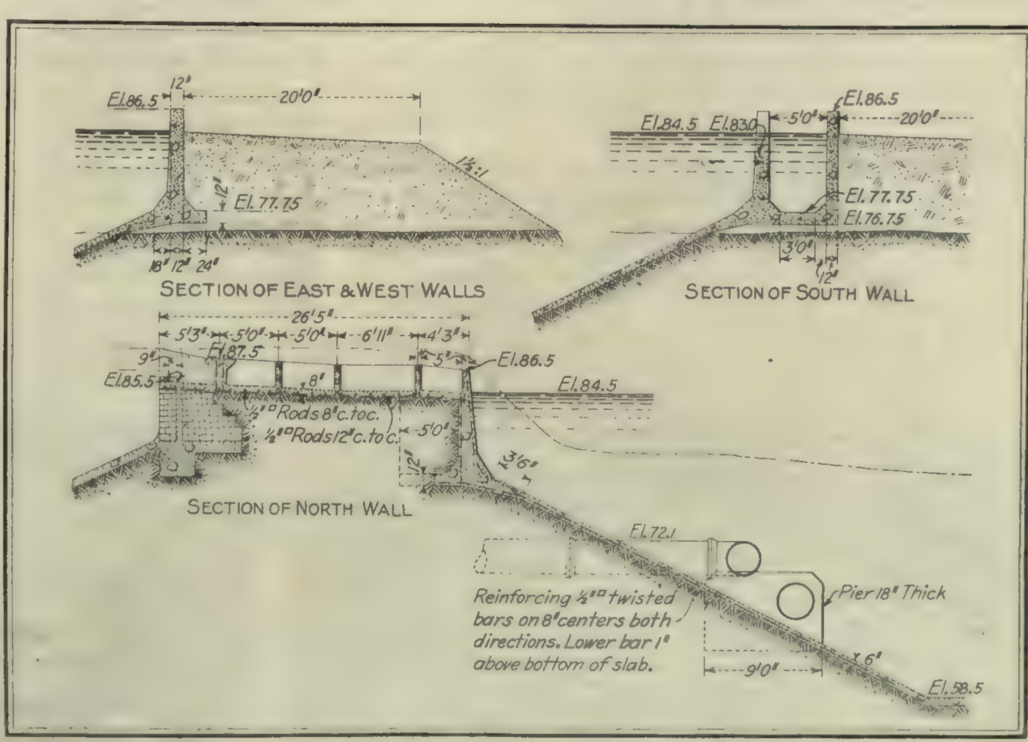
The basin has a capacity of 15,000,000 gal. and is constructed partly in excavation and partly in embankment. The material was removed by elevating graders, dump wagons and wheeled scrapers, and deposited on the embankment, spread in 6-in. layers, thoroughly wetted, and compacted with 10-ton road rollers. The middle third of the embankment was kept at a lower elevation than the sides, and special precautions were taken on the inner edge to insure a high degree of density. The earthwork was completed in the fall of 1914, with the exception of about 1 ft. of excess material on the inner slope, which was left to prevent erosion below the desired finished grade.

The slopes were trimmed to grade in the spring of 1915, and with the aid of the hydraulic or sluicing method the material was removed cheaply. Prior to the construction of the embankment, sewers for emptying and washing the basin had been constructed, and through these the material trimmed from the bottom was washed out with the aid of a hose stream. Following the concreting of the floor, the slopes were trimmed and the material placed on the finished floor and removed in a similar manner after the completion of the basin.

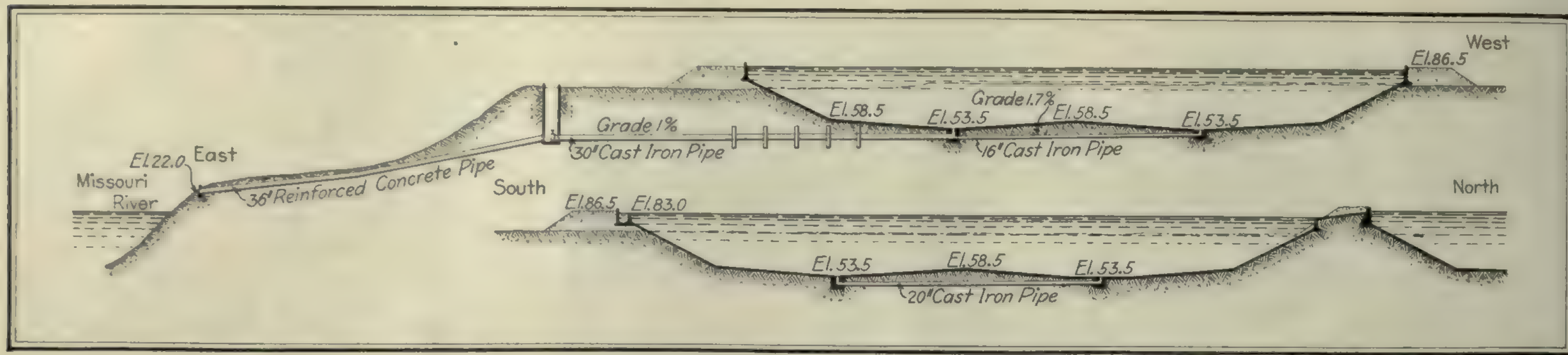
LINING OF FLOOR AND SLOPES

The slopes were trimmed by cutting narrow trenches at intervals of about 12 ft. to the finished lines of the earthwork and removing the larger part of the material between by means of a fresno or wheeled scraper attached to the hauling line of a steam hoist. The line was reeved from the hoist through a sheave on a movable deadman on the basin floor, and thence to the fresno. This gave a pull into the basin, and the fresno was brought back to a digging position at the top of the slope by a tag line attached to the handle of the fresno and operating over the niggerhead of the hoist. Trimming to the exact lines was done with hazel hoes, the material being so compact as to require a sharp cutting edge.

The lining of the floor and slopes consists of a monolithic slab of concrete 6 in. thick, reinforced in both directions with ½-in. square twisted bars on 8-in. centers, with the lower bar 1¼ in. above the bottom of the slab. In the corners additional reinforcing was used parallel to the slopes, also where the slab crossed the line of the trench excavated for the sewer. Above the slopes is a vertical wall section, with a double wall on the south side to form a skimming weir and collecting gallery. The spillway on the



SECTIONS THROUGH BASIN 6 SHOW REINFORCEMENT AND VARIOUS DETAILS



PROFILE OF DRAIN FOR BASIN 6, SHOWING HOW FLOOR IS SLOPED TO FORM POCKETS

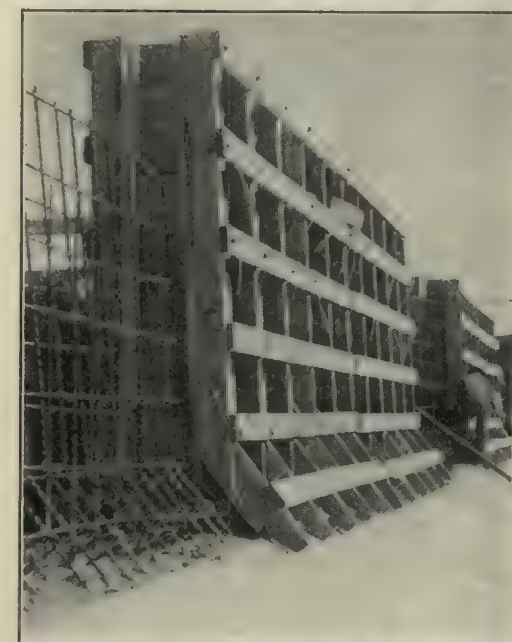
north, between Basins 4 and 5 and Basin 6, is a slab similarly reinforced, and the baffles are reinforced and tied into the floor with vertical bars.

All reinforcing steel was tied at approximately every fourth intersection by the use of formed ties instead of the usual annealed-iron wire ties. The shape of these ties permits their use as supporting chairs. During the progress of the steel placing these chairs were allowed to sink into the earth to prevent deformation; but immediately before the placing of the concrete the steel mat was raised and a short piece of lath inserted under the chair. It is believed that this type of chair effected a decided economy in the cost of placing the steel. To insure the rigidity of the mat during the pouring, in addition to the certainty of its being in its proper place in the slab, the use of this chair seemed imperative.

Uniform Density Obtained

The concrete was proportioned 1:3:5, using Portland cement, washed Platte River sand and crusher-run limestone without dust. Integral waterproofing mixed with the tempering water was utilized throughout. While the proportions were approximately as mentioned, they were varied somewhat to give a concrete of uniform density even though the grading of the rock varied. The wheelbarrows employed in charging were of a uniform size, and by the use of boards dapped at the ends, so as to drop the striking edge more or less below the top of the body of the wheelbarrow, the load could be struck off to a predetermined amount, different boards being used when a different size of load was desired. Every load, both of sand and rock, was measured in this way, and by means of a specially designed gaging tank above the mixer the quantity of water per batch was made absolutely uniform.

It was thus possible to control the consistency of the concrete without resort to the judgment of the operator, and the value of the method was clearly demonstrated. It was found that the consistency of the concrete at which it could be handled best in the chutes was that at which it could be placed on the slopes without slipping, as well as that at which minimum separation occurred in wheeling from the mixer to the chute or forms, and the extra labor involved in charging the mixer was more than compensated for in the reduced cost of placing. A further advantage in this method, and probably the most important, was apparent in the appearance of the concrete, for the separation of the aggregate was so slight as to be readily overcome by spading within the forms.



WOOD FORMS USED FOR 20-FOOT WALL
Steel reinforcement continuous from slope slab into wall

Determining Proportions

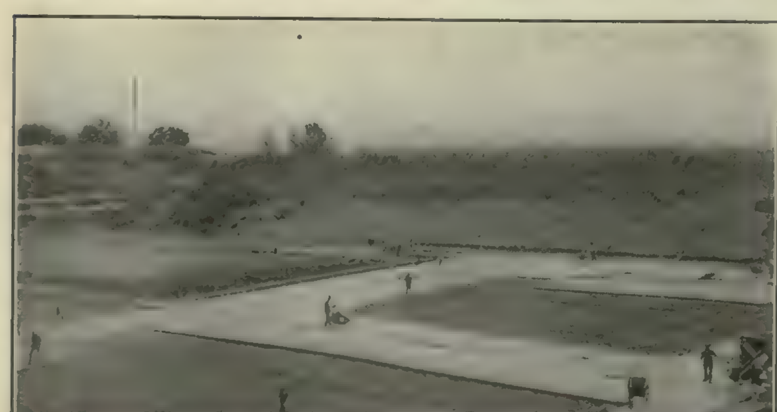
The method used in determining the proportions from day to day is shown in the "daily log," reproduced herewith. Daily measurements of concrete placed and of material used were made, and the concrete judged from the computed data on this report. The factor that was used as the index of the quality of the concrete was item q, "Excess mortar to voids," and it is believed that this method may be safely substituted for the method of mechanically graded mixtures on work where the cost of equipment for the latter plan would be prohibitive. This report was in the hands of the construction engineer each morning for the previous day's run, and from it the proportions for the start of the day's run were made. While this method does not entirely eliminate the human element in the proportioning of concrete, it was found to be a valuable aid, and remarkably constant results were obtained during the progress of the work.

In pouring the floor the concrete was conveyed in two-wheeled buggies from a hopper supplied from the mixer by a chute. The slopes were poured by using a trussed chute receiving concrete from buggies, as described in the Engineering Record of Oct. 16, 1915, page 491. The arrangement for dumping the buggies into the wall forms was shown on page 28 of the issue of Jan. 1, 1916.

Concrete Placed in Horizontal Courses

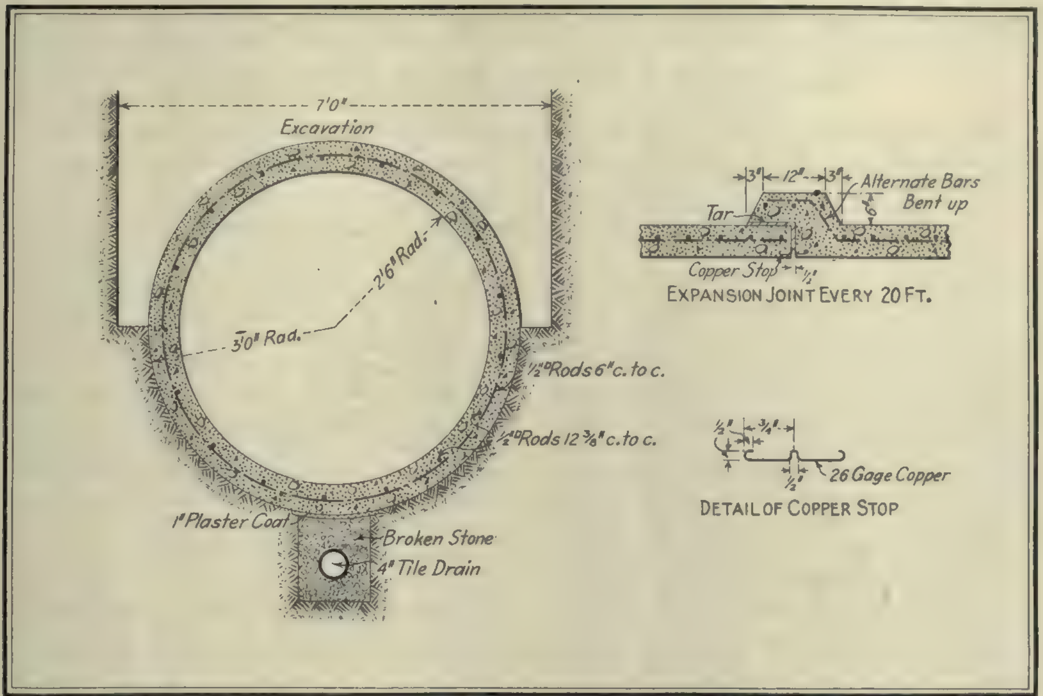
The concrete on the slopes was placed in horizontal courses around the basin, since it was thus found possible to work the concrete at a consistency best suited to reinforced work without the slipping of the fresh concrete due to the high head resulting when worked in vertical strips. The joints being horizontal, fresh concrete placed against the old tended to work down against the former, and this, together with the fact that a complete horizontal course could be placed in a day, resulted in good joint efficiency.

Dilute hydrochloric acid, a clear-water wash and a neat-cement grout were applied in turn to the face of the old concrete just in advance of the placing of the new course, special care being taken to remove all dried concrete not covered by the protecting canvas, or pieces that had become shattered in removing the forms. The floor and slopes



VIEW SHOWS VARIOUS STAGES IN CONSTRUCTION OF FLOOR

LONG-HANDLED 12 x 24-INCH FLOATS PRECEDE STEEL TROWELS



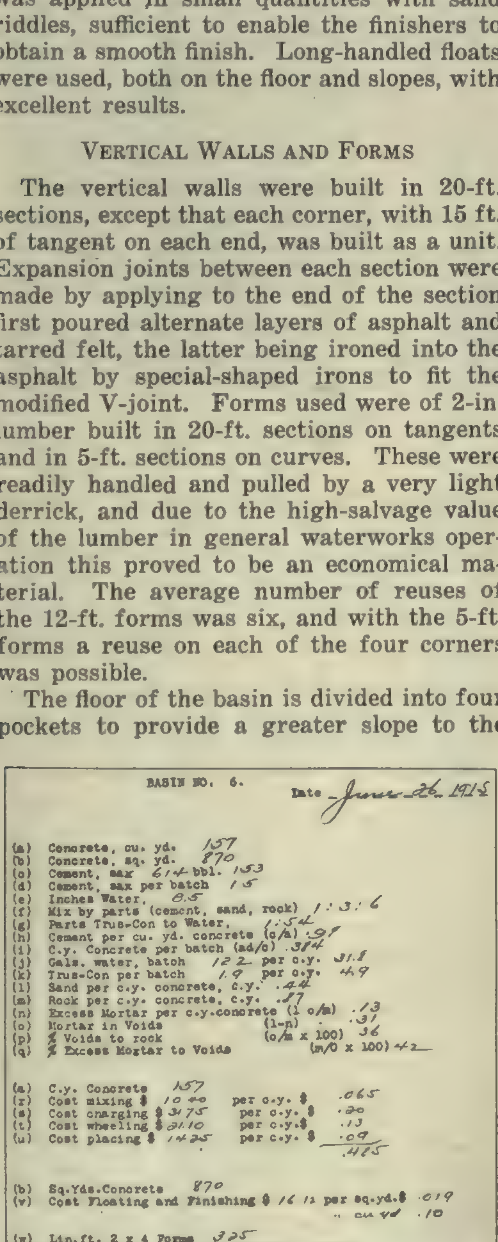
DETAILS OF 60-INCH CONCRETE BYPASS PIPE DESIGNED FOR 10-POUND HEAD

are of the one-course type such as is being generally used in paving work, no topping or mortar coat being used. To absorb the excess water that was flushed up during the floating, a dry mixture of sand and cement was applied in small quantities with sand riddles, sufficient to enable the finishers to obtain a smooth finish. Long-handled floats were used, both on the floor and slopes, with excellent results.

VERTICAL WALLS AND FORMS

The vertical walls were built in 20-ft. sections, except that each corner, with 15 ft. of tangent on each end, was built as a unit. Expansion joints between each section were made by applying to the end of the section first poured alternate layers of asphalt and tarred felt, the latter being ironed into the asphalt by special-shaped irons to fit the modified V-joint. Forms used were of 2-in. lumber built in 20-ft. sections on tangents and in 5-ft. sections on curves. These were readily handled and pulled by a very light derrick, and due to the high-salvage value of the lumber in general waterworks operation this proved to be an economical material. The average number of reuses of the 12-ft. forms was six, and with the 5-ft. forms a reuse on each of the four corners was possible.

The floor of the basin is divided into four pockets to provide a greater slope to the



BASIN NO. 6. Date June 26 1915

(a) Concrete, cu. yd. 157
(b) Concrete, sq. yd. 870
(c) Cement, sax 614 bbl. 153
(d) Cement, sax per batch 15
(e) Inches Water. 8.5
(f) Mix by parts (cement, sand, rock) 1:3:6
(g) Parts Trus-Con to Water, 1:54
(h) Cement per cu. yd. concrete (c/a) .98
(i) C.y. Concrete per batch (ad/c) .384
(j) Gals. water, batch 122 per c.y. 31.8
(k) Trus-Con per batch 1.9 per c.y. 4.9
(l) Sand per c.y. concrete, c.y. .44
(m) Rock per c.y. concrete, c.y. .87
(n) Excess Mortar per c.y. concrete (1 c/m) .13
(o) Mortar in Voids (1-n) .31
(p) % Voids to rock (c/m x 100) 36
(q) % Excess Mortar to Voids (m/0 x 100) 42

(a) C.y. Concrete 157
(r) Cost mixing $ 10.40 per c.y. $ .065
(s) Cost charging $ 31.75 per c.y. $ .20
(t) Cost wheeling $ 21.10 per c.y. $ .13
(u) Cost placing $ 14.25 per c.y. $ .09
.485

(b) Sq. Yds. Concrete 870
(v) Cost Floating and Finishing $ 16.12 per sq. yd. $ .019
" cu yd .10

(w) Lin. ft. 2 x 4 Forms 325
(x) Cost Forms $ 11.17 per lin. ft. $ .034

DAILY LOG SHEET CONTROLS PROPORTIONS

sewers to aid in washing, these pockets having a maximum depth of 5 ft. The mud valves placed at the sewer openings have a horizontal gate on a vertical stem actuated by a hydraulic cylinder, and are controlled by means of pressure pipes leading to vaults outside the basin walls. Valves of this design have been in use in older basins of this plant for 25 years, and have proved well suited to the service.

The design of the north side of the basin is such as to cause the influent to be discharged across the entire width of the basin; and with the gallery extending across the south side, "short circuits" or fan-shaped flow areas are impossible. On the north side 6-in. vitrified tile elbows are set in the wall, looking down, and receive the influent from the baffled spillway. By the use of stop plank of varying heights it is possible so to control the flow of water through the baffle openings that the discharge from these tiles is equal under all conditions of operation.

CONCRETE BYPASS PIPE

The 60-in. concrete bypass pipe from the south end of Basin 6 to Basin 3 and the 48-in. pipe from this point to Basin 2 are designed for a head of 10 lb. to the square inch, and are provided with copper expansion joints at the end of each 20-ft. section. Each section, invert and arch, was poured as a unit, thus obviating all construction joints at the springing line. Collapsible steel forms were used for the interior, the lower side of the invert being formed by suitable excavation of the trench, and the upper side of the arch by wood forms. The reinforcing was placed as shown in the accompanying drawing. The special construction in this line included a 90-deg. bend, a 60 x 48-in. tee, a 60 x 48-in. reducer and a 60-in. twin 36-in. tee for the outlet into Basin 3. All were executed in reinforced concrete, connection being made to 36-in. cast-iron pipe where necessary. An open mixing chamber or flume 240 ft. long in the bypass line provides a means for thorough mixing of the coagulant before the water being treated enters Basin 3.

This work was carried out under the direction of R. B. Howell, general manager of the Metropolitan Water District of the city of Omaha. The contractors for the earthwork were the Kierle Construction Company and J. P. Williams, and the concrete bypass was constructed by the Offerman Construction Company. All other work was done by water district forces. George T. Prince is chief engineer of the water district; A. B. Hunt, superintendent; H. S. Nixon, assistant engineer, and the writer had active charge as construction engineer.

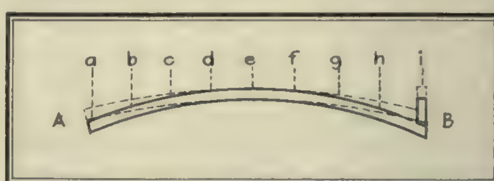
Tests Needed to Verify Concrete-Road Crack Theory

Unequal Saturation of Ground in Cold Weather Accountable for Longitudinal Openings

By S. WHINERY
Consulting Engineer, New York City

THE CAUSE of the frequent longitudinal cracking of concrete pavements and roads has not yet been adequately explained. The observed facts are that such cracks seemingly occur during the winter months, though they usually do not become observable until the warmer weather in the spring; that they are usually found in the middle third of the width of the pavement; that they seem generally to begin at expansion joints regardless of the different spacing of these expansion joints; that they occur most frequently where the pavement is laid on clay or other impermeable soils; that they occur in reinforced pavements, though not so frequently as in those not reinforced, and that they occur in narrow as well as wide pavements.

For reasons not necessary to detail here, temperature expansion and contraction of the concrete itself does not offer a sufficient explanation of their occurrence, and some other general cause must be looked for.



METALLIC LEVELING PINS SHOULD BE FIXED TRANSVERSELY TO DISCLOSE DISPLACEMENT BY HEAVING

From study and observation I believe that the cause will be found in the unequal expansion or heaving by frost of the earth under or around the edges, or curbing, and that under the central parts of the pavement, due not only to the different water content of the earth at the sides and central part of the pavement, but to the different temperatures to which the two parts are subjected. It seems to be a well-established fact that the amount of expansion or heaving of earth by frost is, substantially, directly as the quantity of water contained, up to the point of saturation.

Referring to the accompanying sketch, I conceive that the normal contour of the pavement, shown by full lines, may under the influence of heavy rain succeeded by severe freezing be forced into the contour shown by the dotted lines. If the pavement has no curbing, as shown at A, the water from the natural rainfall, supplemented by that draining from the pavement, would saturate the earth at the edge of the pavement; but this water would percolate slowly into the subgrade and would not be evenly diffused under the pavement for some time, particularly as it must flow slightly uphill.

If in the meantime a severe freeze should occur, the difference in the quantity of the water in the soil at the edge and the center of the pavement aided by the difference in temperature at the two points would result in a difference in the elevation by ice expansion or "heaving," forcing the pavement into the contour shown by the dotted lines; and if the resulting deformation were sufficient the pavement must yield by longitudinal fracture. The maximum moment of the upward force at the edge and the maximum stress on the concrete—assuming both sides to be acted upon—would be at the center of the street, and the cracking would be most likely to occur there, other things being equal. The cracks would naturally begin at the expansion joints where no support is afforded by the adjoining slab.

If the pavement has a monolithic curb, as shown at B, the water from the roadway would be carried away, but the back of the curb would supply an additional hold for the grip of the heaving earth. It is not unusual in severe climates for deep-set, detached curbs to be thus gripped and lifted.

A longitudinal crack thus formed would at first be V-shaped—open at the bottom and closed at the top—until the disappearance of frost from the ground, when the sides would sink to their normal position. In doing so the tendency of the pavement would be to move slightly outward and the crack would appear on the surface.

Tests Should Be Made

The foregoing seems to be a rational theory to account for longitudinal cracking, but it needs to be verified by accurate investigation, and the principal purpose of this article is to suggest that engineers who have the facilities for doing so should make accurate and systematic observations to determine the true cause of this longitudinal cracking.

The following suggestions for such a study are offered:

Select points on several concrete pavements or roads where longitudinal cracking has occurred or is likely to occur. Along a line at right angles to the street, as shown by the letters a, b, c, d, e, f, g, h, i, set metallic leveling pins properly protected from displacement by travel or accidents; take and record the accurate elevation of each pin at different times and seasons, particularly in the autumn before freezing weather, and several times during the winter, especially when the ground is most deeply frozen. Also, at the same time, measure accurately and record the horizontal distance between the outside pins (a and i) to detect any horizontal movements. The levels should be referred to some permanent benchmark not affected by frost, as on a building with deep foundations.

Such a series of tests should throw light on the actual cause, whether it confirms the previously mentioned theory or not. The details of preparing for and making such tests properly need not be gone into; they will occur to every competent engineer. Whatever the results may be they should be published in the technical press, stating all the conditions under which the investigation was made.

Engineering Students Favor Spanish

Out of 231 students entering Stevens Institute of Technology this fall, 180 have elected to study Spanish instead of French or German.

Theory and Tests Presented for Design of Sand Boxes to Lower Arch Centers

Importance of Lowering Devices Discussed and Various Types Described —Amount of Settlement Caused by Compression of Sand Determined

By FRANK P. McKIBBEN
Professor of Civil Engineering, Lehigh University, South Bethlehem, Pa.

STEEL CENTERS used in molding the concrete arches over Rocky River, Cleveland, at the Delaware River crossing of the Delaware, Lackawanna & Western Railroad, at Penn Avenue Viaduct in Reading, Pa., and at the new Susquehanna River Bridge at Harrisburg, Pa., indicate a tendency to secure a simpler and more nearly determinate form of temporary construction than the labyrinth of wooden posts and braces employed for so many centuries as arch centers. Clearly, this desire leads to the use of fewer parts in the form of ribs wherein stresses can be determined with great accuracy after the loads are once found. These larger units in centers necessitate the use of some positive form of lowering device, and it is not a simple matter to secure a cheap and efficient support for heavy loads that will act only when and as wanted.

SPECIAL STEEL CENTERS USED IN CONSTRUCTION OF DELAWARE RIVER BRIDGE
Toggle-joint arrangement at panels next to crown; double screw jacks in the posts lower the centers.

Lowering Devices Important

The necessity of properly lowering the centers after the arch is capable of supporting itself is seen when it is realized that by sudden or careless lowering the ring may be subjected to one or more upward forces, more or less nearly concentrated, acting on its soffit—forces which are indeterminate and not contemplated in design. The bending moments set up by these forces may cause the arch ring to crack, and if the latter is reinforced the adhesion between steel and concrete may be overcome and the steel highly stressed. It seems difficult to imagine a case when any serious damage, such as a collapse, could result, but cracks are certainly undesirable, causing unknown stresses from changes in location of the thrust line.

Various Lowering Devices

The requisites of a lowering device are: It shall safely carry for the required length of time the maximum load to which it will be subjected; its effect on the settlement of the centers can be predetermined; lowering can be accomplished under definite control and with ease, and finally, the cost must be reasonable. The five devices that have been proposed or used to meet the requirements are: Wooden wedges, steel-screw wedges, screw jacks, hydraulic jacks, and sand boxes, Of these, wooden wedges are by far most generally used, and for smaller structures on wooden centers they can be made to act efficiently.

In long-span arches, however, the use of wooden wedges may be accompanied by serious difficulties. Thus, in the centers of the Walnut Lane main arch the wooden wedges, which were cut from 10 x 10 x 18-in. timbers, were so arranged that the unit bearing pressure across the grain, 1000 lb. per square inch, was the same as the unit compression along the grain of the vertical posts—a condition which resulted in crushing the fibers across the grain. In striking centers considerable difficulty was experienced in starting some of the wedges, so much so in fact that jacks were used to reduce pressures, and even then one wedge had to be cut out. Such high unit bearing across the grain should not be allowed even for temporary construction. If wooden wedges are to be efficient the loads must be distributed with metal plates, channels or wooden corbels so that in no case does the unit bearing across the grain exceed 400 lb. per square inch for timber suitable for centers. The simplicity and cheapness of wooden wedges cannot be disregarded, and for small structures, or for large ones when loads are carried at many points, they can be made to give good service. Screw jacks or those operated hydraulically have not been often used. The great objections to ordinary screw jacks are that they are difficult to operate under heavy loads and are not especially stable, while for light structures their cost is prohibitive. Double-

screw cast-steel wedges were used at the Rocky River arch, although their cost is said to have been in excess of that of sand boxes.

Sand Boxes

The idea of having steel cylinders filled with sand which can be withdrawn to lower the centers seems to be a good one, and for concrete arches with steel or other centers where heavy loads are concentrated at few points no good reason for not using sand boxes is apparent. For cases where applicable they are probably the cheapest form of lowering device obtainable, and seemingly possess the further advantage of greater stability as compared with ordinary screw jacks. The simplest form of metal sand box consists of a flat plate bottom to which is connected by a circular angle a steel cylinder made of a thin plate with a longitudinal riveted lap joint with countersunk rivet heads on the inside. A solid wooden plunger of diameter just sufficient to fit in the steel cylinder, and to clear the countersunk rivets, rests on the sand within.

For lowering centers, the removal of one or more plugs in the side of the cylinder near the bottom allows the sand to run out or to be scraped out as the plunger descends into the cylinder. Sand boxes were successfully used with ordinary wooden centers in each of the two main 230-ft. spans of a three-hinged reinforced-concrete arch highway bridge over the Isar near Grunwald, Austria. They were also used to release the falsework under the ill-fated suspended span of the Quebec Bridge at Sillery Cove before it was floated to the bridge site.

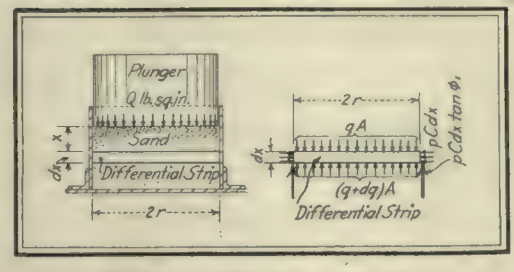
Operation of Sand Boxes

In setting centers on sand boxes allowance must be made not only for their subsequent deflection, either by elevating or cambering the centers, but also for the settlement due to compressibility of the sand. If the sand could be compressed within the cylinder with a force equal to the maximum load to be applied, no allowance need be made for sand settlement, provided, of course, the sand is not subsequently compacted by the continued application of the maximum working load. Uniform preliminary compression of the sand, however, would be a difficult matter, and in practically all cases it is necessary to make allowance for sand compression in placing the centers.

The amount of settlement caused by sand compression should be carefully determined in advance in a testing machine, for it depends on the depth of sand, its quality, the loading pressure per square inch, the ratio of depth to diameter of box, on whether the sand be wet or dry, and to some extent on the length of time required in loading. Plungers should fit into the cylinders with as little clearance as possible to avoid the upward flow of sand between the plungers and inner surfaces of the cylinders, which otherwise will take place even under fairly low pressures.

Either dry or wet sand may be used, although the former flows more readily when the centers are lowered. Wet sand which must be scraped out has the advantage that it cannot flow so quickly, on removal of the plugs, as to get beyond control. It must be remembered, however, that with holes in the sides of the cylinders the flow of dry sand can easily be stopped, even under heavy loads.

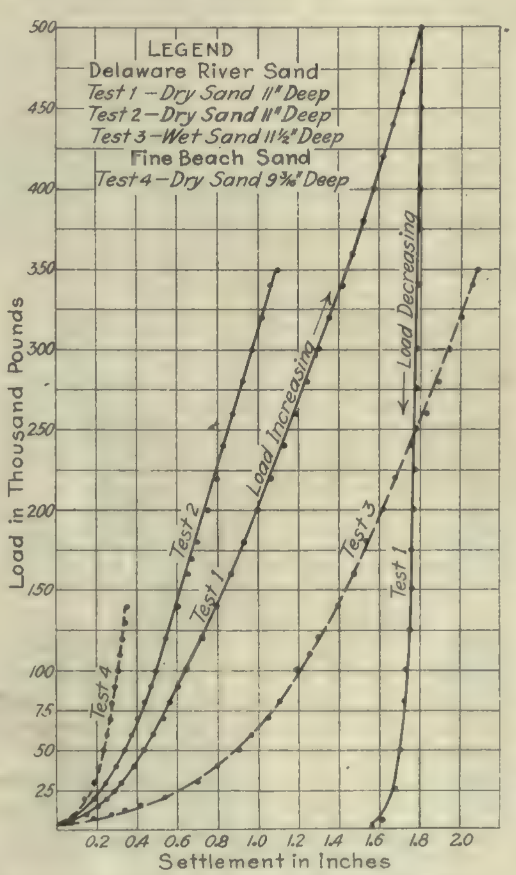
In lowering centers a man at each sand box should be provided with a wrench, a small tin cup for measuring the amount of sand removed, a mallet, and if the sand be wet a scraper will be necessary. At a given signal each man should carefully remove one of the plugs and allow one cupful of sand to run out. The plug should then be screwed back in place and the sand box struck a few blows with the mallet, thus causing the surface of the sand to become level under the plunger. Experiments show that the sand in escaping leaves a depression in the upper surface over the opening. After the foregoing has been done simultaneously for all boxes the process should be repeated until the centers are free from the arch ring.



FORCES ACTING IN SAND BOX

Tests on Sand Boxes

Several tests on sand boxes have recently been made in the laboratory at Lehigh University, and the accompanying diagram shows some typical load-compression curves representing results of four tests. In test 1 loading was continuously applied to 500,000 lb. and the compression of the 150 lb. of Delaware River sand, including that of the wooden plunger, was recorded without stopping the testing machine, which was run at a very slow speed. When the load reached 500,000 lb. a wooden plug was withdrawn from a hole in the side of the cylinder and sand was removed until the load reached the initial load. The settlements corresponding to the decreasing loads show that the removal of very small quantities of sand is accompanied by considerable decreases in loads, as would be expected. Forty-four minutes were required to apply the load of 500,000 lb. and only 9 minutes to release it.



LOAD-SETTLEMENT TESTS OF SAND BOXES

In tests 2 and 3 the load was applied to 350,000 lb., on dry sand in test 2, and in test 3 on wet sand which had been shoveled, not rammed, into the cylinder. To release the 350,000 lb. in the dry-sand test with four holes open required 14 minutes, while under the same conditions in the wet-sand test 24 minutes were required to scrape enough sand from the four holes to reduce the load from 350,000 lb. to 109,000 lb., at which the test was discontinued. Some difficulty was experienced in scraping the wet sand out. Delaware River sand used in tests 1, 2 and 3 is very fine and contains small amounts of clay and other foreign matter. In one test with dry Delaware River sand, not here recorded, when the load reached 320,000 lb. a plug in the bottom of the cylinder was forced out and the sand ran out like water from an orifice. All the load instantly dropped off. The cylinder was elevated in this test so that the plug in the bottom could be used.

Test 4 was made on dry beach sand with very small grains of uniform size, and the load was run up to 140,000 lb. only. This sand is less compressible than that used in the first three tests, and it flows very freely upon removal of one plug from the side of the cylinder; but the flow ceases if the sand is allowed to accumulate in front of the opening. At a load of 140,000 lb., or 550 lb. per square inch, the settlements in tests 1, 2, 3 and 4 were 0.8, 0.6, 1.40 and 0.35 in. respectively. Several other tests were made, and they all show that a fine clean beach sand is excellent for use in sand boxes, as it compresses only a small amount and flows freely.

Pressure Exerted by Sand

The sand pressure against the side of the cylinder tending to rupture the cylinder is an important item in design. The demonstration given herewith is applicable not only to sand boxes but to deep sand bins as well, for in the design of sides and bottoms of bins the pressures are essential, and, clearly, in such cases of a limited mass of earth the usual Rankine theory of earth pressure gives values too large.

The problem may be stated thus: Given a sand box of known depth and diameter, determine the intensities of vertical pressure q and horizontal pressure p at any point. These quantities are given by the formulas:

$$q = \frac{w}{m}\left(1 - \frac{1}{e^{mx}}\right) + \frac{Q}{e^{mx}}$$

$$p = q \tan^2\left(45^\circ - \frac{\phi}{2}\right)$$

In which m is a constant, computed by

$$m = \tan^2\left(45^\circ - \frac{\phi}{2}\right)\frac{C}{A}\tan\phi_1$$

These formulas are derived as follows: Let r, C, and A be the radius, circumference and area respectively of the inside circle of cylinder; w, the weight of sand per cubic inch; ϕ, the angle of repose of sand; ϕ_1, the angle of friction of sand on steel; Q, the vertical pressure from plunger per square inch; q, the intensity of vertical pressure, and p, the intensity of horizontal or bursting pressure at any depth x; e, the base of the Naperian logarithmic system, or 2.718. All dimensions are in inches.

By equating vertical forces on the differential strip, shown in the diagram herewith, and simplifying.

$$dq = dx\left(w - p\frac{C}{A}\tan\phi_1\right)$$

But since in any material without cohesion

$$p = q\tan^2\left(45^\circ - \frac{\phi}{2}\right)$$

there is obtained, after transposing,

$$dx = \frac{dq}{w - qm}$$

Integrating and remembering that the constant of integration may be found when x is 0, because then $q = Q$,

$$x = -\frac{1}{m}\log(w - mq) + \log\frac{w - mQ}{m}$$

From this there results

$$\frac{w - mq}{w - mQ} = \frac{1}{e^{mx}}$$

Therefore

$$q = \frac{w}{m}\left(1 - \frac{1}{e^{mx}}\right) + \frac{Q}{e^{mx}}$$

This gives the intensity of vertical pressure at any depth x, and p, the intensity of horizontal pressure, is then easily computed.

The problem is therefore solved as soon as ϕ and ϕ_1 are determined experimentally.

It is interesting to notice that the first term in the equation for q gives the increase in vertical pressure, as the depth increases, due to the weight of material in the cylinder, while the other term gives the vertical pressure at any point x due to the superimposed load from the plunger. Evidently the latter term decreases with the depth. In an ordinary sand box for arch centers the first of these terms is negligible, but the second is not; whereas for deep sand bins without superimposed loads the reverse is true. The solution given in the foregoing follows somewhat that of a special case given by Morsch in "Der Eisenbetonbau."

Applying the foregoing equations for q and p to a sand box of 9 in. radius; depth of sand, 9 in.; weight of sand, 0.052 lb. per cubic inch; $\phi = 36^\circ$; $\phi_1 = 30^\circ$; $Q = 550$ lb. per square inch, corresponding to 140,000 lb. total load on an 18-in. plunger, there results: $e^{mx} = 1.35$; at the top of sand, $q = 550$ and $p = 143$; at the bottom, $q = 408$ and $p = 106$.

With p known it is a very simple matter to compute the thickness of plate required for the cylinder. Assuming a unit tensile stress in the cylindrical plate of 16,000 lb. per square inch and an efficiency of its vertical seam of 50 per cent, t, the thickness of the plate in inches, is $rp/8000$.

Causes of Low Break

The following table, taken from a report by H. E. Breed on the progress of New York highways, refers to causes of low break as determined in the state's road-testing laboratory:

	Per Cent
Sand, dirty, containing loam and also dirt from subgrade	35.4
Stone or gravel, coated	35.0
Sand, too fine	8.5
Poor quality of stone or gravel	8.2
Poor manipulation in making cubes	4.7
Lack of proper mixing	3.5
Miscellaneous, too wet, etc	4.7

Experiences in Tuning Up St. Louis Filters Indicate What Will Not Work

Brewery Hose and Lead Pipe Are Not Affected by Chlorine or Coagulant Chemicals—High-Rate Wash Does Not Eliminate Mud Balls

A YEAR'S OPERATION of the 160,000,000-gal. filter plant at St. Louis is included in the annual report of E. E. Wall, water commissioner, ending in April. In the detailed report of C. M. Daily, assistant engineer and acting superintendent, is an account of the experiences with chemical pipes, pumps and trial methods of washing that will help in the design and operation of other plants. The following information is from Mr. Daily's report.

The chlorine meters and dissolving towers, which are placed on the second floor of the headhouse, were connected by 1½-in. hard-rubber pipe to a 4-in. vitrified clay pipe laid in concrete (having a minimum thickness of 3½ in. around the tile), running from the outside wall of the building to the drawing conduit chamber. Along the north wall of the chamber the vitrified clay pipe, incased in concrete, was supported by two 8-in. I-beams. Three 2-in. brewery hose from this pipe projected a few feet below the surface of the water. On starting, leaks occurred at the connections of the rubber pipe to the vitrified pipe and were repaired with litharge. In a few days leaks developed all along the vitrified pipe, which was about 3 ft. below the surface of the ground, scarcely any of the chlorine water reaching the drawing conduit chamber. Repairing this line seemed useless, as the concrete was rotten where the chlorine water came in contact with it. A 2-in. brewery hose was run through the 4-in. vitrified clay pipe, couplings being made with hard-rubber pipe and litharge, and no further trouble has been experienced with this line.

The strength of the aluminum-sulphate solution used varies from 1 to 3 per cent. From the solution tanks in the headhouse the solution is pumped into orifice boxes, two at the south end of the filter house and five at the north end. The chemical lines at first were three in number, two flow and one return, made of 8-in. vitrified clay pipe, surrounded by concrete of a minimum thickness outside the pipe of 3-in., and 4-in. fiber-pipe connections to the orifice boxes and meters, and from them to the point of application.

Alum Lines Leak

When these lines were tested, about April 20, 1915, leaks developed to such an extent along the entire length of approximately 850 ft. that when pumping was at the rate of 200 gal. per minute none of the water reached the orifice boxes, which were about 30 ft. above the lowest part of the line and 15 ft. above the level of the solution in the tanks. Repairs were made by cutting out the concrete and replacing it with new concrete. A retest made about a week later developed new leaks under the groined arches and also under the floor of the headhouse. The floor was torn up, the pipe removed and a sub-base of concrete 5 in. thick laid, on which the 8-in. vitrified pipes were placed, the joints being well calked with oakum and plastered with cement mortar and then surrounded with 3 in. of concrete. After repairing the new leaks under the groined arches, a retest was made and only about one-half of the water pumped reached the orifice boxes at the north end of the filter plant. Other portions of the line were removed and replaced as in the headhouse, and with the entire line repaired a final test was made about May 10. After 6 hours water was noticed coming through the floor of the headhouse from leaks in the relaid pipe, and with numerous small leaks all along the line. It was then decided to abandon the entire vitrified clay-concrete line.

A 2½-in. firehose was used as a temporary line from the pumps in the headhouse to the 4-in. fiber connecting line at the orifice boxes at the south end of the plant, and the first chemicals were added to the influent flume May 20. The fiber line broke the first day in use while under a head of less than 15 ft. The broken section was replaced and additional braces and anchors were installed, but the pipe became soft and the liquid oozed through the walls, the pipe breaking many times.

About July 7 it became necessary to add aluminum sulphite in larger quantities than was advisable in the influent flume, and the hoppers beneath the orifice boxes at the north end of the plant were provided with a grating and the dry aluminum sulphate was brought in in trucks and emptied into them, water from a ¾-in. pipe sprayed over the chemical and the solution run through the 4-in. fiber lines to the point of application at the Venturi meters outside the building. The 4-in. fiber pipe lasted about two days, being repaired several times, and was replaced with 2½-in. hose until lead pipe could be installed.

Lead Pipe Holds

The replacement of the 8-in. vitrified clay, the 4-in. fiber and the temporary hose lines by 4-in. 8-lb. lead pipe in 20-ft. lengths—the lengths being connected by cast-iron flanges through which the pipe had been run—was started as soon as the pipe could be obtained. In the filter house the new lines were laid on the effluent or clear-water conduit between the washwater line and the pressure line. In the headhouse the new lines were run through the 8-in. clay pipe. Two lines were completed July 31 and the third one was laid in February. The cost of the original piping was $1,300, and of the new piping complete in place, $2,309.05.

The chemical pumps (3-in.) made of Vanadium Victor Silver metals, as specified by the city, are corroded by the aluminum sulphate solution to such an extent that new labyrinth rings are now necessary and the impeller wheel is slightly reduced in thickness. The capacity has also been reduced over 20 per cent, but the replacement of the labyrinth rings may overcome the loss of capacity to a great extent.

The automatic chemical-feed controllers have worked very successfully, the only trouble being that the brushes on the small motors, made of woven wire, cut the commutators and have had to be replaced with carbon brushes. The master controller and indicator were installed in 1915 and are working satisfactorily. The controllers work very satisfactorily, requiring no special care or attention.

The first test was to determine how much filtered water should be wasted after washing. The turbidity of the effluent was measured every 3 minutes at various rates of filtration without wasting any of the effluent, and it was found that the 500,000-gal. rate, the lowest at which it was possible to control, gave the best results. (Each filter has a capacity of 4,000,000 gal. daily when run at a rate of 125,000,000 gal. daily per acre.) Running at the low rate the first effluent was clear, became turbid for a time, and then became clear again. A probable average was 5000 gal. of clear water and more than 18,000 gal. turbid. Dry aluminum sulphate was added to the water in the central gutter when filling the bed after washing; 1, 2 and 3 gr. per gallon for the quantity of water above the sand amounting to 7, 14 and 21 lb. per bed were tried. Fourteen pounds gave the best result.

Amount of Aluminum Sulphate

Adding 14 lb., the turbidity during the turbid period seldom exceeds 1 part per 1,000,000, and is often as low as ¼ part per 1,000,000, the average amount of effluent running clear immediately after washing being about 4500 gal., and the turbid amount equaling 11,000 gal. The time after washing until running clear varied from 40 to 50 minutes, and after this time the rate could be raised to any amount up to 5,000,000 gal. daily, the highest rate run up to this time, the effluent remaining clear. The immediate increase in the loss of head after raising the rate varied 1 to 3.5 ft. As a result of these experiments 14 lb. of dry aluminum sulphate is put in the central gutter as the bed is filling after washing, no effluent is wasted and the filter is run for 1 hour at the 500,000-gal. rate and then raised to the required rate.

Another problem was the quantity of water to be used for washing the filter and the rate at which washing was to be done. At first the rate of washing was limited to 18 in. per minute vertical rise, the washing being continued until clear patches of water appeared on the surface. It was observed that a smaller amount of water was used per wash at the highest rates to accomplish the same results. The rate was gradually increased until now a maximum rate of 24 in. is allowed.

Cannot Wash Out Mud Balls

It has been noticed that after a period in which the turbidity of the influent is low and there is very little flock in the water, during which the time between washings increases in some cases to 105 hours, the film would become very hard to break up, and the formation of mud balls, which are found in the sand varying in size from ⅛ to ¾ in. in diameter, mostly of the smaller size, was increased. It is very difficult to dissolve these balls, and screening them out while washing is now being tried with ¼ an ½-in. mesh screens. The results are encouraging. The mud balls cannot be washed out, even at a 28 to 30-in. rate.

One strainer plate only was found split after a high-rate wash.

The rate of washing as developed thus far is from 3 to 6 in. per minute until the bed is broken. Then the rate is raised from 21 to 24 in. per minute and continued until clear patches of water cover about half of the bed.

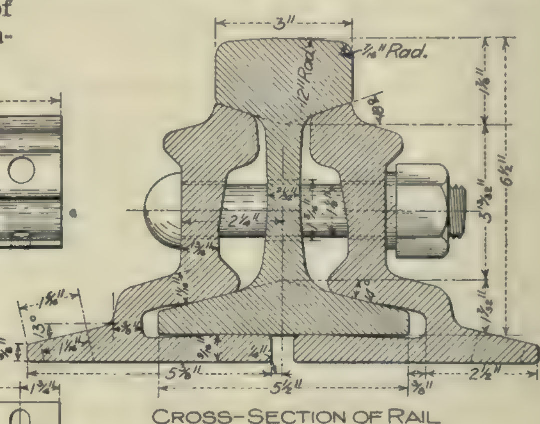
For a study of the sand in washing a device was constructed for collecting samples of the sand at various depths simultaneously, consisting of fifteen telescoping copper cans, 3 in. in diameter and 3 in. high, provided with ¼ x ¾-in. openings near the top, covered with rubber slip valves, each can having an air vent projecting above the water when submerged. The cans, fastened on a frame, are lowered into the sand while washing, and, all the slip valves being removed at once, a good sample (nearly two-thirds of a canful) can be obtained at the various depths. These samples indicated a close grading of the sand and the location of the mud balls.

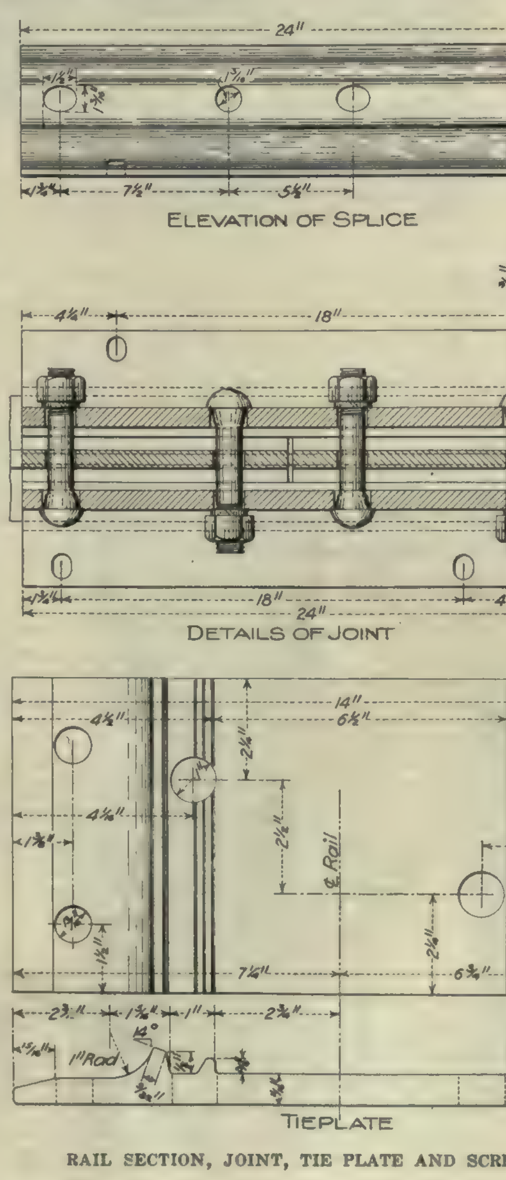
Screw Spikes for New York Connecting Railroad

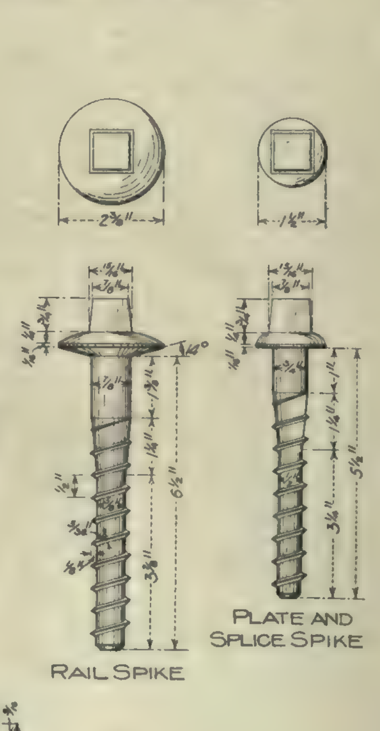
Standard Pennsylvania 125-Pound Rail Is Being Laid, with Supported Joints and Six Spikes to Each Tie Plate

SIX screw spikes to each tie plate are being used in the track of the New York Connecting Railroad, which is expected to be put in service in January. Each plate has three projecting shoulders as shown, the small one to align the plate with the rail base, the two larger ones to give support to the spike head. Four ¾-in. spikes hold the plate to the tie, and two ⅞-in. spikes hold the rail. The Pennsylvania standard 125-lb. rail is being used, with four-bolt supported joints. The spike holes in the joint plates are normal to the slope of the base to give an even bearing.

The track details were designed and the track is being laid under the direction of A. C. Shand, chief engineer of the Pennsylvania Railroad.







RAIL SECTION, JOINT, TIE PLATE AND SCREW SPIKES, NEW YORK CONNECTING RAILROAD

Highway Commission Wants Results, Not Excuses

Instruction Sheets to Inspectors Succinctly Tell What Must Be Done and How to Accomplish Vital Features

"REMEMBER, we want results, not excuses." This is the starting and ending slogan in the instructions for inspectors of concrete roads on state highway work in Outagamie County, Wisconsin. Other things which the inspector must do are set forth in succinct, epigrammatic form.

"Accomplish two things—first, well-executed work; and, second, the co-operation of the people in the community where you are working. One is as important as the other. Therefore you must attend strictly to business at all times, start work promptly every morning when the contractor does and remain on the job as long as he is doing any work, or until the last section of concrete laid is floated. You are expected to stay on the job all the time except during inclement weather. Intoxicating liquor in any form is prohibited on state-road work. Inspectors must keep out of saloons during working hours.

"You should be thoroughly familiar with the plans and specifications. It is not necessary for the contractor to complete the subgrade and ditches the full width before he hauls his materials, but he should have a subgrade completed about 22 ft. wide, perfectly flat and well rolled. The center

line should be staked out at least 1000 ft. ahead of the materials to see if there are any errors in alignment.

ACCURACY ESSENTIAL

"The contractor should have a straight edge and carpenter's level on the job. The straight edge should be at least a foot longer than the width of the concrete pavement. Check the form crosswise with the straight edge a few feet ahead of the mixer. When the straight edge is level, subgrade should be 6 in. deep. See that the subgrade is level, and not 7 in. deep in one place and 6½ in. in another place, and so on. We want exactly what the contract calls for.

"See that all contract materials are clean and that the shovelers do not shovel dirt from the subgrade in with the sand and stone. Check the contents of the wheelbarrows by means of a box that will contain 1 cu. ft. of materials. When the materials are dumped from the hopper into the mixer, see that the materials remain in the mixer at least one minute before being discharged. Don't accept a wet, sloppy concrete.

SETTING OF JOINTS

"Joints should be set as directed in the specifications. They should be set vertical and should extend to the bottom of the pavement, and should be wide enough so that they will be at least ½ in. above the center of the pavement. The edger should be run along both sides of the joint and along the forms. The subgrade should be kept sprinkled before the concrete is discharged from the mixer.

"The strike board should be cut to a curve and should be at least 18 in. longer than the width of the pavement, and should have an iron shoe on the under side. Check the strike board to see if it has the right crown at the center before using it. The strike board should be run over the concrete about three times and not over five times, to get the right amount of finish. Too much striking brings too much fine material to the top. The floating should be done by a man working from a bridge, on his knees. The concrete should not be floated when too wet.

"The pavement should be covered with an earth covering as soon as hard, and should be kept wet for at least two weeks. Keep all travel off for thirty days. See that both ends of the road are well blocked so that nobody can drive in. Each day's concrete should be protected at night with woven wire to keep dogs and chickens from getting on it while it is wet. Keep track of the cement as it arrives on the job.

"Finally, remember we want results, not excuses."

Gasoline Output Grows

Vast increase in the production of raw gasoline from natural gas resulted from expansion of the casing-head gasoline industry during the last calendar year. The U. S. Geological Survey recently announced that 65,364,665 gal. of raw gasoline was extracted and sold during the year. That was a gain of 22,712,033 gal., or 53 per cent, over 1914. An average price of 7.9 cents a gallon for the unblended product was received at sources of production, and the entire market value of the year's output was $5,150,823—a gain of $2,044,914 over 1914. It is estimated that 24,000,000,000 cu. ft. of natural gas was utilized in the manufacture, with the average recovery 2.57 gal. of gasoline per 1000 ft.

Puddling and Rolling to Assure Impervious Foundation for Keechelus Reservoir

Embankment Carefully Constructed to Make Watertight Connection—Piling Displaces Concrete Core in Water-Bearing Gravel

By C. E. CROWNOVER
Construction Engineer, U. S. Reclamation Service, Meadow Creek, Washington

IN THE DESIGN of Keechelus reservoir on the Yakima River in Washington every possible precaution was observed to make the dam watertight. The aim has been to discourage, so far as possible, the entrance of water either into the embankment or under it. Should seepage reach the lower side of the core wall, provision has been made to prevent saturation of either embankment or foundation and to drain away any water that may not have been intercepted. Particular care has been taken in the construction to prevent seepage along the wall of the conduit.

As noted in the discussion of the design in the Engineering Record of Oct. 14, page 474, it was found more economical at the river section to place the core wall in a deep, narrow trench. The position of the wall with reference to the cross-section of the dam was shown in the issue mentioned.

Because of the large amount of water encountered at the south end of the dam in passing through a stratum of water-bearing gravel, 9 x 12-in. Wakefield piling of Douglas fir was used instead of concrete. This core wall or break—it is just an obstruction to discourage the travel of water between the natural ground and the constructed embankment—was thoroughly puddled in by hand with earth for a depth of about 2 ft. above its top or until it was possible to go upon the puddle with teams and steam roller after settling. It was then carried up in rolled layers, the whole becoming an integral part of the rolled portion of the embankment.

Across the river section and well into the banks on either side, the core wall extends 25 ft. below outlet conduit grade and up into the embankment to a height of 20 ft. above the top of the conduit. The portion below grade is 4 ft. thick, but from this point narrows up to 18 in. at the top.

CORE WALL IN IMPERVIOUS CLAY

The core wall for its entire length is founded on gravelly clay that is practically impervious. At a depth of 31 ft. below outlet conduit grade, or 6 ft. below the bottom of the core wall in the river section, test holes disclosed a fine sand under much pressure. This sand formation is of considerable depth and test holes were driven for a depth of 35 ft. without passing through. It was considered too deep to pass through with a cutoff, and the core wall was therefore founded well above in impervious material. A series of wash drill holes was driven along the conduit line within the dam prism and the heights to which the water rose in them observed. No relation seemed to exist with the height of the water in the lake above the dam. The bed of the lake was thoroughly explored by drill holes for a considerable area in front of the dam and for a depth of 40 ft. below gate-sill elevation. It was found to be covered with from 5 to 20 ft. of blue ooze overlying a very tight gravelly clay of great depth. For 1700 ft. farther out in the lake the same blue ooze was found, but no apparatus was available to bore below it in such deep water. It is therefore quite certain that an impervious mud blanket covers the lake bottom, effectively cutting off any connection of the lake water with that found in the sand strata below the dam.

THE LOWER END OF THE OUTLET CHANNEL WAS EXCAVATED WITH A DRAGLINE EXCAVATOR; THE LAKE END WITH A DIPPER DREDGE. SPOIL WAS CARRIED AWAY BY 50-YARD CENTER-DUMP SCOWS AND DEPOSITED BELOW LOWEST RESERVOIR ELEVATION

Assume for the sake of argument that the water-bearing strata did connect with the lake at a point 40 ft. below gate-sill elevation, or the farthest point out at which definite soundings were made. Then with full reservoir the water pressure would be equivalent to a 96-ft. head, while the total distance from the point of intersection to the downstream toe of the dam is 1600 ft., giving an average gradient of 1:16.6. The point of intersection of the water-bearing strata on which the foregoing assumption is based is definitely known to be much farther out in the lake if it exists at all. Hence it is believed positively certain that there can be no danger of piping or leakage water with the full reservoir exerting an upward pressure on the material forming the foundation of the dam. For additional safety, however, the conduit was extended 35 ft. beyond the bottom of the 2:1 slope and blanketed with sand and gravel. This extension was also desirable in that it removed the stilling pool away from the toe of the main embankment.

The embankment consists of 522,000 cu. yd. of material, one-third of which is gravel on the lower side and two-thirds fine se-


LEFT, CONDUIT UNDER CONSTRUCTION—RIGHT, EMBANKMENT GIVEN NOT LESS THAN SIX IMPRESSIONS WITH 12-TON TRACTOR

lected rolled material on the water side. The gravel portion was dumped, spread and rolled over the higher sections. The low fills were dumped directly into place. This material was of a consistency that will not slough under saturation. A rock-filled drain extends the entire length of the dam, just under the lower toe. On fills of 20 ft. or more a 12-in. tile drain with open joints was placed in the gravel section, with outlet drains to the toe trench at all low points. Both of these features were shown on the section at Station 15 in the Oct. 14 issue.

Rolling Watertight Part of Dam

The fine material forming the watertight portion of the dam was spread in 6 to 8 in. horizontal layers, sprinkled and given not less than six impressions with a 12-ton traction engine giving about 300 lb. pressure per inch of tread of rear wheels. The rolling was done in two directions, with a roller having two separated wheels, tending to avoid continuous jointing in planes. As the material was spread and before rolling, all rocks 4½ in. in longest dimension were picked out and particular care taken to insure that the smaller rocks remaining were well distributed.

As this portion of the embankment was being built test pits were dug at intervals of about 200 ft. and so located as to give a continuous record from the original ground surface to the top of the dam. A classification of each pit was made and particular attention given to stratification, cleavage along horizontal planes, amount of moisture, etc. The pits were then filled with water and seepage observations made. Mechanical analysis and silt tests were also made from samples taken from the test pits. The former showed that about 28 per cent of the material passing a No. 4 sieve would pass a No. 100 sieve. The silt tests disclosed the fact that about 25 per cent of that passing a No. 4 sieve was silt. The remainder of the material was of a gravelly nature and well graduated.

A surfaced roadway will be built across the top of the dam connecting the transcontinental line of the Chicago, Milwaukee & St. Paul Railway with the Sunset Highway leading across the Cascade Mountains through Snoqualmie Pass to Seattle and other Puget Sound points.

Construction Plants

Electric power is delivered to the construction work at Keechelus dam over a 2200-volt transmission line 1¾ miles long and transformed to 110 or 220 volts as required. The waterpower plant has a working head of 280 ft. obtained by 2000 ft. of wooden flume and a 24-in. wooden penstock 1000 ft. long. The powerhouse equipment consists of two 200-hp. turbines, two 120-kw. 2300-volt three-phase 60-cycle alternating-current generators, each direct-connected to turbines, two Lombard oil-pressure governors for turbines and one three-panel switchboard.

The rock crusher, sand rolls, revolving screens, concrete mixers, pumps, sawmill and repair shop, and all other machinery are operated by motors. The heavy equipment—steam shovel, dragline excavators, embankment rollers and dipper dredge—is steam-operated.

Construction Methods

After clearing the dam site all stumps larger than 12 in. in diameter were loosened with stumping powder, pulled and piled with a logging donkey, and burned. Two feet of the top soil was then removed by plowing and by using teams with slips, fresnos and scrapers. The cutoff trench was excavated with a 1½-cu. yd. Lidgerwood Crawford dragline excavator. The core-wall trench was dug by hand and the concrete hauled by train from the mixing plant and chuted to the forms. The backfill of the cutoff trench was thoroughly puddled in by hand up to 2 ft. above the top of the core wall. The remainder was placed with teams, spread and rolled.

A 2-ft. gage railroad extends the entire length of the dam on which all material for the embankment, except the river section, is brought in by trains of 12½-cu. yd. cars hauled by 9-ton locomotives. After being dumped the material is spread with fresnos into 6-in. layers and rolled with a Buffalo-Pitts steam roller. Riprap and foundation rock are brought to the dam in the same manner and placed by hand. Material for the river section is hauled in on the lower elevations by 2-cu. yd. three-horse dump wagons, dumped where needed and spread with fresnos before rolling.

CORE WALL PLACED IN BOTTOM OF TRENCH

The lower end of the outlet channel was excavated with a dragline excavator, while the lake end was dredged with a 1½-cu. yd. Fairbanks dipper dredge. The spoil was towed by gasoline launches to the lake in 50-cu. yd. center-dump scows and dumped below lowest reservoir elevation.

Concrete-Handling Methods

Rock excavated for the spillway is used for riprap and crushed for concrete. From the crusher both stone and sand are hauled by train to the mixing plant, where they are dumped into storage bins. From the bottom of the bins they pass by gravity through measuring devices into a hopper where the cement is added. After being mixed in a 1-cu. yd. Ransome mixer the concrete flows into a Lakewood automatic tilting concrete hoist bucket and is again hoisted to the track. From there the aggregate is dumped, chuted into concrete cars and transported by trains for use in the core wall. The mixing plant was so located that the concrete was handled direct to the river conduit and gate tower by chuting direct to forms or pushing for short distances in concrete cars. For the spillway concrete a mixer will be installed near the crushing plant.

Work was begun in the spring of 1913 and will be completed, with the exception of a portion of the clearing, during the present season. The work is located only eight miles from the summit of the Cascade Mountains in the region of deep winter snows. It has therefore been necessary entirely to close down each winter for four or five months. During the short season work is prosecuted vigorously, both night and day, with a force of from 500 to 700 men.

Complete Construction Crews Organized

On work of this character, where unknown conditions require frequent change of plants, where classification of material is particularly difficult, and the working season short, it has been found that it can be done much more satisfactorily with government forces than by contract. It was therefore necessary to organize complete construction crews, as well as an engineering and supervisory force. The construction department assumes the position of a contractor and is required to execute all work under rigid inspection of the engineering department.

As noted in the Oct. 14 issue, the work is

under the general direction of the U. S. Reclamation Service, of which A. P. Davis is director and chief engineer. Until July, 1915, the work was under the administrative supervision of G. H. Swigart, supervising engineer of the Washington division. Later, S. B. Williamson, chief of construction, had supervision. The writer is in direct charge of construction on the Yakima storage project, assisted by R. E. Post, superintendent of construction, and J. R. Sherman, assistant engineer.

Rules Proposed to Control Motor Trucks in Jersey

Tentative Schedule of Restrictions on Size, Weight and Speed Suggested as Forerunner of Legislation

As a preliminary to legislation regulating the weight, size and speed of motor trucks in New Jersey a special committee, appointed by William L. Dill, state commissioner of motor vehicles, has submitted a tentative set of rules placing certain restrictions upon this type of traffic. The rules have been formulated, of course, to protect the state's highways from unreasonable use. In their present form, however, they are considered too drastic by the Motor Truck Club of America, whose counsel, Charles G. Bond, of the firm of Coulter & Bond, at a meeting of the club in New York City Oct. 18, presented the case of the motor-truck interests, outlining the results of his conferences with the New Jersey committee and calling upon members of the Motor Truck Club to express their views regarding the proposed legislation. A summary of the New Jersey rules, which are subject to change before final adoption, is given below and the objections of the motor-truck interests are discussed in an editorial on page 519.

REPORT OF NEW JERSEY COMMITTEE

The special committee appointed by William L. Dill, commissioner of motor vehicles of the State of New Jersey, on May 4, 1916, for the purpose of preparing rules and regulations to govern the use of motor vehicles or trucks on the highways of the State of New Jersey, submits the following:

1. No commercial vehicle or truck of over 4000 lb. weight shall be more than 96 in. in width, outside measurements, except that in extreme cases the commissioner of motor vehicles shall be privileged to issue permits for the operation of motor vehicles or trucks with a width of load over 96 in. where the weight of the load is not a factor.

2. No commercial vehicle or truck shall be equipped with metal tires that may be in contact with the surface of the road, nor shall any such vehicle or truck be equipped with any tires which have a partial contact of the metal with the surface of the road.

3. No commercial vehicle or truck shall be equipped with any tire covering of metal, or with any lugs or hobs, or other sharp devices which would be in contact with the surface of the road, except chains which may be used in accordance with the Motor Vehicle Act.

4. The height of all commercial vehicles or trucks shall be limited to 12 ft. 2 in.

5. All commercial vehicles or trucks should be equipped with a sealed governor, the speed to be regulated as per schedule attached hereto.

6. No commercial vehicle or truck shall be equipped with center searchlight, but that the lights of all commercial vehicles or trucks shall be in conformity with Section 4 of the Motor Vehicle Act.

SCHEDULE SHOWING ANNUAL FEE AND FEE IN SEPTEMBER, BASED ON GROSS WEIGHT

Gross weight of truck and carrying capacity, pounds	Annual fee	Fee in September
4,000 or less	$15.00	$7.50
4,000 to 5,000	17.50	8.75
5,000 to 6,000	20.00	10.00
6,000 to 7,000	22.50	11.25
7,000 to 8,000	25.00	12.50
8,000 to 9,000	27.50	13.75
9,000 to 10,000	30.00	15.00
10,000 to 11,000	32.50	16.25
11,000 to 12,000	35.00	17.50
12,000 to 13,000	40.00	20.00
13,000 to 14,000	45.00	22.50
14,000 to 15,000	50.00	25.00
15,000 to 16,000	55.00	27.50
16,000 to 17,000	60.00	30.00
17,000 to 18,000	65.00	32.50
18,000 to 19,000	70.00	35.00
19,000 to 20,000	75.00	37.50
20,000 to 21,000	81.25	40.63
21,000 to 22,000	87.50	43.75
22,000 to 23,000	93.75	46.88
23,000 to 24,000	100.00	50.00
24,000 to 25,000	106.25	53.13
25,000 to 26,000	112.50	56.25
26,000 to 27,000	118.75	59.38
27,000	125.00	62.50

7. The extreme length of motor vehicles or trucks shall not exceed 23 ft. 6 in.

8. Not more than one trailer shall be allowed to any commercial vehicle or truck; in every case said trailer shall be equipped with rubber tires.

9. All commercial vehicles or trucks shall carry a spare wheel, so as to avoid the possibility of any part of the steel rims coming into contact with the surface of the road, should the rubber tires become broken or otherwise damaged.

10. All drivers of commercial vehicles or trucks shall carry way bills for each load, said way bills to show the gross weight and net weight carried.

11. The commercial size of tires used on all commercial vehicles or trucks shall be determined on the maximum width of rubber.

12. All license fees shall be based on the maximum wheel load carried on same, said wheel load to be determined by the size of tire used and adopted in conformity with the schedule hereto attached.

13. All trailers or semi-trailers shall be licensed on their carrying capacity.

14. All counties in the state shall place signs showing the clearance on all bridges in their respective counties, if the clear headroom is less than 12 ft. 6 in.

15. A special permit shall be secured from the state motor vehicle commissioner for the use of trucks as pleasure vehicles.

16. The trucks or commercial vehicles equipped with under-sized tires shall not be licensed.

17. On each rear wheel one-third of the gross weight of truck and carrying capacity combined must be within the limits of the schedule of the respective diameter of wheel, size of tire and speed in miles per hour as shown in schedule hereto attached.

18. The front axle shall carry the balance of the gross weight of truck and load combined and must be within the limits of the schedule of the respective diameter of wheel, size of tire and speed in miles per hour for single tires, as shown by the schedule hereto attached.

19. All commercial vehicles or trucks carrying any load extending beyond the sides or ends of the outside dimensions of said vehicles or trucks shall have displayed at the outside extremity of load a red flag which shall be not less than 12 in. square and shall be so long as to present a full view to approaching vehicles.

The committee submitting this report consisted of Thomas J. Wasser, chairman; John J. Albertson, Garwood Ferguson, Alvin Fox, and Frederic A. Reimer, secretary.

PROPOSED SCHEDULE OF LOADS, SPEEDS, TIRE WIDTHS AND DIAMETERS

Tire size, inches		Wheel diameter, inches — Maximum wheel load in pounds: 32	34	36	38	40	42	Speed, miles per hour
2	Single	565	595	625	660	690	720	20
2½	Single	840	890	940	990	1,040	1,090	20
3	Single	1,125	1,190	1,250	1,315	1,375	1,440	20
3½	Single	1,415	1,490	1,565	1,640	1,715	1,790	18
4	Single	1,690	1,780	1,875	1,970	2,065	2,155	16
5	Single	2,250	2,375	2,500	2,625	2,750	2,875	14
6	Single	2,815	2,970	3,125	3,285	3,440	3,595	12
7	Single	3,375	3,565	3,750	3,940	4,125	4,315	10
2	Double	1,125	1,188	1,250	1,312	1,375	1,438	18
2½	Double	1,675	1,775	1,875	1,975	2,075	2,175	18
3	Double	2,250	2,375	2,500	2,625	2,750	2,875	16
3½	Double	2,825	2,975	3,125	3,275	3,425	3,575	14
4	Double	3,375	3,560	3,750	3,940	4,125	4,310	13
5	Double	4,500	4,750	5,000	5,250	5,500	5,750	12
6	Double	5,625	5,940	6,250	6,565	6,875	7,190	10
7	Double	6,750	7,125	7,500	7,875	8,250	8,625	10

$18,000,000 Worth of Highways Accounted For

Review Made of Costs and Notable Features of California Commission's Work Since 1909

With the expenditure of the last of the $18,000,000 which was authorized in California in 1909 for the construction of trunk highways, the highway commission has been able to show a road system laid out in complete detail with finished roads in every part of the state on those routes where the immediate need was the most urgent. The aggregate mileage completed includes 966 miles of oil-surfaced concrete pavement, 129 miles of oiled macadam and 395 miles of graded dirt road.

COSTS SUMMARIZED

A review of the costs and notable features of the work accomplished by the commission, from which the following has been taken, was recently prepared for the California Automobile Association by Eric Wold, who was retained for that purpose. His résumé of the commission's statement of expenses shows the following figures:

Construction cost:	
Payments on contracts, materials and day labor work	$14,284,552.11
Equipment (1.15 per cent of construction cost):	
Expenditures of all classes of equipment and furniture	164,394.46
Expenses (16.64 per cent of construction cost):	
Expenditures for engineering, legal accounting, purchasing, laboratory, services and expenses incidental thereto	2,372,757.41
Total expenditure to June 15, 1916	$16,821,703.98
Total amount available from state highway fund	18,000,000.00
Unexpended balance June 15, 1916	$1,178,296.02

Since June 15, 1916, at which time the foregoing figures were brought up to date, the commission has obligated itself for the expenditure of approximately the entire balance remaining out of the original $18,000,000.

A general survey of 175 contracts under which the commission has let highway construction work developed the following average prices, which include the cost of material:

Excavation, including clearing right-of-way, shaping and finishing of roadbed, watering and rolling, per cu. yd.	$0.41
4-in. concrete pavement, per sq. yd.	.738
1½-in. asphalt wearing surface, per sq. yd.	.45
⅜-in. oil top, per sq. yd.	.054

A total of 2350 miles of road was surveyed at a cost of $744,957, or $317 per mile. Of this total only 1490 miles have been constructed, as before stated, so that the cost of locating ready for construction about 860 miles of highway is included in the expenditures made to date. This mileage of survey on which construction was not undertaken was necessary because of the difficulty and delay in securing certain necessary rights-of-way which forced the commission to construct disconnected lengths of road.

The handling and delivery of all materials used on construction were undertaken by the commission, and the overhead charge of 10 to 20 per cent of the net cost of the contract, which is usually allowed for this item, was borne by the commission and is included in the commission's expenses. A summary of the equipment which the commission purchased to carry on this work is as follows:

CALIFORNIA ROAD-BUILDING EQUIPMENT

Equipment	Cost	Per cent salvage	Salvage
Sand plants	$27,259.19	100	$27,259.19
Construction equipment	21,257.49	100	21,257.49
Engineering equipment	25,716.10	50	12,858.05
Furniture	21,328.05	40	8,531.22
Stable	17,070.99	100	17,070.99
Auto	41,380.55	40	16,552.22
Camp	6,429.32	20	1,285.87
Laboratory	3,952.74	50	1,976.35
	$164,394.43		$106,791.38

Therefore the 17.79 per cent of the total expenditure, which is shown in the first table as gross overhead, includes in reality salvable equipment, surveys (the advantage of which has not yet been realized), and other minor items, such as designs, supervision, etc., given gratis to counties undertaking independent road work. The net overhead chargeable to the construction work on the roads actually built, including allowance for these items, amounts to 12.75 per cent of the gross construction costs, which is considered a very reasonable allowance for net overhead on public work of this character.

FOUR NOTABLE FEATURES

Four notable features of the construction work are pointed out as follows: (1) The construction of the Ridge Route road from Los Angeles to Bakersfield (described in the Engineering Record of Sept. 11, 1915, page 322), which shortened the distance between these two cities 25 miles and afforded a maximum gradient of 6 per cent, as compared to the 20 per cent gradient of the older routes; (2) the construction of the new San José-Salinas route, which eliminated the dangerous San Juan grade; (3) the elimination of the Bell Springs grade on the Mendocino-Humboldt line, which reduced the maximum grade from 30 to 6 per cent and eliminated 2686 ft. of rise and fall; (4) the construction of the Yolo Causeway (described in the Engineering Record of Aug. 28, 1915, page 248), which connects both sides of the Sacramento Valley and afforded the first open-all-year crossing in the 200-mile stretch between the Chico bridge and the Benicia ferry.

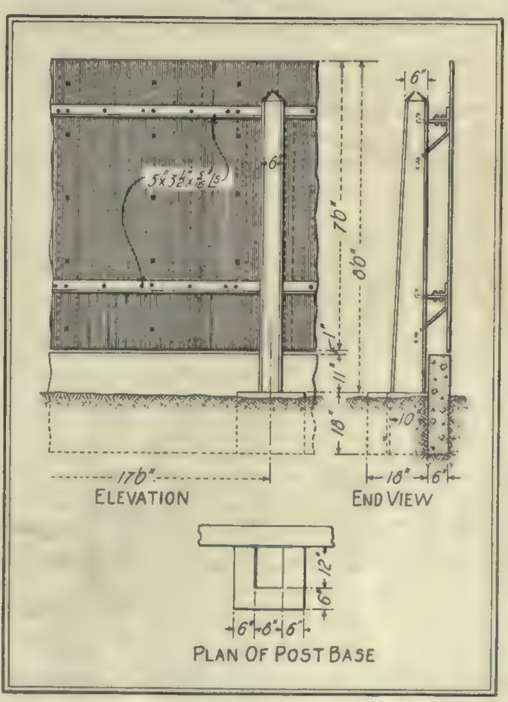
The commission has made surveys and maps of the rights-of-way for the entire length of the highway system. The purchasing department, by developing a system which enabled it to buy in the wholesale markets and distribute to all parts of the work effectively, made a gross saving of $500,000, it is claimed, on purchases and freight reductions. The cost of the legal-department work has been kept down to $30,000, and in all of the right-of-way disputes to be settled there have been no injunction or ejectment proceedings. The commission early established its own test laboratory, where a total of about 5000 tests has been made on the variety of materials used in road construction. The entire expense of the laboratory department, including salaries and the services of an expert geologist, totaled $27,700, which is stated to be about $12,000 less than the cost of having the same tests made by private corporations.

Use Galvanized Corrugated Steel and Concrete Fence

Industrial and Factory Plants and Grounds Protected and Their Appearance Improved by Practically Permanent Inclosure

MANY ADVANTAGES are claimed for the combination type of galvanized corrugated steel fence supported by reinforced-concrete posts which has been used extensively by the American Sheet & Tin Plate Company during recent years. Twelve of this company's plants now use this type of fence, which apparently is highly satisfactory in combining strength and low maintenance cost. The photograph and drawing illustrate the details of these fences.

There are several reasons why this type of fence should be a great improvement over an ordinary wooden fence, especially for industrial and factory plants. It is efficient in prohibiting trespass and in insuring privacy. The concrete curb keeps a constant level in the yard by preventing the soil from washing out, the depreciation is very small and structurally the fence is amply strong to resist high winds and drifting snow.



DETAILS OF CORRUGATED-STEEL FENCE


INSIDE AND OUTSIDE OF TWO SECTIONS

The concrete curbing, 6 in. wide and 29 in. high, placed about 18 in. below the ground level, is made of a 1:3:5 gravel concrete. The post base is cast with the curb, a pocket, shown in the drawing, being left for the post. The posts are of 1:2:4 gravel concrete reinforced by six ¼-in. bars, and are spaced 17 ft. apart. The supports for the longitudinal angles are 3 x ½-in. flats bent as shown and cast in the concrete. These posts are cast as separate units.

The angles for supporting the galvanized corrugated steel are 17 ft. long, set with their 3½-in. legs vertical, and are connected to the sheeting by ¼-in. rivets. Copper-steel sheets 26 in. wide are used, erected 24 in. to the weather, and after six months' exposure are painted.

Meters Save Water for Terre Haute Despite New Consumers

Although there were 500 more consumers of water in Terre Haute in August of this year than during the same month in 1914, the maximum amount pumped was 4,000,000 gal. for any one day during the recent hot period. Two years ago is used for comparison, for a hot spell of similar intensity was encountered. The peak load in 1914 was a 16,000,000-gal. daily rate. This year it was less than 10,000,000 gal. The lowered rate is due to the fact that 93 per cent of the services are metered and the remaining 500 flat-rate payers are small consumers.

Repair Beams and Columns in Concrete Structure

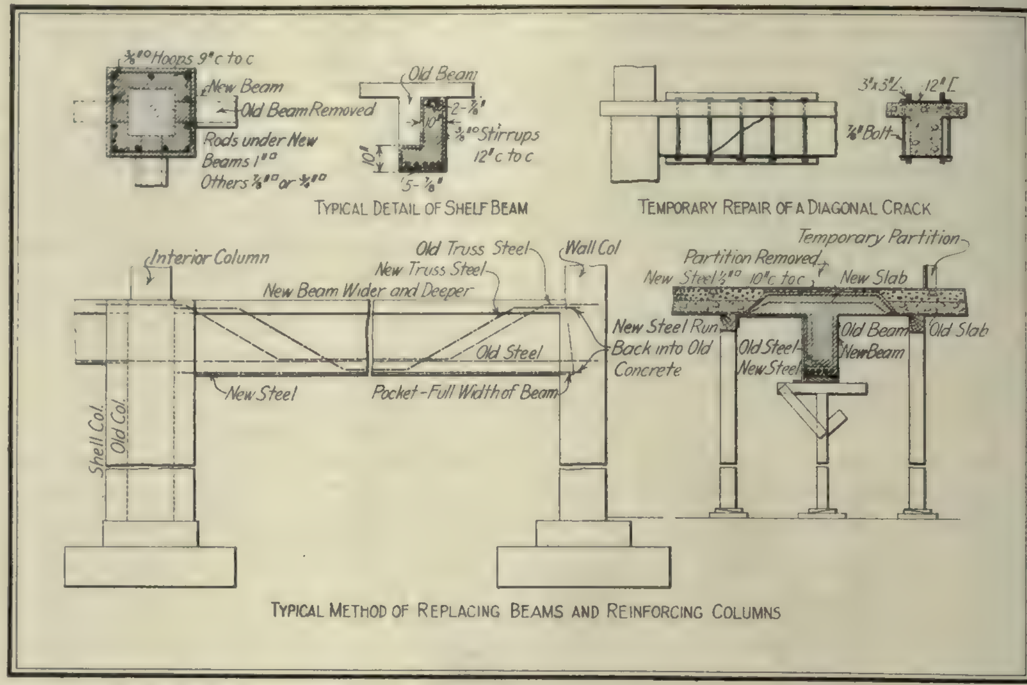
Cracked Floors of Theater Building in Fort Worth, Tex., Strengthened by Addition of Reinforced Concrete

PARTIAL FAILURE of the Majestic Theater and office building in Fort Worth, Tex., evidenced by cracks and sagging in the reinforced-concrete beams and floor slabs, led to the requirement by the building department that the floors be adequately strengthened and repaired. Permission was given to carry on this repair work without removing tenants, so that the unusual problem of constructing envelopes for columns, removing and replacing beams and slabs, and increasing the sections of beams with least inconvenience to tenants was encountered.

Nature of Cracks

The building was constructed in 1910-11, before the city building department was created and before a building code was in force. A trivial accident to an electric sign in 1914 requiring the presence of a building inspector led to the discovery of serious cracks in the floorbeams. Investigation showed many slabs with tension cracks due to negative moments and with large deflections, and a great number of beams badly cracked and sagging. In the latter were tension cracks at the center and diagonal cracks near the quarter points, and in several cases horizontal cracks near the neutral axis running the full length from one diagonal crack to the other. These cracks were by no means microscopic, but were such as appear in laboratory tests upon complete failure. In several columns the concrete had spalled off at the pouring joint and the reinforcing rods at the corners had buckled out. Laitance, dirt and organic matter in columns, from ½ to 3 in. thick, at the pouring joints, showed that the concrete had been placed too wet.

In making the repairs without removing tenants, the usual routine in replacing a single beam consisted in building a temporary wood partition, removing the permanent partition or wall over the beam, shoring the slab, wrecking out beam, replacing concrete of enlarged section, and then refinishing partition, plastering, etc. In some instances it was considered advisable to remove the entire slab panels along with the beams. In some cases it was possible to cut pockets in columns to receive new beams, while in others it was necessary to build a shell column around the old one to reinforce it and to form a beam seat, as indicated on one of the drawings.

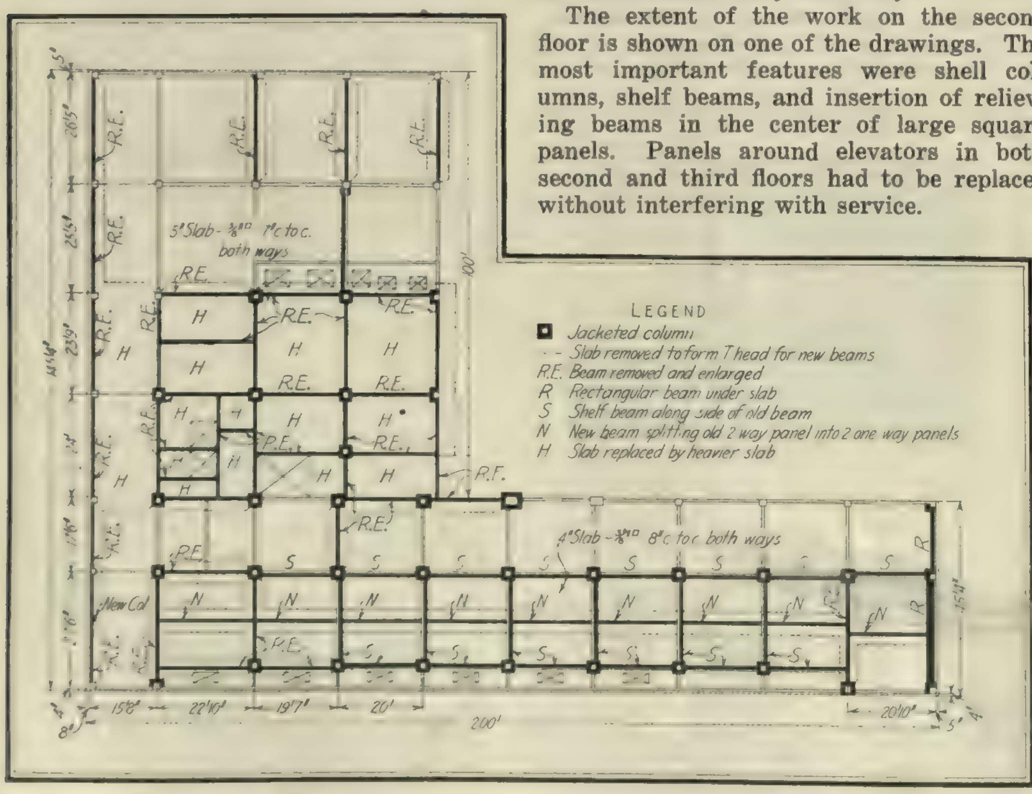


DETAILS OF METHODS USED TO STRENGTHEN BEAMS AND COLUMNS

Extent of Repair Work

The bulk of the repair work consisted of replacing the front beams, reinforcing first-story columns, and strengthening the second floor. The front was handled in three sections of two panels each. In the three-story part all beams in two panels were removed at one time and replaced at one time, but in the four-story part a new column was introduced to divide a long span, and only one floor was taken every other day.

The extent of the work on the second floor is shown on one of the drawings. The most important features were shell columns, shelf beams, and insertion of relieving beams in the center of large square panels. Panels around elevators in both second and third floors had to be replaced without interfering with service.



PLAN OF SECOND FLOOR INDICATES SCOPE AND NATURE OF REPAIRS

In only one place was it found impossible, on account of tenants, to replace old construction. Here channels reinforced with angle irons were placed top and bottom of the beams and bolted together where diagonal cracks had occurred, as indicated on the drawing herewith.

The cost of work of this character is naturally very high. Form labor ran about twice normal costs per square foot, concrete labor averaged about three times normal cost for new work, and finishing, while not so high in proportion, naturally ran higher than new work. A large additional expense was incurred in moving tenants where necessary and in making good the damages to their furniture and fixtures.

All badly cracked beams and several others only slightly cracked have been replaced, and the building can be considered reasonably safe. The building department, however, has the entire building under close observation for future developments. The design for repairs was made by W. T. Buck, architectural engineer, of Fort Worth and Houston, Tex., and the work was done by day labor under the direction of Mr. Buck. The original design and construction were by H. L. Stevens & Company of Chicago.

Stone Sidewalks Standardized

Until last year the city of Newton, Mass., allowed abutting property owners who desired artificial stone sidewalks and driveways to have the work done by any contractor they might select, at their own expense in the first instance. On completion of the work the city allowed the property owner the same amount that the city would have to pay if coal-tar concrete sidewalks were laid, instead of artificial stone. A different policy was adopted recently, according to the annual report for 1915 of Edwin H. Rogers, city engineer. Specifications for the construction of artificial stone sidewalks, driveways and curbing were prepared by the city's engineering department, proposals were advertised for and a contract for doing such work as might be ordered by the city was entered into with a local firm. Arrangements were made whereby the city paid substantially one-half the cost of this sidewalk construction.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Joints in Concrete Roads Laid Late in the Season

SIR: Referring to the article in the Engineering Record of Oct. 14, page 465, regarding widening of joints in concrete roads laid late in the season: To my mind concrete pavement laid in the fall is liable to all sorts of trouble on account of possible freezing of the surface and also expansion of the slabs the following summer, due to insufficient width of expansion joints. The proper remedy for these conditions is to get the concrete work done in the summer months, or at least completed early enough in the fall so that there will not be danger of low temperature.

CHARLES J. BENNETT,
State Highway Commissioner.
Hartford, Conn.

Hydrated Lime and Faulty Brick Piers

SIR: The writer has read with a great deal of interest Sanford E. Thompson's report on the causes of the failure of a school building at Roxbury, Mass., in your issue of Sept. 2, page 294.

This article brings home the unfortunate fact that manufacturers of certain standard materials of construction, such as cement, lime and gypsum, are compelled to depend upon factors of construction beyond their control, which in the past have often been the cause of failures. As an example, the reading of Mr. Thompson's report may possibly influence some to consider the use of lime as being partly responsible for the failure; but close analysis of the complete report shows clearly the abuses to which building materials, including lime, are often subjected.

The time of laying the brick masonry was during freezing weather; and Mr. Thompson's report indicates that the operation of slaking the lime was hurriedly done and that the lime was used before it was completely slaked, as unslaked lime was found in the mortar after the failure. Of course, the heat that is generated during the process of slaking lime may have been expected to ake the place of heating the materials; but this is poor practice. During the mixing of the mortar, apparently no attention was paid to the correct proportioning, as is evidenced by the great variation in the quantity of lime in different batches—fifteen shovelfuls of lime in one case and four in another.

With reference to the use of lime in cement mortar for brick masonry, results of carefully conducted tests completed during the last year reveal facts connected with the use of hydrated lime which are worthy of more than passing interest at this time. The developments referred to are those brought out in the investigation conducted in 1915 by Prof. James S. Macgregor at Columbia University, New York City. In this investigation hydrated lime was used throughout. In the use of this material absolutely accurate measurements may be made, of course, either by weight or by volume, and thus eliminate such wide variations as occurred in the building which failed.

On page 165 of the Engineering Record of Aug. 5 a summary of the results of Professor Macgregor's tests shows the increase in compressive strength at 7 days, 28 days and 3 months periods brought about by the use of varying replacements of Portland cement by hydrated lime. A mortar containing 50 per cent hydrated lime, 50 per cent Portland cement and three parts of sand shows a higher compressive strength at all of the ages mentioned, and at 90 days it is shown that a mortar of these proportions gives a compressive strength almost 1000 lb. per square inch in excess of that developed by a straight 1:3 cement mortar.

Judging from the results of this investigation, which showed that a volumetric replacement of Portland cement by hydrated lime up to 50 per cent was entirely on the safe side, there seems to be no question that a satisfactory and safe mortar would have resulted had a normal amount of judgment been used in mixing the materials and heating them to prevent freezing.

B. NAGY,
Chief Engineer, Hydrated Lime Bureau, National Lime Manufacturers' Association.
Pittsburgh.

Abnormally Slow Setting of Small Areas of Concrete

SIR: About a year ago I was called upon to examine some 72-in. concrete sewer pipe being cast and steam-cured for the city of Salt Lake, Utah, by the Lock Joint Pipe Company. The pipe were giving trouble at irregular intervals by sticking to the forms, leaving pitted spots, which had to be patched by hand. The concrete was poured into greased iron forms and steamed for two or three hours as soon as poured, then the forms were removed and steaming continued for a total of seven hours. The mixing, placing, and all operations seemed to be properly done, and the irregularity with which the sticking occurred seemed unaccountable.

In the pitted spots the concrete remained soft and crumbling for some time. While examining one of these I pulled out several fragments which crumbled easily between the fingers, and dropped them in my raincoat pocket. Several months later, on using the coat, I was surprised to find the pieces perfectly hard and sound.

Experiments made following the inspection showed the cement to be normal, and the sand was suspected, but no definite conclusion reached. Having seen cases of abnormally slow setting in large pieces, it occurred to me that this might take place in small areas which would ordinarily pass unnoticed. Accordingly, I have made experiments, the results of which offer a possible explanation.

Without going into the details of these operations, I would say that I have been able to reproduce the pitting effects by means of retarding the set locally, and I find that in these spots the cohesion may be about the same as, or less than, atmospheric pressure when the surrounding concrete has become set, which would explain the sticking to the forms. Although unable to work with the original material, I am convinced that certain substances which might easily be present in any sand or gravel near Salt Lake City will dissolve sufficiently by the heat of steaming to diffuse through a small area and exert a strong retarding effect before the rest of the concrete, not affected, has secured its set.

While this incident may be quite isolated, and my experiments of little interest to cement users, yet these conditions may be of more common occurrence than would be supposed, and I would like to ask through your columns if other cases of local abnormal retardation of set have been observed and studied.

E. G. PIERCE,
Consulting Chemist.
Youngstown, Ohio.

Estimated and Actual Cost of Baguio Railway

SIR: The article in your issue of Sept. 16, page 351, describing some of the features of the construction of the Baguio Railway, is of interest, both for what it tells of the conditions in the Philippines, as well as those under which this line was built, and also for the marked discrepancy between the estimated and actual costs of construction as quoted therein.

The estimate given in Table 1, said to have been made from a projected location, amounts to some $1,750,000, whereas it was stated that the actual cost was nearly $5,000,000. Practically no adequate explanation is made regarding this discrepancy, and final comment or criticism must be deferred pending further information, which it is hoped may be forthcoming.

It is true, the preliminary estimate did not include track, buildings, telegraph, water-supply or general expenses, engineering, etc., but it would hardly seem that on a line 25 miles long, even with the rack, these could have amounted to more than $1,000,000, possibly not half that, which still leaves a considerable discrepancy to be accounted for.

The article mentions some items of difference, namely, that concrete cost $15 per cubic meter (1.3 cu. yd.) instead of $5 as originally estimated, that the quantity of steel was increased to nearly double, that clearing was somewhat more costly, that the earthwork, while exceeding the estimated quantities, was carried out for approximately the estimated costs or even less, and that the length of the tunnels was nearly doubled.

There is some indication in the article that the preliminary estimate quoted might have been revised later, but for the benefit of engineers and others interested in the broader questions of railway economics, and especially at this time when American engineers may have a more extended interest in railroad construction in foreign countries, further light on this phase of the situation will be of interest.

As the matter stands now, the question naturally arises as to whether the decision to adopt the rack line on 12 per cent gradients was affected by these estimates, whether more nearly correct estimates were made before a decision was arrived at, or whether if an estimate had been made more nearly in accord with the facts as developed

by actual construction a different decision would have been reached.

It will be of not a little interest to know later on how the cost of operating the rack line compares with costs on adhesion lines on the same railroad, both the actual operating cost per ton-mile reduced to a unit providing for the actual "work done" in overcoming elevation as well as distance, and also the maintenance cost per mile of line.

F. LAVIS,
Consulting Engineer.
New York City.

[A copy of the foregoing letter was sent to Mr. Butts, author of the article in question, and his comments on it follow.—EDITOR.]

SIR: Your letter containing comment by Mr. Lavis on my article received.

Mr. Lavis is under the impression that I stated that the cost of the Baguio Extension was $5,000,000. In the middle of page 352 the following appears: "And probably one of the most expensive for its length, as the cost will probably reach $5,000,000." The same paragraph says: "The European war necessitated the cutting down of the work, but its completion, which will require 2 years, is assured."

The estimate shown in tabulated form was made in 1911. In 1912 construction work was begun, and because the government officials wanted the road finished at the earliest possible moment, a factor entirely unforeseen, work was pushed from both ends at the same time, necessitating hauling by automobile trucks and by carts a distance of about 30 miles. As the government owned and operated the automobile line, the expense was even more than it would have been under railroad management. The haul was also increased when the rainy season required the removal of the railroad track at Camp 1, making the haul about 50 miles.

Next in line to increase the cost of the line above any foreseen difficulties was the constant friction with the government-hired and incompetent foreman, who reported to the governor of the mountain province and not to the engineer in charge. The money wasted because the engineer in charge could not handle the foreman and the labor as he wanted to, but instead had to submit to unheard-of red tape, was enormous. Then all reports and every move the railroad company made had to be O. K.'ed by the government before anything could be done. Duplicates of all reports had to be handed the government, and all surveys had to meet with the approval of the government "expert."

Next appeared an engineer from Switzerland, who was to act as consulting engineer. He could speak neither English nor Spanish; and although he was a fine man personally and perhaps as good an engineer as could be found, he took issue with American practice, with the use of reinforced concrete and with the use of degrees of curvature instead of radii, and generally unsettled everything because he did not have the proper authority to carry out his ideas, but could hold up and delay all work.

This Swiss engineer next brought a dozen more Swiss, Italians, Montenegrins and Germans, with whom he had formerly been associated, to the islands, all of them at round salaries. They were given charge of the tunnel work and were supposed to act under the instructions of the resident engineer; but they devoted themselves largely to causing all the trouble possible. They could not talk to the workmen, and only through an interpreter could they communicate with the resident engineer. Friction of all kinds resulted, and finally nearly all of them went back to Europe after having accomplished nothing at all compared with the expense they had been to the company.

Finally, the Swiss consulting engineer succeeded in effecting changes in the line and abandoned parts already finished. The tunnel distance was nearly doubled and concrete piers were discarded for piers built of cut stone where concrete materials were easy to get and cut stone was exceedingly expensive. The tunnel sections were unnecessarily enlarged, and rammed concrete placed practically dry was the final step.

Of course, the facts that the cost of clearing was underestimated, the drainage areas were increased and numerous slides were met with did increase the cost of the work considerably, but I think that every engineer who came into intimate contact with the work will account for the expenditure of more than was estimated by reviewing the friction between the government and the railroad, the red tape necessitated by the fact that the government was advancing the money and guaranteeing a 4-per cent interest on the same and because the consulting engineer was not in accord with American practice.

W. M. BUTTS,
Assistant Division Engineer, Nashville, Chattanooga & St. Louis Railway.
Tullahoma, Tenn.

Time to Abolish "Yardage"

SIR: Yardage expresses a pet inconvenience which engineers fondly cling to from habit only. They assume that quantities of area and volume of certain classes of construction must be referred to in yards, as that is the established custom. Many young engineers realize that this is a mistaken idea and should be abandoned, but they are seldom in a sufficiently independent position to act contrary to the established "trade custom." The use of yards to express quantities of masonry and concrete work is particularly inconvenient. For earth and roadwork it is also very inconvenient and is an item of considerable cost.

The most common reason given is that large quantities require large units. The ridiculous feature of this explanation may be noted by referring to data usually published of dams. The quantities of earth and masonry in the dam are ordinarily given in cubic yards and the amount of water impounded is given in gallons, although this is a reversal of the idea of using large units for the larger quantities. Volumes of concrete when reduced to cubic yards are usually given to tenths, often to hundredths and sometimes to thousandths of a cubic yard, thus losing any possible advantage which might be claimed for the yard as a large unit which requires the use of less figures to express.

The square yard as a unit for pavements is convenient in size for stating construction costs, but rather a small unit for maintenance costs and unreasonably small for cleaning costs and data. Many engineers use the square yard as a pavement unit in order to show a comparison of costs with other localities, but it is now realized that a uniform unit of measurement is of slight value in comparisons unless similar items of cost are covered in all cases, and this is not the usual condition.

On practically all construction work the foot is used as the unit in which dimensions are measured. The transformation of volume to weight is usually based on tables giving weights per cubic foot of materials. Practically all areas and volumes are first estimated in feet and then divided by 9 or 27 to reduce the results to square or cubic yards. This work of translating quantities from feet to yards is all waste work and is also a prolific source of error. Every engineer is supposed to be an efficiency engineer to the extent of dispensing with all useless labor.

The expense of this constant reduction of quantities from feet to yards can be conveniently shown by using highway construction as an example and estimating the cost of reducing the quantities in cubic feet to cubic yards.

Road Surveys—Assume eighty cross-sections per mile. The quantities would be figured and checked at least three times, a first and a final estimate by the engineer and one by the contractor. Each reduction to yards averaging one minute, the cost per mile may be taken as follows:

$80 \times 6 = 480$ min. $= 8$ hr. at 70c. $= \$5.60$

Bridges and Culverts — Assume three classes of concrete in each structure, each class being reduced to cubic yards. A first and final estimate made by the engineer and eight bidders figuring the work, each operation being checked, the cost per structure may be taken as follows:

$3 \times 10 \times 2 = 60$ min. $= 1$ hr. at 70 cents	$0.70
Add for excavation, materials, etc.	.30
Total	$1.00

This shows a useless expense of more than $5 per mile of road surveys and $1 each for structures. Bridges and culverts will average at least one per mile of road, making the total more than $6 per mile of road.

In the United States about 16,000 miles of improved roads are now being constructed per year and about $16{,}000 \times \$6 = \$96{,}000$ is being spent annually for worse than useless work in reducing quantities to yards.

The Federal Aid Road Act will assist in the construction of about 25,000 miles of road, and $6 per mile, or a total of $150,000, may be estimated as the cost of reducing all quantities to yards on this work. If the maximum possibility of this item is desired, the cost per mile may be applied to the 2,175,000 miles of unimproved rural highways of the United States.

By the use of tables, slide rules, etc., reductions may be done more quickly than estimated above, but the reductions of surface area to square yards, not included in the estimate, will probably overbalance any saving of time made by mechanical means.

The use of yards (and barrels) on concrete work has been a very decided factor in the confusion of ideas attendant on the use of concrete. The Joint Committee on Concrete and Reinforced Concrete has presented a report in which, under "Preparing and Placing Mortar and Concrete," it specifies: "The unit of measure should be the cubic foot. A bag of cement containing 94 lb. net should be considered the equivalent of 1 cu. ft."

The capacity of nearly every concrete-mixing machine is now rated by the manu-

facturer in cubic feet. The Cement Users' Association some years since adopted rules for the measurement of concrete work in which it was specified that the unit of measure for concrete should be the cubic foot. Cement is usually handled in sacks, and under nearly all specifications one sack of cement is considered to be 1 cu. ft. This naturally requires the other materials to be measured in cubic feet in order to use proportions as specified. It is hard to understand why material which is fed into a mixer and mixed in cubic feet must be expressed in cubic yards when it leaves the mixer and is placed in the work.

If a larger unit than feet is desired, some unit based on the decimal system of numbers should be employed. Larger units consisting of groups of 10, 100 or 1000 of the smaller units are found to be very convenient in many classes of measurements, and there is no reason why this system cannot be applied to engineering construction.

O. W. CHILDS,
Office of Public Roads and Rural Engineering.
Washington, D. C.

Who Shall Select the Types of City Pavements?

SIR: The stand taken by your journal in the matter of who should select the type of pavement to be used on a particular street (see Engineering Record, July 8, page 35, and Oct. 14, page 458) is undoubtedly the correct one. The selection of pavement should be left solely to the responsible official in charge of the paving department of the city, by whatever title known. If he is not competent to make such selection he cannot be made competent by petitions. Abutters are not usually qualified technically to determine the best kind of pavement to be used. In any case, the personal interest of the petitioner takes precedence of the interests of the traveling public, especially where the street is extensively used.

The foregoing statements hold good even though petitions are actually what they purport to be—the expression of an honest belief that a particular type of pavement is the one best adapted to the locality. If signatures are made on account of friendship with a contractor or a director of a paving corporation, or secured by paid canvassers, the petitions are obviously of no value. Petitions for paving streets are particularly easy to secure, especially in cities like Boston, where the city bears the entire expense of repaving.

The officials in Boston have been, however, remarkably free from annoyance by paving petitions, the practice being practically confined to advancing the interests of one firm of contractors. The methods that have been used are well shown in a report of the Boston Finance Commission.

On the other hand, I doubt that in the majority of cases petitions alone have any effect in influencing the decisions of paving officials. So far as my observation goes, petitions for paving, as well as for other municipal actions, are particularly used as "accessories after the fact" to furnish an excuse for actions previously determined upon, regarding which the official expects criticism.

If the responsible official is honest and competent, I fail to see why petitions for paving should cause him any embarrassment.

GUY C. EMERSON,
Boston. Civil Engineer.

Wooden Dam Fails When Foundation Scours

SIR: The recent failure of a timber diversion weir, 380 ft. long and 16 ft. high, on the San Joaquin River, near Mendota, Cal., is of some engineering interest, particularly as the weir is of that class in which "piping action" is a vital feature. In other words, it is a weir built on a permeable foundation. In this connection I call your attention to the paper by W. C. Hammat in the *Transactions* of the American Society of Civil Engineers, December, 1913, entitled "A Western Type of Movable Weir Dams." The Mendota weir is mentioned in this paper. The illustrations in the paper (Mr. Hammat's) give an idea of the construction of the weir, although, apparently, none of his sections are for the weir in question.

I have not personally visited the failure. I have, however, investigated the circumstances sufficiently to know that the descriptions given in the newspapers are approximately correct.

Assuming that the dimensions as given are accurate—a 50-ft. watertight floor, two lines of 14-ft. sheet piling, and a difference of 10 ft. in the head at the time of failure between the overflow level and the level of the tail water—it is interesting to apply the principles for design of this type of weir, as so admirably treated by W. G. Bligh in his "Practical Design of Irrigation Works." The length of enforced percolation in this case is equal to the length of floor plus four times the length of the sheet piling, or 50 ft. plus 56 ft., or 106 ft. With a head of 10 ft. the percolation or "piping" factor is 10.6. Mr. Bligh's recommended value for a soil of this nature is 15. It is very possible, also, that the floor was not watertight. In fact, in reading Mr. Hammat's paper the inference was gained that in many of these timber weirs, weep holes were purposely left in the wooden floor.

The publication of the description of this weir failure may bring more definite data from engineers who may be familiar with the design of the structure.

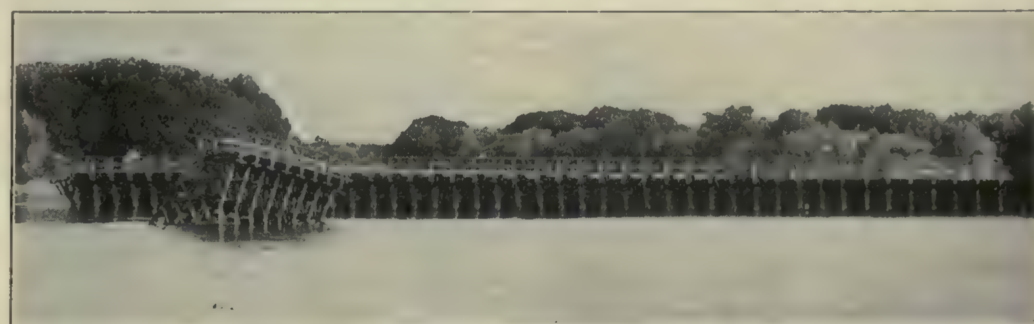
HENRY D. DEWELL,
San Francisco. Civil Engineer.

[An account of the failure, prepared by this journal's Pacific Coast representative, is appended.—EDITOR.]

Just below the junction of the San Joaquin and Kings rivers, in Southern California, there was constructed, in 1908, a wooden dam 350 ft. long and 16 ft. high from floor to deck. Recently a break occurred, apparently caused by the undermining of foundations, in which a 65-ft. length was washed out, releasing the waters of the reservoir and cutting off the supply of a large area of irrigated land in the upper San Joaquin Valley.

The dam foundation consists of three rows of sheet piling transverse to the stream, 25 ft. apart, and driven 20 ft. in the sandy bottom. These were tied together with 10 x 12-in. timbers, which also served as sills for the floor, which was 50 ft. wide, made of 2 x 12-in. planking. At the dam site the river bed is entirely drifted sand. F. W. Bomar, the company's resident manager, examined the structure immediately after the failure. He thought that the first cause was a slight break in the downstream row of sheet piling, which allowed the sand to escape from under the floor. The failure occurred, he believed, after the foundation had been washed out to such an extent that it would not bear the weight of the water on the upstream face of the dam, which is inclined at an angle of 30 deg. At the time of the failure the water level in the reservoir was 10 ft. higher than the downstream level.

The first evidence of the failure was a 3-ft. settlement of the section washed out, after which the pressure of the escaping water carried away the wrecked portion. If the defect had been in the upper row of piling the structure would have "buckled up," Mr. Bomar pointed out. The break occurred 50 ft. from the east end and the washed-out section separated into two parts, one of which lodged near the structure, while the other continued about 100 ft. downstream.



WOODEN DAM FAILS WHEN FOUNDATIONS ARE UNDERMINED

Temporary relief will be provided by a timber-and-brush dam being constructed upstream. It is expected that this will serve the canals during the brief remaining period of the present season. Meantime plans for reconstruction at the old site will be prepared.

Although the old wooden dam is about eighteen years old, its timbers are said to be sound and the structural connections intact. Until the site is unwatered decision will not be made as to whether it would be better to repair the wooden structure, which originally cost about $30,000, or to build a concrete dam at an expenditure of about $75,000.

The structure is owned by the San Joaquin and Kings River Canal & Irrigation Company.

Power Station First of Its Kind to Be Built in Iceland

A hydroelectric plant has been proposed for the city of Reykjavik, Iceland, and a Norwegian firm of engineers engaged to prepare plans for the project. This is the first plant of its kind to be built in Iceland. As no runoff data are available the stream must be gaged and the drainage basin surveyed. A high-tension transmission system is also to be included in the design.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Readily Built Bin Has High Salvage Value

THE type of bin shown in the photograph can be very quickly built, requires no framing and no bolts except a few tie rods, and can be readily dismantled so as to leave the lumber in practically as good shape as before use. This bin is fairly common in Canada, but seems to be little known to American contractors. The one here shown is part of the gravel-screening plant of O'Brien & Doheny and Quinlan & Robertson in use on Section 3 of the Welland Ship Canal, described in last week's issue of the Engineering Record, page 490. The posts and floor are made of 12 x 12-in. timbers, while the bin walls are made of 2 x 8-in. plank, laid flat in a manner resembling the construction of a log crib, with a few light nails through each plank at each intersection. Of course, sand or gravel stored in such a bin and drawn out by bottom gates must slide on itself, and the design of a bin of this character contemplates having the corners permanently filled with material. While this means supporting extra weight and a slightly steeper angle of slope on which the material will slide, somewhat reducing the capacity over a hoppered bin of the same height, the plank cribwork can be put up so much more rapidly and cheaply than the framed construction that these disadvantages are outweighed. In addition practically all the lumber used in such a structure is saved.

BIN USED ON WELLAND CANAL WORK EASILY BUILT WITHOUT SAWING LUMBER

Work on the Welland Ship Canal is under the direction of J. L. Weller, engineer in charge for the Department of Railways and Canals of the Canadian government.

Windlass Replaces Tripod and Derrick for Pipe Laying

A PIPE-LAYING appliance which has taken the place of the three and four legged derrick for pipe up to 16 in. in diameter was described by G. E. Keppelmann, of the Pacific Gas & Electric Company, in a paper presented at the recent annual convention of the Pacific Coast Gas Association. The method should be equally effective for laying water mains.

A wooden trestle supports a windlass pipe turning on wooden bearings by means of a common pipe chain tongs and operated by one man at one end of the pipe, while at the other end a ratchet is screwed to the pipe and fastened to one leg of the trestle. The ratchet prevents any reverse motion in the pipe.

The fitting or pipe to be lowered is rolled or skidded in the usual manner over the trench, a rope is fastened to it and the free end is wrapped four times around the transverse pipe, acting as a windlass. One man handles the chain tongs and another takes in the slack rope, while the ratchet automatically takes care of any slip on the part of either man. When the skids are cleared they are removed, and the fitting is lowered in place by the one man easing up on the rope. This must be done carefully to avoid surges that might break the rope.

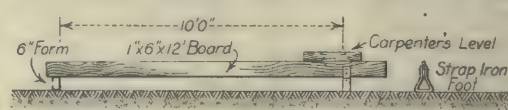
In the case of pipe of any diameter so far used (up to 16-in. cast iron) the rope is fastened a little to one side of the center toward the bell, and on being lowered the spigot end is depressed in order to clear any dirt that may have lodged in the pipe.

TWO MEN LOWER PIPE IN TRENCH FROM WINDLASS ARRANGEMENT ON SINGLE TRESTLE

Device Checks Subgrade on Concrete Road Construction

By RALPH P. BROWN
Urbana, Ill.

A DEVICE to permit inspection of the subgrade before the second line of forms was set was perfected last summer by P. M. Johnston & Company. It was used on a 10-ft. concrete road in Illinois. Inspection of the subgrade was necessary because it was possible to set only one line ahead of the mixer, as a side-loading machine was used the hopper of which interfered with setting the other line. A 1 x 6-in. piece of board 12 ft. long was fitted with a strap iron foot on one end, as shown in the sketch, and an ordinary carpenter's level attached. It was not practicable to use a bubble tube, because of rough handling. The device enabled the form setter or inspector to check the subgrade and adjust the line of forms for small variations of the grade.



DEVICE USED TO CHECK SUBGRADE

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Alfred Craven Retires as Subway's Chief Engineer

Becomes Consulting Engineer to New York Public Service Commission—D. L. Turner Appointed Acting Chief Engineer

Alfred Craven will retire Nov. 1 as chief engineer of the New York Public Service Commission, in charge of the city's subway construction, and will occupy the newly created position of consulting engineer to the commission. This action, according to a letter made public this week, comes at Mr. Craven's own request and was approved by the Public Service Commission at a meeting Oct. 17. The commission also has announced the promotion, on Nov. 1, of Daniel L. Turner, formerly deputy engineer of subway construction, to the position of acting chief engineer at a salary of $12,500. Mr. Craven, as consulting engineer, will receive a salary of $12,000. The commission has not, as yet, announced any appointment to the vacancy of chief engineer, but the compensation of this position has been reduced from $20,000 to $15,000 a year. Comment upon the change in personnel of the commission's engineering department will be found in the editorial columns of this issue.

Mr. Craven's Record

Alfred Craven, a son of the late Admiral Craven of the Navy, was born Sept. 16, 1846, at Bound Brook, N. J. He received his education at the U. S. Naval Academy at Annapolis, from which institution he was graduated in 1867. He then entered the naval service, where he remained four years, resigning to accept a position with the California Geological Survey. He stayed with that organization for two years. The next eleven years were spent in private practice as a civil and mining engineer in California and other Western states.

In 1884 he came to New York and accepted the appointment of division engineer with the Croton Aqueduct Commission. On completion of the aqueduct he was retained to supervise the construction of several large dams and reservoirs in the Croton Valley, after which he was put in charge of the construction of the Jerome Park reservoir. He remained with the aqueduct commission until 1900, when he resigned to become division engineer with the Rapid Transit Commission, in which capacity he supervised the construction of a section of the Manhattan subway. On the completion of the present subway Mr. Craven was appointed deputy chief engineer, under George S. Rice, who succeeded William Barclay Parsons as chief engineer. Oct. 1, 1910, on the retirement of the then chief engineer, Henry B. Seaman, Mr. Craven was assigned to duty as acting chief engineer at the salary of $10,000 a year. A year later he was appointed chief engineer at a salary of $15,000 a year, and in 1914, when the work of the dual system was in full swing, his salary was raised to $20,000 a year, the highest remuneration paid any public official in the State of New York.

Mr. Craven's Letter of Resignation

Mr. Craven's letter of resignation and a reply from Commissioner Straus follow:

THE HON. OSCAR S. STRAUS,
Chairman, Public Service Commission
for the First District.

DEAR MR. CHAIRMAN:

I have for some time contemplated requesting the commission that I be retired from the position of chief engineer. You will recall my statement to this effect in talking with you today, as well as on a prior occasion several months ago.

The work of advancing the last of the principal construction contracts for the dual subway system is now about complete and the work of actual construction is already well advanced toward completion, while many miles of the system are now in actual and successful operation. I feel, therefore, the time has come when I can properly make this request for retirement, and I ask that you present this matter to the commission for its consideration.

As to your suggestion that I remain with the commission in the capacity of consulting engineer, I shall be pleased to consider such an offer or request should the commission desire to make it.

I remain, dear Mr. Chairman,
Yours very truly,
(Signed) ALFRED CRAVEN.

Chief Engineer of New York Subways Resigns—Becomes Consulting Engineer to the Public Service Commission

ALFRED CRAVEN

Chairman Straus' reply to Mr. Craven was:

ALFRED CRAVEN, ESQ.,
Chief Engineer, Public Service
Commission for the First District.

DEAR MR. CRAVEN:

I have the honor to acknowledge receipt of your letter of the 13th inst., wherein you inform me that for some time past you have contemplated requesting the commission that you be retired from the position of chief engineer.

The commission, acting in pursuance with your request, have accepted your resignation to take effect on November the first. The commission further resolved, in appreciating the valuable and important services you have rendered and for the purpose of retaining your experienced co-operation in a less exacting ca-

(*Continued on page* 544)

Green Concrete Blocks New York Subway Track

Failure of Sidewall Form Allows Concrete to Run Over Third Rail, Delaying Traffic an Hour—Work Is Well Advanced

The failure, Oct. 22, of a sidewall form being filled with concrete next to the northbound express track of the present subway between Fortieth and Forty-first Streets and Park Avenue in New York City, allowed several yards of wet concrete to run out over the third rail and track as a northbound express train was passing. Express traffic on that track was delayed for about an hour. The accident occurred just before 11 o'clock in the morning, at a time when the form was filled to a height of 6 or 7 ft. above the bottom. The motorman of the express train brought it to a stop, the passengers were transferred to a northbound local on the adjoining track and the express train was cut in two at the point of the break. The concrete was shoveled from the track and traffic resumed. The total delay was about an hour, during which time express trains were sent north over the local track.

The form which failed was a wood wall form secured with rods similar in design to the usual practice on subway work. After the form gave way, some part of it appeared to have been struck by the express train, but it is no longer possible to determine what part of the form broke first.

Progress of Subway Work

The section on which the accident occurred is one of the most interesting under construction on the new dual rapid transit system, and was described on page 255 of the Engineering Record for Aug. 28, 1915. The northbound and southbound tracks on the present subway are carried in independent tunnels separated by a big core of rock. The turnout section being constructed will connect these tracks with the new Lexington Avenue subway. As will be remembered from the article referred to, the new express tracks are carried under the present northbound tracks. They come up in the core of rock between the old tunnels, being broken into the old tunnels on each side by an unusual method of construction which replaces half of the old tunnel arch and takes the thrust from the other half across the new track to the rock wall. This portion of the construction is virtually completed, and the structure enclosing the new express track has been finished north to the point where they dip under the present northbound tracks.

It was about 75 ft. south of this point that the form which broke was being filled with concrete carried in over the top of the wooden lining which temporarily enclosed the northbound tracks of the old structure. It was necessary to replace the concrete arch over the old structure, as new work left it without support on either side. The street over this section had accordingly been decked, a lining of wood lagging secured to angle irons had been placed inside the old tube and the old concrete cut away. When the concrete for the depressed structure enclosing the new express tracks had been finished along this stretch, work was begun on the new structure to enclose the present tracks, the concrete being carried in cars from the plant at Forty-second Street and Park Avenue. In prosecuting this work since the accident, the additional precaution is being taken of having men stationed below the forms on the present running tracks to keep a constant watch for any occurrence that might cause a repetition of the accident.

Except for this delay to traffic, the extraor-

dinary work of cutting into the old tubes at this point has been virtually completed without interfering in any way with the full operation of the existing subway. The new southbound local track has been constructed beneath the four tracks in use, and completed to the south side of Thirty-eighth Street, where the work of cutting it into the present southbound local track is practically completed. The work of cutting the two new express tracks into the two old ones is entirely finished, and the only difficult job remaining is the building of the new express structure beneath the present northbound tube, where work is just being started. The portion of the diagonal station in the Grand Union lot at the corner of Forty-second Street and Park Avenue is also nearly finished.

On the other portion of this contract, which included the work of extending the Steinway tunnels to Park Avenue underneath the new and existing subways, work has progressed so far that the new structure has been in use for some time. Work on these sections is being carried out by the Rapid Transit Construction Company, of which George H. Pegram is chief engineer and Robert A. Shailer, tunnel engineer. The work is under the direction of the Public Service Commission, of which Alfred Craven is chief engineer, Robert Ridgway, engineer of subway construction, and John F. Meyers, division engineer in charge of the district including the section.

Will Draft Bill Creating Minnesota Conservation Department

A bill calling for the creation of a state conservation department to have charge of all reclamation, drainage and relief work in Minnesota will be drafted and presented to the next legislature. The action is the result of a recent visit to Minnesota by M. G. Barnes, consulting engineer, of Albany, N. Y. Mr. Barnes is quoted as saying that "much of the drainage work being done in Minnesota is causing more harm than good. It may improve lands it is intended to improve, but it damages a greater area. The present condition is largely due to the fact that the creation and planning of drainage systems are the duties of county commissioners instead of being vested in one central power with an organization to study and plan for the whole state as a unit."

National Conference on Universities and Public Service Nov. 15 and 16

The third national conference on universities and public service will be held Nov. 15 and 16 at the University of Pennsylvania, Philadelphia. The convention is under the auspices of the Society for the Promotion of Training for Public Service.

Good-Roads Show to Be Held in Boston February 5 to 9

The eighth national exhibit of road machinery and materials will be held Feb. 5 to 9, in the Mechanics Building, Boston. The show will be in connection with the fourteenth annual convention of the American Road Builders Association.

114-Mile Windstorm Hits the South

The southern states were swept by a severe windstorm Oct. 18, during which the wind is said to have reached a velocity of 114 miles per hour. One life was lost. The damage to property was small compared to that caused by the hurricane of last spring. The barometer at Pensacola, Fla., registered 29.05.

"The Engineer," by Dr. Frank Crane

In printing the article entitled "The Engineer," by Dr. Frank Crane, in the Oct. 21 issue, notice of the copyright was omitted. "The Engineer" is copyrighted by Frank Crane and was reprinted in the Engineering Record through courtesy of the Associated Newspapers, New York City.

Alfred Craven Retires as Subway's Chief Engineer

(Continued from page 543)

pacity, to tender you the position of consulting engineer at a salary of twelve thousand dollars per annum. I hope it will be agreeable to you to accept this new appointment, which the commission takes great pleasure in tendering to you.

With the assurance of my highest esteem,
Very truly yours,
(Signed) OSCAR S. STRAUS,
Chairman.

Mr. Turner Named Acting Chief

Daniel L. Turner, who becomes acting chief engineer of the Public Service Commission Nov. 1, was graduated from Rensselaer Polytechnic Institute, Troy, N. Y., in 1891. During the next year he was instructor in mathematics at the institute, and then spent a year in general railroad practice. From 1893 to 1900 Mr. Turner was instructor in surveying and hydraulics at the Lawrence Scientific School, Harvard University, and at that institution organized and conducted the summer school in surveying. While at Cambridge he also supervised construction of the Harvard Stadium. In January, 1900, Mr. Turner became assistant engineer on the New York Rapid Transit Commission, and later was made general inspector of subway stations, in which capacity he served until 1907.

With the creation of the new Public Service Commission in 1907 Mr. Turner became chief of the bureau of transit inspection and in this capacity formulated the procedure by which the commission exercises control over service on the city's various rapid transit lines. His next work was as division engineer on the subway, under Mr. Craven, and from this post he was promoted to deputy engineer of subway construction, his immediate superior being Robert Ridgway, engineer of subway construction. In this position his duties were largely executive and concerned the headquarters department. As acting chief engineer Mr. Turner will be the ranking man of the Public Service Commission's engineering organization, pending the appointment of a chief engineer.

Seepage Through Earth Dike Causes 25-Foot Gap

Washing Away of Embankment at Schenectady, N. Y., Results in $40,000 Damage—No Lives Lost

Part of a dam owned by the Schenectady (N. Y.) Milling Company failed at midnight Oct. 19. The uncontrolled water flooded several business blocks, twisted a wooden mill building from its foundation, and caused damage estimated at $40,000. No lives were lost.

The dam was faced with wooden sheet piling and backed with an 18-in. masonry wall. The 20-ft. intermediate space was filled with earth. An earth dike extended from the south end of the dam to the south bank of the pond. Through this dike seepage started and quickly caused a 25-ft. section to be carried away. The break came during a heavy rain at midnight.

Tons of Silt Carried Away

The dam and dike held back a pond from which water was carried in a 20-in. steel pipe to a point where about 40 hp. was developed under a 20-ft. head. The natural bed of the stream was 20 ft. below the top of the dam, but accumulated silt deposits had reduced the depth of water to only 6 ft. The scouring action of the water cut a channel in the soft bed of the pond as shown in the picture and removed tons of dirt and silt. The arrow on the right indicates the elevation of the bed of the pond. The cross is drawn at the back of the dam. Some of the wood facing is seen where it has fallen into the water. The high place at the left of the picture is the top of the dam.

LOOKING THROUGH THE GAP IN THE EARTH DIKE OF THE DAM AT SCHENECTADY, N. Y., THROUGH WHICH TONS OF SILT WERE CARRIED AWAY BY THE RELEASED WATER

This information was supplied by Warren C. Taylor, assistant professor of civil engineering, Union College.

Illinois Engineer Company Ordered Home from Texas

Company A, Illinois Engineer Corps, was ordered home Oct. 17, but at the time of writing it was not known whether to Chicago, Springfield or Fort Sheridan. Lieut. H. S. Baker, assistant city engineer, preceded his company by a week. The Chicago Association of Commerce has organized a service to put the returning national guardsmen in touch with positions as quickly as possible. There have been about 150 applicants, and places have been found for two-thirds of them. A total of 200 positions open were listed. The engineers can also avail themselves of this service.

Pennsylvania Highway Engineers Meet for Annual Conference

Engineers and superintendents of the Pennsylvania highway department met at Harrisburg Oct. 18 in annual conference on engineering and maintenance problems. Frank B. Black, commissioner of highways, and W. D. Uhler, chief engineer, addressed the gathering. The engineers spent the following two days inspecting roads in southern Pennsylvania and Maryland.

Advisory Board of Railroad Presidents for University of Illinois

The college of engineering of the University of Illinois is to have the benefit this year of an advisory board for the railway industries of Illinois, which, upon the recommendation of the dean and the approval of the president of the university, has recently been appointed by the trustees. The presidents of five of the larger railroads centering in Chicago, and having their administrative offices in that city, have consented to serve as the members of this advisory board.

Elephant Butte Dam Was Dedicated October 19

Settlers' Problems Discussed at Twenty-third Irrigation Congress—Rain Caused Postponement of Dam Dedication

The twenty-third National Irrigation Congress convened at El Paso, Tex., Oct. 16, 1916, with President R. F. Burgess, of that city, presiding. The opening session was to have marked the dedication of Elephant Butte dam Oct. 14 as announced in that issue of the Engineering Record. Heavy rains caused a postponement of the dedication exercises to Oct. 19.

The first address after the opening exercises was by A. A. Jones, first assistant secretary of the interior. He brought out the fact that the chief problem now before the irrigation projects of the west is the settlement of the lands, aiding settlers to get a start, and the securing of better marketing facilities. He also stated that the national irrigation fund is now nearly exhausted and that the Irrigation Congress should suggest means whereby this fund could be increased.

Means for Securing Government Aid

Among the more important discussions was that of means for securing additional government aid. The Jones bill, which provides for the guaranteeing of interest on irrigation bonds by the federal government, was discussed as one solution; methods and means for stabilizing and unifying irrigation district laws and increasing the value of the lands in the investment market through additional laws and better supervision was another. The construction of storage reservoirs in the national forests from the proceeds of the sale of ripe timber was suggested as a third remedy. On the other hand the question of relief from payment of at least a part of the obligations on government reclamation projects, on account of alleged engineering mistakes and of works constructed for general flood protection, was brought out.

Several papers were read on the operations of existing irrigation district laws and co-operation with the federal government in carrying out provisions of and securing the benefits from these laws. "How to Secure Settlers" was the subject of much discussion. It was said that it is not enough to sell the land to people for investment purposes. Unless settlers actually come upon the land, farm it properly and prosper, the project is a failure. Attempts to handle too large an acreage, insufficient capital, and ignorance of irrigation farming were given as the three potent causes of the failure of individuals.

Rural Credits Discussed

Among the more active causes of seepage are an impervious subsoil, poor irrigation methods, excessive irrigation and leaky ditches, according to the discussion. The question of proper methods of drainage was said to be much more difficult to answer on irrigated lands than on swamp lands owing to the many unknown factors. The engineer must therefore rely chiefly upon judgment and experience in selecting an adequate system.

Rural credits was the subject of several papers. The conclusion drawn was that some form of federal or state aid be adopted whereby tenants or other persons might, without capital, become land owners, and thereby increase the number of prospective settlers.

Papers on markets and marketing occupied one period of the congress. Co-operation between the farmers and the formation of produce associations was thought to be the best method of handling this question. That some means must be devised for reaching the consumer without the excessive toll now exacted by middlemen seemed to be the sense of the convention.

At the concluding session George Albert Smith, of Salt Lake City, was elected president, and Arthur Hooker, of Spokane, re-elected secretary. The next convention city has not yet been chosen.

Elephant Butte dam was formally dedicated Oct. 19, under the auspices of the International Irrigation Congress. The principal address was made by A. A. Jones, first assistant secretary of the interior, who was present as the personal representative of President Wilson. Mr. Jones reviewed the events which led up to the construction of the dam and pictured the development which is to come to the valley below through its operation. Congressman W. R. Smith made a short address bearing chiefly on the co-operation of the different interests that have worked together in the development of the project. A. P. Davis, director and chief engineer of the U. S. Reclamation Service, discussed the engineering phases of the dam, the question of the reservoir filling with silt, and some of the different remedies therefor. E. H. Baldwin, construction engineer of the dam, and now senior engineer and project manager of the Rio Grande project, made a short address covering the operations during construction.

The convention activities were reported to the Engineering Record by W. A. Perkins, of the U. S. Reclamation Service.

Scope of Washington City Planning Board Enlarged

City and County Planning Discussed at Everett (Wash.) Convention—Old Type Maintenance Clause Omitted

Among the many important features of the seventh annual convention of the League of Washington Municipalities and the state conference on city planning, held in Everett, Wash., Oct. 12, 13 and 14, was the enlargement of the scope of city planning into a county planning board to assist and co-operate with similar city organizations. This point had not been discussed at former conventions of the league. Twelve engineers representing Washington cities assembled at the convention. After deliberating upon the proposition of organizing as an engineers' association, they decided that the time is not ripe for a separate organization. Plans were made to continue as a factor of the municipality league.

D. W. McMorris, assistant city engineer of Seattle, presided. The engineers discussed paving and paving materials, maintenance contracts and other road problems. On the subject of the maintenance clause in road contracts the opinion of the meeting was that the old type maintenance clause should be eliminated and that chemical tests on ingredients and careful subsequent inspection during laying periods be substituted.

Standard Traffic Laws Recommended

Among resolutions endorsed by the league at the final meeting were: To add a section known as the building-construction, housing and fire hazard; to ask the legislature to pass a law permitting cities to build stockades on municipally owned property outside corporation limits where prisoners may be worked; endorsed and recommended as a law the regulation of water supplies and sewage under state board control; recommended drafting standard traffic laws for cities, which matter was placed in the hands of a special committee for framing.

Officers of the league serve two-year terms and are as follows: President, Leonard O. Meigs, North Yakima; vice-president, W. H. L. Ford, Everett, and secretary-treasurer, Dr. Herman A. Brauer, University of Washington.

Structural Mechanics Course Offered

Requests from a number of graduate engineers practising in Seattle have led the University of Washington to offer an evening course in advanced structural mechanics, beginning Oct. 17. Charles C. More, professor of civil engineering, will conduct the course.

Engineering Society Activities

The Philadelphia Association of Members of the American Society of Civil Engineers elected the following officers at the Oct. 2 meeting: President, Samuel T. Wagner; vice-president, Edgar Marburg; directors, Harrison Souder and Frederick E. Schall; secretary, C. W. Thorn. W. L. Stevenson was elected director to fill the unexpired term of Col. George A. Zinn, resigned.

The Engineers Society of Western Pennsylvania held a special meeting, Oct. 25 in Pittsburgh at which engineering phases of smoke abatement were discussed by Osborn Monnett.

The Albany Society of Civil Engineers met Oct. 24. The program for the evening consisted of a symposium on concrete on the general subject of present-day concrete practices or safety first in concrete, under the leadership of R. S. Greenman.

The Canadian Society of Civil Engineers will hold its next monthly meeting Nov. 2 in the rooms of the society in Montreal.

The Oregon Society of Engineers, at its Oct. 20 meeting, heard Frank F. Sinks describe the manufacture of steel on the Pacific Coast.

The Municipal Engineers of the City of New York met Oct. 25. The Moodna supplementary shaft and tunnel was described by George J. F. Carey, assistant engineer, Board of Water Supply, New York City. The engineers will hold their fourteenth annual dinner Nov. 25 at the Hotel McAlpin.

The Harvard Engineering Society of New York will meet Nov. 2, in the Harvard Club, New York City. A. A. Cohill, chief engineer for Patrick MacGovern & Co., will give an illustrated lecture on the Dorchester tunnels recently completed in Boston by the shield method under compressed air.

The Western Society of Engineers was addressed Oct. 16 by Harrison P. Eddy, consulting engineer, of Boston, on "A Comparison of the Activated Sludge and the Imhoff Tank-Trickling Filter Processes of Sewage Treatment."

What Engineers and Contractors Are Doing

LOUIS C. KELSEY, consulting engineer, of Portland, Ore., has been engaged by the city of Twin Falls, Idaho, to direct the construction of a water supply and the improvement of the distributing system. About $300,000 will be expected. Surveys have already been started.

CHARLES GILMAN HYDE, professor of sanitary engineering at the University of California, has been appointed acting dean of the college of engineering during the absence of Charles Derleth, Jr. Professor Hyde has been a member of the faculty of the University of California since 1905, previous to which he was assistant engineer in charge of the improved waterworks at Harrisburg, Pa. Since his association with the university he has been connected with many California water projects in a consulting capacity.

CLARK R. MANDIGO has resigned as assistant city engineer of Kansas City, Mo., to join the engineering staff of the office of the Portland Cement Association in that city. Mr. Mandigo was graduated from Harvard University in 1907, following which he entered the service of the engineering department of the Northern Pacific Railway. The following year he became civil engineer and superintendent of construction in the U. S. Army. He served in the quartermaster's department until 1911, when he was made assistant city engineer of Kansas City, Mo.

O. L. DAVIS has left the employ of the bridge department of the Chicago, Burlington & Quincy Railroad lines west of the Missouri River to become designing engineer with the Concrete Engineering Company. He will have headquarters at Omaha, Neb.

ALLEN F. SHERZER, who was recently engaged by the British America Nickel Corporation, Limited, to work on the hydroelectric project at Wahnapitae, Ontario, has resigned to take a position with the Union Carbide Company, of Niagara Falls, N. Y.

MYRON E. FULLER, for the last two years resident engineer for George W. Fuller, of New York City, in charge of the recently completed Plainfield-Dunellen, N. J., joint sewage-disposal project, has been appointed to a position in the bureau of surveys of Philadelphia. The sewage-disposal division, with which Mr. Fuller will be associated, is preparing plans for several large modern disposal plants for the city districts.

GUY BONNEY, who resigned from the water department of Baltimore, Md., last year, and who has since been engaged on construction work in New Jersey, has joined the engineering department of the Bethlehem Steel Company at Sparrows Point.

A. W. FUCHS was recently appointed assistant sanitary engineer with the U. S. Public Health Service. His duties are in connection with the construction and operation of experimental trade waste disposal plants. After graduation from Cornell University in 1913, Mr. Fuchs joined the Baltimore Sewerage Commission, where he was employed until early in this year. Since last March he has been in the bridge department of the Lehigh Valley Railroad at South Bethlehem, Pa., and on New York Barge Canal work.

M. A. H. SCULL has been transferred from the New York division of the Philadelphia & Reading Railway, where he was assistant supervisor, to the valuation department of that road. As assistant engineer in the latter department Mr. Scull will have charge of bridges and buildings. Since graduation from the civil engineering department of the University of Pennsylvania in 1912 he has been in the service of the Reading.

E. W. DAHL, of the U. S. Reclamation Service, was recently appointed county engineer of Yuma County, Arizona.

H. S. HARDING has resigned from his position in the office of the estimating engineer, commissioner of accounts, New York City, to become assistant to the contract manager of the Turner Construction Company. Mr. Harding had occupied his recent position since 1914. Before that he was with the Board of Water Supply of New York City for seven years.

T. MCLEAN JASPER, captain 172d Brigade, Royal Field Artillery, formerly assistant engineer with Alvord & Burdick, Chicago, writes that he is at Treviddo, Liskeard, Cornwall, England, recovering from his second wound, but expects to return to the continent about Jan. 1. In addition to his description of trench fighting he states that he was in charge of a squad of engineers making surveys for the location of gun foundations. Another detail was to pick up German shells, an increasing number of which, he says, do not explode.

R. R. CLARK, structural engineer of Portland, Ore., has been appointed by the state highway engineering department to supervise the erection of steel work on all bridges in the state of Oregon which come within the jurisdiction of state officials. He is now completing a further report on the collapse of a reinforced-concrete bridge at McMinnville. A detailed report will be available shortly.

WILLIAM MEADOWCROFT, for the last ten years assistant engineer with the Board of Water Supply of New York City and formerly connected with the engineering service of the Philippine Islands and the Metropolitan Water Board of Massachusetts, has volunteered for field service with the American Ambulance in France. Mr. Meadowcroft sailed for Paris Oct. 14.

CLYDE POTTS, consulting engineer, of New York City, has been retained to design outlet trunk sewers and sewage-disposal works for the city of Carbondale, Pa.

A. E. CHANDLER, of the California Water Commission, is in Honolulu, where he will assist the Hawaiian Water Commission in preparing the new water code for the Hawaiian Islands.

W. S. LINDSAY, commissioner of Clark County at Vancouver, Wash., has been selected by the Interstate Bridge Commission temporarily as general superintendent of the interstate bridge across the Columbia River between Vancouver and Portland.

ARTHUR E. LODER, division engineer of the California highway commission, has been appointed assistant chief engineer of the U. S. Office of Public Roads and Rural Engineering. He will take up his new duties in Washington on Nov. 1. His office will administer the expenditure of the recent federal appropriation of $85,000,000 of which $75,000,000 is to be used in road construction in states where state funds of equal amount are raised. The $10,000,000 is to be used for road construction in the National Forests. This is to be undertaken in addition to the work now devolving upon the office of Public Roads and Rural Engineering. Mr. Loder was graduated from Purdue University in 1904. From then until 1907 he was assistant engineer in the U. S. office of public roads. In this position he was engaged in location and construction of roads that came under federal supervision. His work included a survey and investigation for a road and trail system in the Teton Forest Reserve in Wyoming. In August, 1907, he was made chief engineer of the Los Angeles County highway commission, in which capacity he laid out the road system constructed under a $3,500,000 bond issue. This work involved about 300 miles of highway and included the elimination of the notorious Fremont Pass grade, which was replaced by a route using a 435-ft. highway tunnel. After about 200 miles of the system had been built, Mr. Loder resigned in 1911 to engage in private practice in Los Angeles. Since 1912 he has been in charge of the state highway work in division IV, which centers at San Francisco. About 300 miles of road were planned in that division as part of the state highway system. Of this total 200 miles, including some of the heaviest construction in the system, have been located and constructed under Mr. Loder's supervision.

FRANK A. NIKIRK has been named temporarily as assistant city engineer of San Jose to fill a vacancy made by the resignation of J. W. Ford. The permanent appointment is to be made after a civil service examination has been held.

L. G. BURRELL has resigned as assistant engineer for the Farris Bridge Company of Charleston, W. Va., to become bridge engineer of Wyoming County, in the same state.

CLEVELAND A. JAMES, formerly resident engineer at Buffalo for the Lehigh Valley Railroad, in charge of terminal construction in that city, has opened consulting offices in the Fidelity Trust Building, Buffalo. After two years with the Cambria Steel Company he joined the engineering corps of the Pennsylvania Railroad. He resigned in 1905 to go to the Pensacola, Alabama & Western Railroad. Later in the same year he returned to the Pennsylvania. Mr. James was employed alternately by that road and the Tidewater Railway during the following three years, finally joining Delaware, Lackawanna & Western Railroad engineering department in 1908. At the time of his resignation in 1910 to go to the Lehigh Valley he had risen to the position of assistant engineer. His first work with that road was on the construction of the Hays Creek branch. Since February, 1914, he has been in charge of the terminal improvement at Buffalo and work on the western end of the road.

SEÑOR ESTABAN DUQNE ESTRADA, engineer of Havana, Cuba, is making a tour of the United States studying the design and operation of garbage-disposal plants.

M. F. STEIN, formerly assistant engineer of design in the filtration department of Cleveland, has been made assistant engineer with Hering & Gregory, consulting engineers, of New York City. Mr. Stein was with the Cleveland engineering department for three years, previous to which he was associated with Chester & Fleming, consulting engineers, of Pittsburgh, for four years. Mr. Stein has devoted most of his time to a study of waterworks and water purification.

LOUIS L. TRIBUS, of Tribus & Massa, consulting engineers, New York City, has been retained as special engineering advisor to Mount Vernon, New York. That city is actively considering the municipalizing of its water system, one feature of which would be the acquisition of the essential portions of the plant of the New York-Inter-Urban Water Company, now furnishing its supply. George W. Fuller and James A. Harding have been appointed voting members in a conference board, to meet with J. W. Ledoux and Allen Hazen, who will represent the water company. If these four can not agree as to values a fifth engineer will be selected. The final reports, however, will not be binding on either city or company, but will undoubtedly have great weight in the subsequent negotiations or proceedings.

Obituary Notes

LIEUT. CARL J. BEATTY, Royal Flying Corps of the British Army, was recently killed in action. He left the employ of the engineering department of the British Columbia provincial government to enlist. From 1907 to 1911 Lieutenant Beatty had been a member of the engineer corps of the Northern Pacific Railway, rising to the position of assistant engineer at the time of his resignation to go to Canada.

LEWIS H. BOOKER, a member of the contracting firm of Booker & Campbell, Bellingham, Wash., was killed Oct. 16 when the walls of a dry kiln at the Earles-Cleary Lumber Company's plant, being razed, collapsed and buried him beneath the brick and mortar.

J. HOWARD JACKSON, of the firm of Jackson & Co., civil engineers, of Brantford, Ontario, died recently in that city. He was born in England and had spent many years in New Zealand in charge of engineering and surveying projects before coming to Canada. He was 59 years old.

JAMES SHEPPARD, of Queenston, Ontario, superintendent of the Welland County good roads system, was killed recently at Brookfield by an express train. He had been in charge of the Welland County road work since its inception.

LEONARD W. RUNDLETT of St. Paul, Minn., at one time city engineer of that municipality and a director of the American Society of Civil Engineers, is dead. Mr. Rundlett was connected with the city engineering department of St. Paul for about twenty-five years, according to available records. His duties as city engineer ceased in March, 1911, when a new administration came into power. Early in 1912, when Moose Jaw, Canada, was contemplating extensive waterworks construction, Mr. Rundlett was made commissioner of public works of that city. He resigned in February, 1914, and returned to St. Paul.

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Bad Effect of Prohibition

IN the article on Colorado highways, published in a recent issue, we read that the supply of convicts available for road work has decreased in Colorado since the state "went dry." Viewing the fact from our selfish interest in desiring the highway system of the country to be improved as fast as possible, our first impulse is to deplore the dethronement of King Alcohol. We have been strenuously fostering the use of the convicts on the roads. Now come some idealists, just as we are getting well started, to take away our beloved and useful convicts. In our calmer moments, however, we view the situation differently, and contemplate with undisguised pleasure the cleaner men, the happier homes which go hand in hand with the decrease in the number of convicts available for road work.

Standards for Municipal Work

THAT progress is being made in the adoption of standard units for reporting municipal work is evident from the committee report of A. Prescott Folwell, chairman, presented at the recent convention of the American Society of Municipal Improvements. Under present conditions it is not of much value to know that "pavement" in a certain city cost so much per square yard, when no thickness is specified and when the term "pavement" may, in one case, mean the wearing surface only and in another the wearing surface and the base. To bring order out of this chaotic state of affairs in reporting results the committee has proposed certain standard terms which make clear exactly what figures on city improvements mean. Thus far attention has been focused principally on paving and sewer work. The movement was commended in an editorial in the Engineering Record of July 1, page 3, and deserves the support of engineers throughout the country. A definite form of procedure in reporting results was decided upon some time ago, and the important thing now is to secure for the recommendations the publicity which they merit. Definitions on printed cards have already been distributed to the society's membership and to about two thousand city and town engineers, superintendents of streets and other officials. From the replies received it is apparent that in only a few cases have city engineers objected to the adoption of the units proposed. The usefulness of work of this sort is dependent upon a universal adoption of the principles involved. Engineers can make the committee's work effective not merely by commending it, but by actually using the methods advocated.

Something for Nothing

SOME of the low compensations engineers receive, and also some of the contempt in which laymen hold the profession generally, must be charged up to their methods of doing business. When it became known that Pontiac, Mich., with a population of 20,000 people, contemplated making expenditures for a sewage-disposal plant, outfall sewer and pumping station, several consulting engineers "went after" the business. Some of them made bona-fide offers to make a proper study of the situation and quoted what they considered a reasonable fee. To their surprise they were informed that other engineers, more than one firm, had already proposed to do the preliminary work *gratis* on the understanding that their plans would be paid for if accepted. In answer to a letter from the Engineering Record asking as to the status of the situation, George A. Brown, commissioner of public improvements, writes as follows: "Engineers have been over the ground and will make recommendations as to type, estimate, costs, etc. If their plan is adopted they will be paid on a 5-per cent basis; if not adopted the city will not pay for preliminary work." After the city officials have chosen the type the citizens will have to vote a bond issue to cover the cost. What chance of receiving an adequate compensation has the poor employee of the consulting engineer who gambles first on the caprice of the administration and then on an election? It is certain that not more than one of the competitors will be paid, and there is no assurance that anyone will be. Whether the proposal to get something for nothing came from the engineers or from the city officials, the moral effect on both parties is bad.

Research

THE importance of research work to our industrial future has been repeatedly pointed out in these columns. Recently the organization of the National Research Council has attracted attention throughout the country and much space has been given to it in the daily as well as in the technical and trade press. The sign is indeed a hopeful one and augurs well for the success of the council's work. There are many evidences that there is an awakening on this subject all along the line. One of the evidences is presented in the extracts, on page 552 of this issue, from a brief presented by engineering alumni of the University of Michigan to the board of regents of that institution. The document strongly urges the increase in the amount of research work at the university and its close co-ordination with industry. We can conceive of nothing that would be more beneficial to the industries of the nation than that a similar appreciation of the need of research work were had by the engineering alumni of every great institution, and that these alumni would take the pains to impress their views on the governing bodies of their colleges. The awakening needs to come in every walk of life. Standing close to each of the colleges must be industrial leaders with keen realization of what is to be gained by research work. In our national engineering and scientific societies there must be appreciation of their possibilities as mediators between the investigators and those who will use the fruit of research. Finally atop of all will be the National Research Council, co-ordinating and guiding, laying the broad plans that will lead us on to greater and greater industrial achievement.

Sound Advice on Bond Issues

ENGINEERS who report upon some much-needed public improvement and then see the bond issue for financing it buried by an avalanche of adverse votes on election day wonder why there is no justice in the world. Few of them realize that often the trouble is with themselves. Their reports, which should serve to enlighten the public on the broad general features of the project and its cost, are presented in a form which bewilders a man who has not had technical training. When a man does not know what he is voting for, he will generally vote "No." Failure of the engineer to present his case clearly has sounded the death knell of many a public improvement which, had it received proper publicity, would have gone through with flying colors. Much sound advice on the conduct of bond campaigns is contained in a booklet issued by R. E. McDonnell, of the firm of Burns & McDonnell, consulting engineers, of Kansas City, Mo. Some of Mr. McDonnell's arguments are in line with those which have frequently been enunciated by the Engineering Record in editorials advocating the improvement of engineering reports. The keynote of his remarks is contained in this sentence: "The real value of an engineer's service to the public comes in presenting his subject so clearly to the voters that everyone will see it, understand it, talk it and vote for it." As an aid to the understanding of technical matters, graphic methods always prove effective. Pictures are understandable even by untrained minds. Charts also can be employed to bring out ideas clearer than would words. As for the text portion of engineers' reports, Mr. McDonnell is

correct in stating that the average engineer's effort is too long, dry and technical, and frequently leaves the official in doubt as to what to do next. The real job of raising the funds is as much the engineer's obligation as is the estimate of cost of the project. Engineers who report upon public-works improvements should read Mr. McDonnell's little treatise. They will find in it many suggestions which may be applied, with profit, to their own work.

Sewage Nomenclature

THERE is no need of pointing out the value of the work which the sanitary section of the American Public Health Association is doing in promulgating nomenclature in the field of sewerage and sewage disposal. At the Cincinnati convention last week the committee headed by George S. Webster submitted a tentative report defining terms commonly applied in this branch of engineering. Confusion has always existed in regard to the word "sewer." Is a conduit for storm water a sewer, or should this term be limited to lines carrying only domestic or industrial liquid waste? The committee proposes to differentiate the two types of carriers by means of the terms "sewer" and "drain," the latter referring only to conduits intended to carry storm surface and ground water.

Another moot point is raised by such terms as "sewage disposal," "sewage treatment" and "sewage purification." As for "sewage purification," if our recollection is correct, Professor Whipple of Harvard University recommended the abandonment of this term some years ago. The same position is taken by the American Public Health Association's committee. "Sewage disposal," according to the recent recommendations, is to be considered as a generic term applied to the act of disposing of sewage by any method. "Sewage treatment," on the other hand, is the process to which sewage is subjected in order partly to remove its impurities and render it fit for final discharge.

Under the heading "Tank Treatment" the committee suggests a dual designation—Imhoff or Emscher—for the type of two-story construction which during recent years has attained such wide popularity in this country and in Germany. To the Engineering Record it is not clear why two names should be sanctioned for a single type of apparatus. As this journal interprets the work of the committee, its chief function is to eliminate ambiguity in the use of sewage terms. The Imhoff and the Emscher tank is one and the same thing. Why, then, the two names for it? One would serve the purpose adequately and would eliminate any confusion, particularly in the minds of laymen who, in reading reports, might conclude that the Imhoff and the Emscher tanks were two distinct forms of equipment.

General usage in this country favors the expression "Imhoff tank," named after its inventor. When the committee undertakes the final revision of its report—which is understood to be merely suggestive at present—it would be desirable to have only one name for the two-story tank—the Imhoff tank.

Competition Versus Monopoly in Public-Utility Operation

MR. GALLOWAY'S article on page 561 of this issue advances some views not often heard. Fortified by general experience, we seldom question the advantages of protected monopoly, as against competition, in public-utility ownership and operation. In fact, monopoly in this type of enterprise, combined with governmental regulation, has been crystallized into the laws of the land.

Reduced to the simplest terms, Mr. Galloway's protest is against over-regulation. "There is a middle course in all things," said the old Roman proverb, and to just this Mr. Galloway's views reduce. The thought when applied to public-utility regulation is not new. Mr. Galloway sees in over-regulation, however, more than inconvenience for the utility manager. To him it means the stifling of individual initiative and a consequent weakening of the forces responsible for American achievement.

Undoubtedly there are grounds for his fears. We are in a state of flux with reference to public-utility regulation. What the ultimate form will be, what the character of supervision, only the future can tell. Certainly if the ultimate result is going to be one that will work for the best interests of the whole people, the danger that Mr. Galloway sees must be clearly appreciated.

The specific plea made by Mr. Galloway is for competition, as opposed to monopoly, in public-utility regulation. He sees in protected monopoly danger of plants and systems falling to a low degree of efficiency because the stimulus afforded by competition is removed.

As in the broader matters, there are grounds here for Mr. Galloway's fears. While with competition stifled there is not the direct incentive to invention, the present policy of regulation, forcing as it does improvement upon improvement and expenditure upon expenditure, at the same time crowding the return on the property down to a minimum, provides an indirect stimulus for discovering new methods and new economies.

And without going to the length of again establishing competitive conditions, it is possible, under monopoly, to stimulate utilities to still higher efficiency. It cannot be done when the maximum allowable earning is put upon a fixed percentage basis. The utility owners, as well as the public, must be allowed to share in the economies. Franchises of this sort have been drawn up and must eventually become universal.

Moreover, past experience has condemned competition in the public-utility field. To throw aside this experience and revert to competitive conditions is to invite further experimentation, further turmoil, and to put off the day of sound handling of this difficult problem.

It is conceivable that a turn of affairs may come in which it will be considered desirable to again permit competition in the public-utility field. Such a turn, though, cannot now be foreseen. Should competition, however, be re-established the investment will be greater than under present conditions, and a larger profit must necessarily be allowed the competing companies. Mr. Galloway, reverting to this subject, brushes aside lightly the matter of duplicate plants, but he does so, in our judgment, without warrant.

While, then, this journal cannot agree with Mr. Galloway in his particular plea, it does believe that a presentation of such views has value in the work of developing a sane and adequate public-regulation policy. If only conventional views are presented, if those who see danger ahead are silent, if abuses are not uncovered, the world will stand still. Public-utility regulation is still in its infancy. Conditions border on the chaotic. There is no unity of theory or policy in the work of the state commissions. Out of the experimentation, out of the variety of theory, will eventually come a policy that will meet our conditions, that will safeguard the interests of the public as well as those of the utility investor. To believe less is to lack faith in our ability successfully to meet the problems of democracy.

Government Ownership for England

ENGLAND has about the highest railroad rates in the world. English railroads, on the other hand, pay comparatively low wages and dividends. England, therefore, of all countries, might be expected to afford the strongest arguments for government ownership as a panacea for private inefficiency. In fact, there is much agitation there for nationalization of the railroads after the war. The London *Engineer* does not accept the arguments. Apologizing for repeating trite facts, on the ground that the government-ownership proponents cling to their old themes, the *Engineer* points out why English rates are high and English dividends low, and contends that nationalization offers little or no remedy for the conditions.

The Engineering Record repeats the apology and the facts for the same reason. Ton-mile costs vary inversely with the average haul. In England this average haul is short. In the United States, where, as the *Engineer* points out, the lowest ton-mile rates in the world prevail, the average haul is long. On the other hand, if the rate per mile is high in England the miles are few, and the *Engineer* thinks the rate grievance is therefore exaggerated. As to dividends, it is pointed out that the English railroads are highly capitalized because they were expensive to build—being expensive to build because of the high pioneer prices for materials, the high cost of land and the continuous public opposition to railway development.

The sum and substance of the *Engineer's* argument is that rates and dividends are based fundamentally on conditions quite apart from the question of private or pub-

lic ownership. Applying the theory to the United States it might be said that our rates are low because of long haul, and in spite of private ownership. The first part of this is unquestionably true—but so long as rates are low, for whatever reason, and so long as so many evidences of government extravagance and inefficiency are seen about us, it seems the part of wisdom to let well enough alone.

Politics and Highways

THE New York State Highway Department has been dragged into the present political campaign. The Democratic candidate for governor has said that the highways were never in worse condition; the governor's campaign book, on the other hand, takes undue credit for the department's work and casts aspersion on the management of the department under his Democratic predecessor. Both candidates are in the wrong. The state as a whole would have been the gainer had they been silent about the highway department and left it where it has been to a great extent in the last four years—out of politics.

Time was when the highway work of the state was honeycombed with graft and inefficiency. It was a political football. The organization was demoralized. Four years ago a change for the better began. John N. Carlisle was made commissioner. The strong political control of the department was broken. Efficient division engineers were chosen and given competent subordinates. In less than two years the organization was remade. An *esprit de corps* that was admirable replaced the demoralization. The funds were efficiently spent, the roads of the state greatly improved.

This better organization the present administration inherited and, in the main, retained. Some changes were made, certain appointments were political—and these the adherents of the former administration condemned. The appointments, however, were good ones, the appointees competent. The good work of the department has been continued. It will increase still more in efficiency if the organization is left to work out its destiny as an engineering body—if politicians will leave hands off.

As to the conditions of the roads, the testimony of experienced highway engineers gathered by this journal controverts the Democratic candidate's statement. The roads are in better condition as a whole than they have been before. It is true that in the spring of this year conditions were bad. The late winter was exceptionally hard on the roads. There were repeated thaws followed by hard frosts. In addition, when the working season opened, it was almost impossible to secure labor. As a consequence, the work of repairing the winter's damage was dragged out much longer than usual. Long since, however, the work has been caught up.

The department has made such progress in recent years that it is a pity that unwarranted statements have been made—especially when intended for political effect. What troubles the highway department did have years ago were due entirely to political machination. The department to-day is well organized. It is doing good work. It will do still better work in the future if politicians will give it credit for what it has done, and, for the good of the state, endeavor to increase its efficiency and not use it for personal and political aggrandizement.

Electric Welding Possibilities

CONCEDING that the suggested use of the electric spot weld in the field of structural engineering as outlined by Mr. Hinckley in the article on page 524 of last week's issue is in the nature of a prediction that cannot be wholly justified by existing facts, nevertheless it should arouse the profession to a more active interest in the immediate further development of experimental data. Whether the recent rapid growth in the applications of the electric spot weld will continue to that degree which will make the process a really economical competitor of the riveted joint in the next few years is doubtful.

Limitations in thickness will handicap the process so that the economy which might otherwise be effected in long-span structures where decrease in dead load is a large item can hardly be expected in the near future. Furthermore, there are inherent weaknesses in welded joints due to the impossibility of adequate inspection and the danger from brittleness and sudden failure under impact. Structural engineers would hesitate before using welded joints in structures subjected to the action of moving loads unless it could be absolutely demonstrated by uniform results of an extensive investigation that the steel actually flows together and is not hardened and made unreliable by the process.

Discussing with commercial producers of the welding machines the possibilities suggested by Mr. Hinckley, it is significant that even the most optimistic and interested manufacturers are not yet willing to predict any immediate invasion of the structural field by the spot-weld process. Recognizing, however, that with the development of electrical resources and the increased efficiency possible in welding processes there may be opened up immense fields for more economical fabrication of steelwork, it is strongly urged that scientific and reliable investigations be conducted as suggested by Mr. Hinckley in order to insure the earliest possible further effective application of these new processes.

Inasmuch as the commercial introduction of welded structural steel, like everything else, will proceed commensurately with the growth of public confidence in its merits, manifestly the first important steps to be taken are those necessary for convincing the structural profession in general as to these merits, to accomplish which the creation of a widening interest in the subject is first essential. It is expected that the assertions and claims in the article will provoke a certain amount of discussion and criticism, adverse as well as otherwise, in which case it will have accomplished its purpose.

No Health Menace in Street Cleaning

WHAT is characterized as "the most valuable body of facts and opinion now extant upon the sanitary aspect of street cleaning and street dirt" is contained in the report of the committee on street cleaning presented last week to the sanitary section of the American Public Health Association at its annual convention in Cincinnati. The fact that S. Whinery, consulting engineer, of New York, acted as chairman of this committee presupposes a thorough and intelligent investigation of the subject, and in this respect the reader's expectations are amply fulfilled.

The report is somewhat different from others in this general field. It is confined to the human, rather than to the technical, elements of the problem. It deals not with street-cleaning methods or costs, but with the effect of street dirt and dust upon the health of employees charged with its collection and of the public in general. The committee's findings are largely negative. Conclusions based upon a questionnaire to officials of street cleaning and health departments, hospitals and life-insurance companies in American and Canadian cities having a population exceeding 100,000 indicate that street cleaning and the work connected therewith are not more unhealthful than other laboring occupations. Since those most directly and constantly exposed to street dirt seem to be as healthy as other classes, the inference is that the danger to the public at large cannot be very great insofar as the street dirt is concerned. In the finely divided dust, however, the chief influence upon public health seems to lie.

In view of this statement, it is necessary to revise the popular conception of the health menace in work of this sort. It has been commonly believed that continued exposure to street dust—a condition common in the work of hand-sweepers, operators of sweeping machines and men collecting and disposing of street waste—is particularly conducive to tuberculosis. This assumption is not borne out by the facts. For example, statistics from the New York Street Cleaning Department, covering a period of six years, show an average death rate of 14.8 per thousand, while the records of the New York Health Department for the same period show that the average death rate for all males between the ages of 20 and 70 years was 15 per thousand. Figures from the records of one large life-insurance company support the view that street cleaning cannot be considered as an unhealthful vocational employment, but another company takes the opposite view.

There appears to be a decided paucity of actual records upon which to base conclusions. The number of replies received in answer to the questionnaire is, according to the committee, "disappointing." Reliable conclusions can be reached only if street-cleaning and public-health departments provide and maintain adequate systems of observation and records from which can be determined the true sanitary aspect of street dirt and street cleaning.

Large Steel-Frame Ship Shed Contains Special Trusses Designed for Vertical and Horizontal Crane Loading

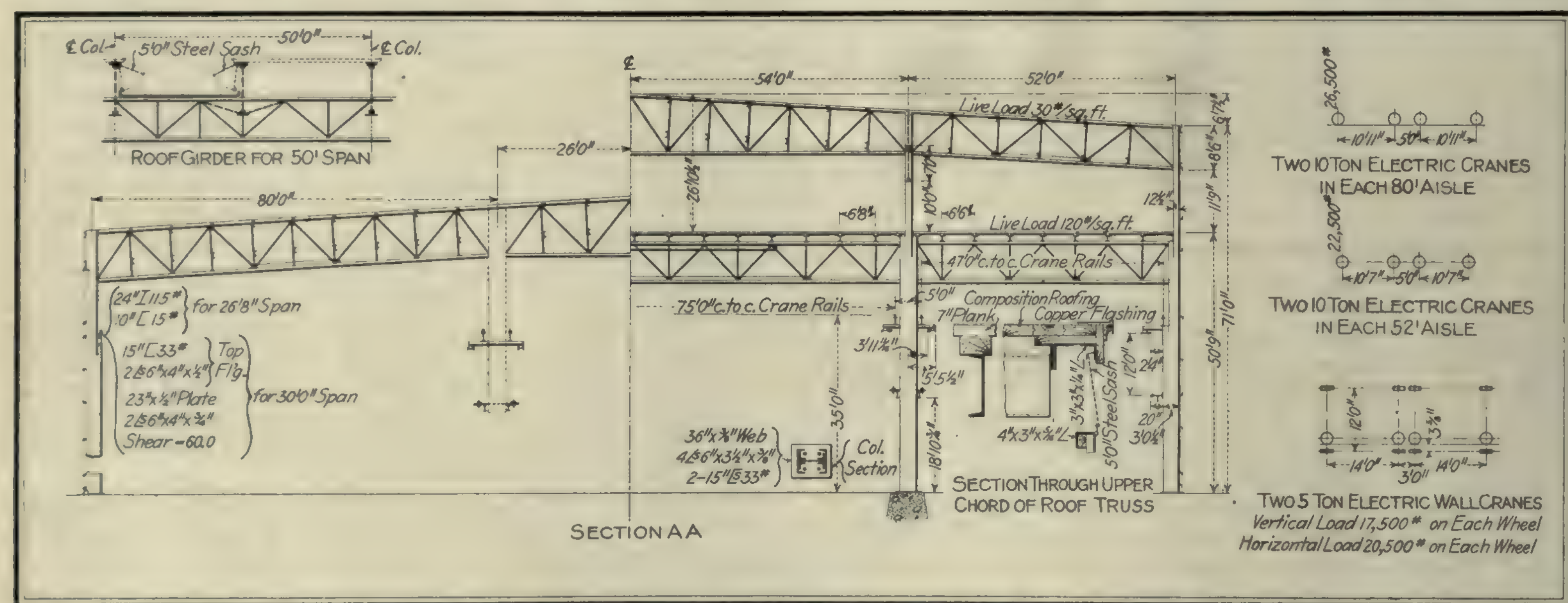
William Cramp Shipbuilding Company's New Structure in Philadelphia Planned to Give Maximum Clear Floor Space and Provide for Traveling Wall Cranes Throughout Length of 540 Feet

DEEP longitudinal trusses having horizontal plate girders as lower chords and at mid-height to resist the horizontal thrusts of a 5-ton wall crane, designed with particular reference to economy, are notable features of the large ship-shed building recently erected for the William Cramp & Sons Ship & Engine Building Company in Philadelphia. Trusses varying in span length from 40 to 80 ft. not only support these wall crane loads but also carry the main 10-ton traveling cranes, the second floor loads on the top chords and the roof trusses. The use of such unusual trusses was necessary to meet the requirements for large unrestricted working spaces on the first floor.

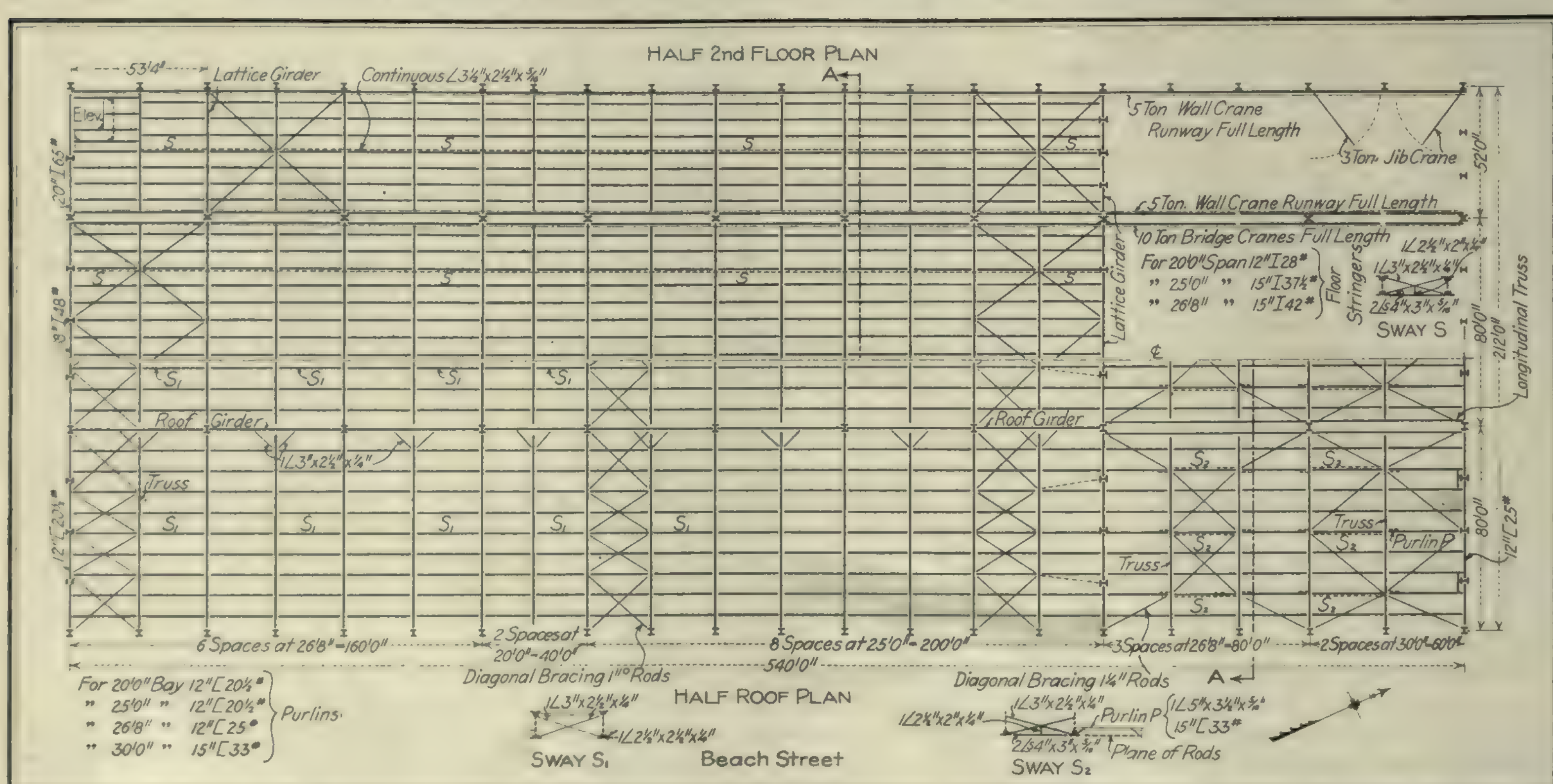
Aside from the special design features of this building, its size of 212 x 540 ft. in plan classes it among the largest of such steel-frame structures in the country used exclusively for ship and engine building. Two bays at one end, occupying a total length of 140 ft., contain the anglesmith department in the 60-ft. bay, and in the 80-ft. bay are two long furnaces for heating angles and one large plate furnace, all of the oil-burning type; while in front of the furnaces for working the miscellaneous materials is a cast-iron machined floor.

The remainder of the building, 400-ft. long, has a concrete floor. On this floor are located the miscellaneous punches, shears, rolls, planers, drills, countersinks, hydraulic benders, jogglers, etc., on which all the material is worked up for the hulls of the ships, ready for assembling. On the second floor, in a space 212 ft. wide by 400 ft. long, is the mold loft. Special attention was given to daylight lighting, and in this large area the center of the floor is as well lighted as along the sides. This is necessary to enable the workmen to lay out to full size the lines of the ships for making the necessary templates and molds, after which they are used on the floor below in getting out the plates and shapes to the proper size.

The total 540-ft. length of the building, 400 ft. of which is two stories in height, is divided into twenty-one bays, varying from



HALF-SECTIONS OF BUILDING SHOW LATTICED GIRDERS AND ROOF GIRDERS—CRANE-WHEEL LOADS SPECIFIED



HALF-PLAN VIEWS OF ROOF AND SECOND FLOOR GIVE LOCATION OF TRUSSES AND LATTICED GIRDERS

20 ft. to 30 ft. for the exterior-column spacing and from 40 ft. to 80 ft. for the interior-column spacing. The building is unsymmetrical transversely, being divided into two 80-ft. aisles and one 52-ft. aisle, as indicated by the accompanying plan and sections showing the general layout of columns, trusses, crane runways and second floor framing.

ELECTRIC TRAVELING CRANES

Each aisle is provided throughout its length with the usual type of electric traveling cranes of 10-ton capacity. In addition, the entire building (except for the east wall in the low-roof portion) is furnished with 5-ton wall cranes, necessitating wall trusses and interior trusses with longitudinal girders in horizontal position, greatly complicating the design and the structural details. Small jib cranes are located as shown, and are attached to the columns only at the level of the lower runway girder.

The timber flooring of the second floor rests upon I-beam stringers, supported by latticed girders. The usual type of triangular truss carries the plank roof on steel channel purlins. The high-low type of roof, with 5-ft. steel sash, was adopted to insure good lighting as required throughout the floor.

The live loads specified for the building are noted on the main sections, with diagrams giving the crane-wheel loads and spacing. Unit stresses as prescribed by the Philadelphia building law governed the design.

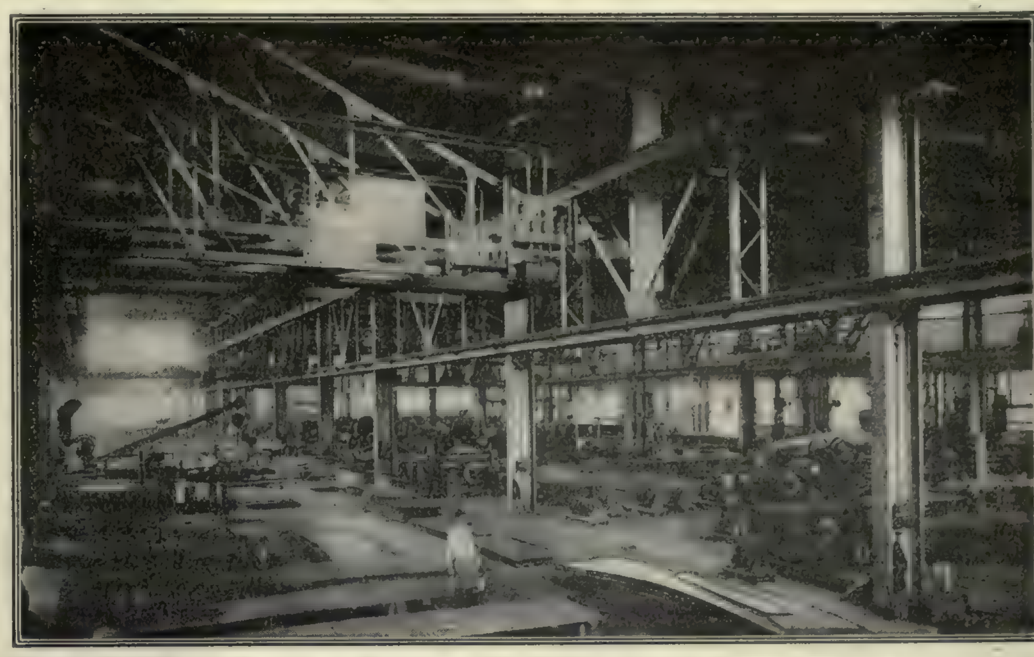
DETAILS OF 50-FOOT TRUSS

Typical details of one of the interior longitudinal trusses (50-ft. span) are shown in one of the drawings herewith. The top-chord angles support the floor, and were therefore designed to resist both bending and direct compression. The main vertical crane loads are carried by 18-in. I-beams in 50-ft. lengths spanning the 12 ft. 6 in. between panel points at mid-height of truss. The vertical loads of the wall cranes are supported by 15-in. I-beams similarly detailed, but connected to the truss at the panel points by transverse 12-in. channels.

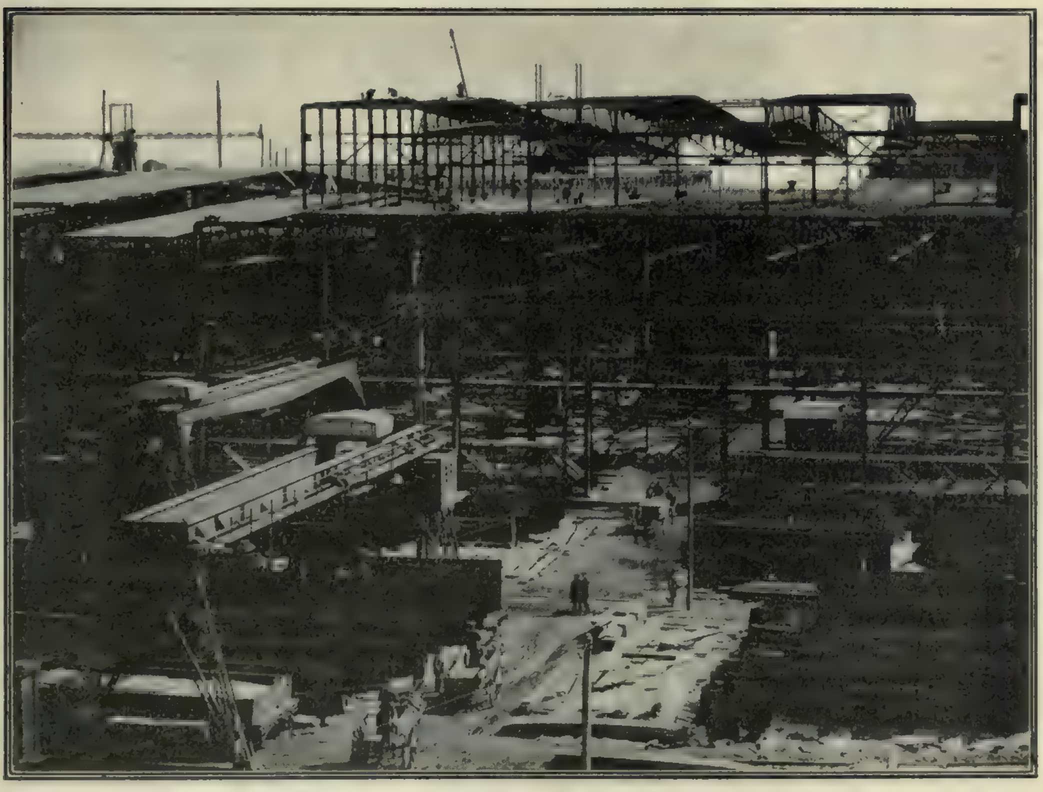
The web-plates of the horizontal girders are riveted to the flanges of these runway beams, countersunk rivets being required in the lower girder where the plate is connected to the top flange underneath the crane rail. The upper horizontal loads of the wall crane are carried by horizontal 15-in. I-beams spanning about 10 ft. between transverse pairs of 8-in. channels riveted to the horizontal girder. The lower flanges of the longitudinal crane beams act as flanges for the upper horizontal girders. The lower horizontal loads are carried directly by the horizontal girders consisting of four angles and a web plate, with the 40-lb. rails connected to the flange angles, as shown in the details.

ERECTION COMPLICATIONS

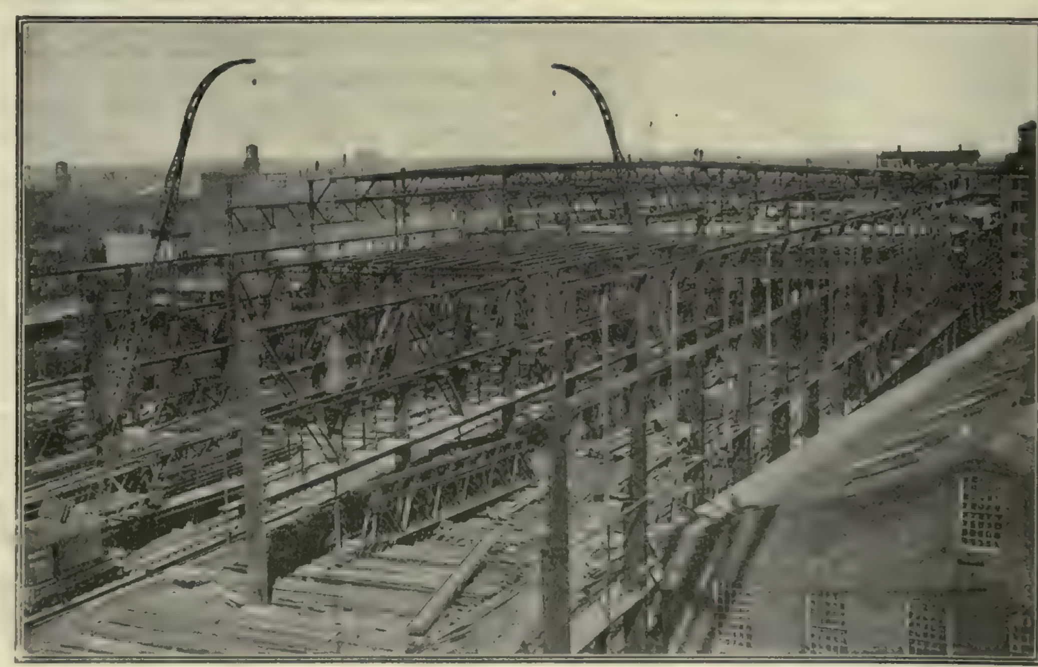
The details of the connections, indicated by the various sections on drawings herewith, are complicated by the erection requirements, the separate field pieces being shown on the drawing by the location of field holes. Slotted holes in the horizontal web plates were necessary to allow truss members to pass through, as noted, and all clips, gussets, etc., on members below the



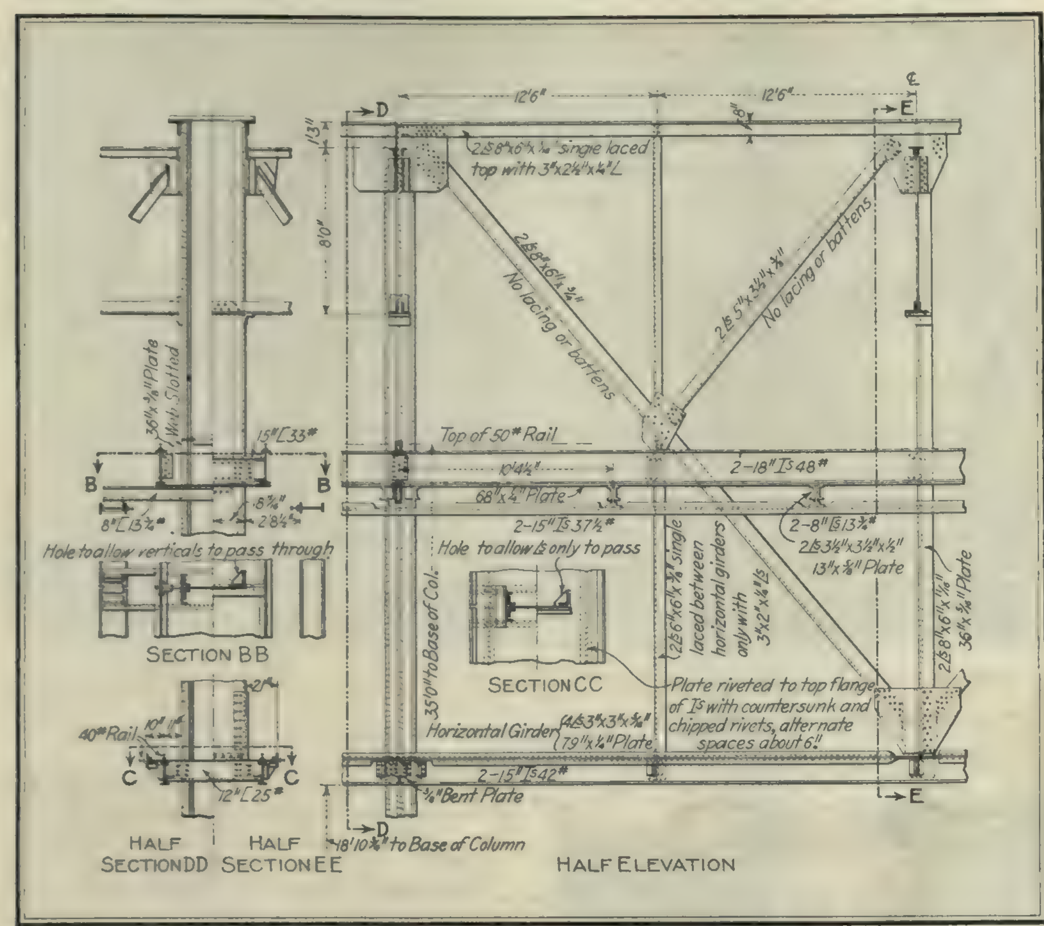
INTERIOR VIEW OF COMPLETED BUILDING SHOWS WALL CRANES AND FABRICATING MACHINERY



LOFT IS LIGHTED BY CONTINUOUS SASH IN HIGH-LOW TYPE OF ROOF



PROGRESS PHOTOGRAPH TAKEN MARCH 11—TRUSSES WITH WALL-CRANE RUNWAYS



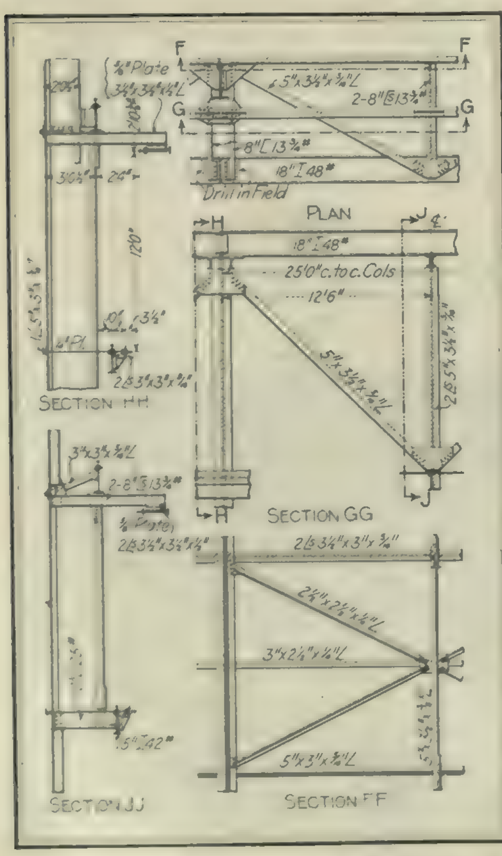
HALF ELEVATION AND SECTIONS OF INTERIOR 50-FOOT LONGITUDINAL TRUSS

Material for truss between 80-ft. aisles is given. Truss between 80-ft. and 52-ft. aisles is same on 80-ft. side, with lighter material on 52-ft. side

upper plate were omitted until after erection. The main diagonal angles are passed through slots in the horizontal plate of the upper girder, and are not laced or battened together.

ECONOMY IN WEIGHT

The other longitudinal trusses, varying in span length from 40 ft. up to 80 ft., and having panel lengths of 10 ft., 13 ft. 4 in. and 15 ft. respectively, are designed with details similar to the 50-ft. truss described. The interior trusses between the two 80-ft. aisles are symmetrical about the central longitudinal plane; but to attain maximum economy for these trusses located between the 80-ft. and 52-ft. aisles the angles used on the 52-ft. side are decreased in thickness to carry the smaller loads from that side. In other words, the two sides of the trusses are assumed to act independently under full loading in the adjacent aisles. In this connection, the omission of lacing and battens in the diagonals should be noted.



TYPICAL SIDE-WALL TRUSS—25-FOOT BAY

SIDE WALL TRUSSES

The details of the 25-ft. side-wall trusses are also shown herewith, these trusses varying in length from 20 ft. up to 30 ft. and providing both vertical and horizontal beam action for resisting the main traveling crane and the wall crane loads. As the span lengths are small, and the second floor loads do not have to be carried by these trusses (channel stringers between columns are used), they are relatively simple in design. The runway beam acts as the top chord of the truss, the plane of which coincides with this beam. Instead of a web plate for the top horizontal girder, diagonal angles are used below the main runway beam. The horizontal I-beam is supported at the center of the bay by the two 8-in. channels indicated in the plan view. The lower horizontal loads of the wall crane are carried by a web plate and three angles for flanges, two on the inside, to which the crane rail is attached, and one on the outside.

The building was designed, fabricated and erected by the American Bridge Company, as approved by H. W. Scott, engineer of plant for the William Cramp & Sons Ship & Engine Building Company, of Philadelphia.

Urge Advanced Research on Public Problems

Composite Opinion of Alumni of University of Michigan Also Advocates Publication of Results in Permanent Form

THAT advanced collegiate work, and more especially advanced technical research on public and industrial problems, are vital and should be encouraged is the practically unanimous opinion of the engineering alumni of the University of Michigan. They believe that the state could well co-operate in the establishing of a state bureau of standards. They also believe that the results of research should be published in permanent form through the creation of a university press. These and other points are brought out in a report submitted last June by the Chicago Engineering Alumni to the president and board of regents of the university. The report is presented as a composite opinion of 524 alumni of all ages, the responses from the classes prior to 1870 being proportionally the most numerous. The investigation was handled by the Chicago Engineering Alumni through a committee of thirty-one, of which Sutton Van Pelt was chairman.

FACILITIES ALREADY AVAILABLE

On the subject of technical research the committee points with commendation to the facilities already available, which include the naval testing tank, the new automobile testing laboratory, the chemical laboratory, the highway laboratory, the sanitary experiment station, the mechanical engineering laboratory and the electrical laboratories. It also calls attention to the survey of St. Clair flats, lake surveys, triangulation of waterways, consultation in water supply and sanitation in numerous cities and the appraisal of public-utility properties totaling $1,300,000,000 in value, and thinks that considering the equipment available the College of Engineering has already done unusual service of unquestioned practical as well as scientific value. That much more, however, in the opinion of the alumni can be accomplished is indicated by these extracts from the report:

"To achieve the necessary breadth of viewpoint, members of the faculty are very properly permitted and encouraged to engage in outside consulting work, and the board of regents is to be commended heartily for its foresight in making this possible. What now seems to be most urgently needed is the separation of graduate and undergraduate work with more space and more equipment, so that advanced technical research may be prosecuted along distinct lines suggested by the most urgent needs of the country's industries. It is hardly to be doubted that the desired outside support would then be available.

"We consider it essential, to render such research of maximum value, that the results be published in permanent form. Should casual publication in magazines and technical society proceedings be depended upon, much good work could hardly hope to find a place of record.

FIELD FOR BUREAU OF RESEARCH

"Finally there exist very important and pressing research problems of a broader nature, which could well receive attention either by the Graduate School, or by the Bureau of Research—such as the technical phases of city planning, administrative effi-

ciency in cities, public utilities and industries, etc. Carrying this idea to its logical conclusion, it should also be possible for the state to repose in such a research bureau as contemplated such functions as would cause it to become a state bureau of standards, thus encouraging standardized precision work.

"Only recently a movement has been inaugurated in one of the American technical societies by which such local research and standardization bureaus should be co-ordinated under the control of a central research organization. . . . The idea is fully as applicable to normal industrial development, and it is quite in accordance with the principles of conservation of resources which this country has definitely accepted."

In slightly condensed form the recommendations of the committee are as follows:

1. That a comparative inquiry be conducted into the work of the College of Engineering and Architecture, the professional standing of its graduates, the compensation of its faculty members in view of the demand from the industries for technically trained men, the equipment and building facilities for both graduate and undergraduate work and the ways and means whereby the integrity of graduate degrees may be best maintained along with adequate undergraduate instruction.

2. That a distinct department of technical research be organized on some plan sufficiently flexible that the laboratories may be developed either as separate units when funds are limited, or more centralized, as may be found more practicable.

3. That a university press be established publishing the results of technical research, as well as the work of other colleges.

4. That intense study be devoted to the immediate needs and opportunities of service to the state and the industries, and that every possible means of encouraging their co-operation be adopted.

5. That attention be given to directing this work into the channels of special usefulness for the furtherance of foreign trade relations, especially with Pan-American countries.

6. That inquiries be made to ascertain the possible field of immediate co-operation with such organized bodies as the Naval Advisory Board and the various engineering societies and commercial bodies for the most efficient organization of technical research throughout the country.

Raise Settled Columns of Big New York Viaduct

Riverside Drive Structure Restored to Level at Small Cost—Settlements of 1 to 7 Inches in Six-Pile Footings

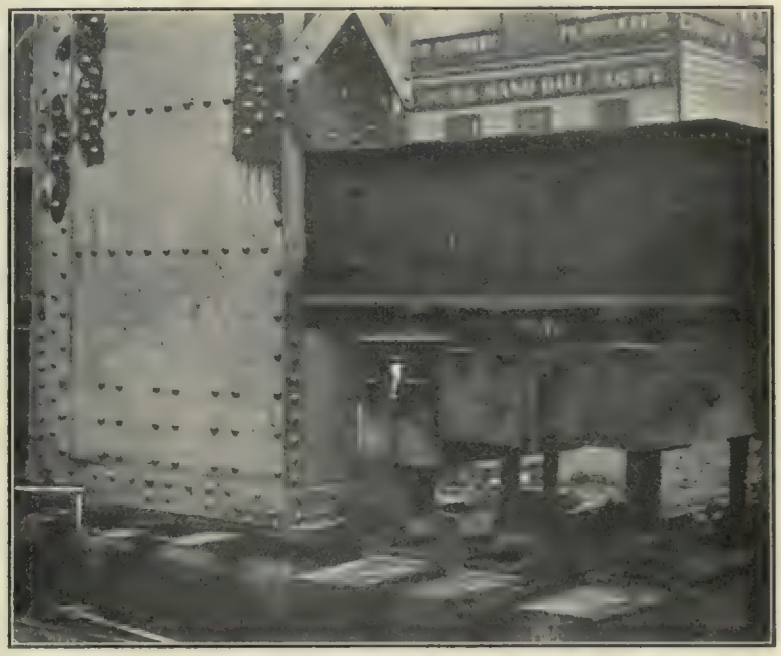
EMPLOYING a small force of men and raising one column at a time, the Bureau of Highways of the Borough of Manhattan, New York City, has restored approximately to original level six steel columns under the Riverside Drive viaduct just north of 130th Street, the pile footings of which had settled from 1 to 7 inches. The six columns which settled are those of the first three bents north of 130th Street, and four and a half years ago, when the settlement was first noticed, the bridge department of the city proposed extending the footings at a cost of $100,000. The present work, however, has restored the viaduct substantially to its original condition for less than one-ninth of this sum, and it is considered quite possible that no further work on this account will ever be required.

The columns under the viaduct transmit their load through heavy steel plates to granite blocks which rest on stepped concrete footings, each founded on 16 piles driven to an approximate penetration of 60 to 70 ft. The load on each of the columns in question is approximately 200 tons. As no settlement can be detected elsewhere in the viaduct, it is considered possible that these six columns are located over a deep pocket of mud. The columns on the east side of the viaduct settled more in each case than the corresponding columns on the opposite side, which resulted in distortion of the west columns, column 16 having deflected till the center line of the column was approximately 2 in. west of the center of the base at a height of 10 ft. from the ground. The unequal settlement also caused the viaduct to lean slightly toward the east, and to some extent warped the east columns. The method by which the viaduct was restored was to raise the columns one at a time, taking first those which had settled most and putting additional steel plates between the column bases and the granite blocks on which they had rested, place cast-iron fenders around the base of each column and fill the fenders with grout.

A diaphragm built up of 4 x 5 x ⅝-in. angles and ⅝-in. plates was put in each column far enough above the base to allow the insertion of needlebeams without removing the lower tie plates. The lower pair of lacing bars on each side were then taken off and the beams put in place. Twelve 25-ton steel screw jacks, arranged on blocking, were used to raise the columns. The lateral movement of the columns necessitated resetting the jacks frequently during the work. In one instance the operation of raising column 16, which had settled 7⅛ in., restored to vertical position column 15 in the same bent, which had only settled ¾ in., but had been considerably distorted. In other cases the jacking operations did not bring the top of the structure back into perfect line, and in order to get the columns plumb the bases were driven over, while the columns rested on the jacks, by means of a 12 x 12-in. timber ram 15 ft. long suspended from a set of falls.

It was the intention to raise each column about ⅜ in. above the original grade. Levels were run for this purpose shortly before the work was started and the steel column bases raised a measured distance above the granite blocks on which they rested. However, levels taken after the last column had been raised indicated that the foundations had settled approximately ½ in. since the first readings were taken. This settlement during raising is accounted for on the theory that the footings continued to carry most of the load even during actual jacking operations, as the blocking under the jacks rested partly on the shoulders of the concrete footings below street level.

The work has been done by forces of the Bureau of Highways, Borough of Manhattan, New York City, of which Eugene W. Stern is chief engineer, under the supervision of R. A. MacGregor, assistant chief engineer.



LEFT, LOOKING NORTH UNDER VIADUCT AT THREE BENTS WHICH SETTLED—RIGHT, 200-TON COLUMN LOAD RAISED ON JACKS

The east columns, at right of left-hand view, settled most. Starting with column at extreme left, the column numbers and amount of settlement at each are: No. 15, ¾ in.; No. 17, 5 1/16 in.; No. 19, 4 9/16 in.; counting in the same way, beginning with column at extreme right: No. 16, 7⅛ in.; No. 18, 7 7/16 in.; No. 20, 5⅞ in.

Future of the Technical and Trade Press

An Address Before the Convention of the Associated Business Papers, Delivered in New York City, October 26, 1916

By JAMES H. McGRAW
President, McGraw Publishing Company Inc.

MR. MCGRAW'S ADDRESS *is more than a mere analysis of a publisher's opportunity. It is an analysis of industrial conditions in the United States to-day as they affect not only technical or business papers, but engineers, contractors and manufacturers. Mr. McGraw foresees for the business paper an era of greater power, and this necessarily implies a larger scope for the men whom the technical and business papers serve.*—EDITOR.

THE remarkable development of the business press during the past twenty-five years is a matter of pride to everyone engaged in this field of publication. This development is proof of the need of the business press, as well as proof of the big opportunity existing. Some may feel that, following this rapid development, will come a slower future progress, on the theory that we have scaled the greater part of the heights of opportunity, and that less lies still above us.

Existing conditions do not justify that thought or feeling. As a matter of fact, opportunities were never so great as they are to-day. Moreover, never have the business papers been so strong financially, so well organized to attack their problems.

The opportunity, however, if it is to be grasped, must be clearly seen not only by a few editors and a few publishers, but by everyone engaged in the production of business papers.

THE OPPORTUNITY

Since the European war began, our industrial problems have appeared in a new light. Specifically, there are three new factors influencing the thoughts of the country with reference to its industrial problem:

1. The situations disclosed in European industry by the war.
2. Our new attitude toward foreign trade.
3. The labor question.

The war has disclosed that Germany is remarkably well co-ordinated as an industrial nation, that the efficiency of her workers and her executives is high, that she has used to the utmost in developing her industries the agencies of scientific and engineering research. England, on the other hand, for the first time in twenty-five years, has understood thoroughly her own industrial position. Her industries are not co-ordinated, her labor efficiency is shamefully low. She has failed to avail herself of the benefit of research work.

When David Lloyd-George undertook to organize the munitions making of England, he put into factories women and girls who had never been in a shop before. Yet within a month's time these inexperienced hands were turning out double the production of the experienced workers before them. In many cases the production was treble that of the men, without fatigue or injury to the health of the women.

This disclosure has not only shocked England into new life industrially, but has caused leaders in this country to inquire whether we are in England's or in Germany's class. Furthermore, the disclosure showed why Germany was making inroads on British foreign trade, and further, that labor was responsible for the throttling of English industrial life. As a result of the munitions-making experience in England, various investigations were undertaken looking to the discovery of a solution of the difficulty. One of these investigations was a study of the possibility of British industry benefiting by scientific research.

THE LESSON FOR US

Had these conditions in Europe been disclosed twenty years ago they would have been sufficiently interesting to stir us to very active thought. But if that would have been true twenty years ago it is far more true to-day. Twenty years ago we were largely self-sufficient in the sense that until then our own development internally had been so rapid as to absorb most of the products of our labor, except surplus food stuffs. Now competition is keener. Now there is a surplus of manufactured products. Not only do we need foreign trade as an outlet for the work of our people, but business men generally realize that a goodly percentage of foreign trade is a remarkable stabilizer. Competent authorities say that every business should export one-third of its production. In this way conditions in all quarters of the globe would be hooked up with our own, and good times elsewhere would help to mitigate conditions when we had relatively hard times here.

But if we are to develop a large foreign trade, must we be in England's or in Germany's class, with reference to our industrial organization? England's own experience in the past quarter century sufficiently answers the question.

SOME OF OUR LEADERS AWAKE

It is apparent that some of our leaders realize how serious our industrial situation is, how great the similarity to England's rather than to Germany's. Within the last year the industrial preparedness committee of the Naval Consulting Board has made an industrial census of the country in order to co-ordinate our industries with the defense machinery of the country. That is a long step forward in industrial co-ordination, even though its chief mission is a military one. There is bound to flow from it, too, benefits in times of peace, because there will necessarily be interchange of ideas, through government agency, regarding production methods, accounting, etc.

The Federal Trade Commission is another indication that we realize that a new era has come into our industrial life.

A third factor is the organization of the National Research Council, which aims to bring together the scientific and engineering brains of the entire country in order that the products of research may be woven into our entire industrial fabric. Germany has won primarily because of her research work and the way it has been tied up to her manufacturing operations. On our own National Research Council will be represented every phase of scientific and engineering endeavor, so that no possible agency which can help us in an industrial way will be overlooked.

THE LABOR QUESTION

The third factor which is causing us to think anew, and seriously, regarding our industrial situation is the demonstration of the power of labor at Washington in September. It is too fresh in mind to be rehearsed in detail. He who thinks that the victory of the railroad brotherhood is an isolated event is blind to the labor movement that is developing in this country. It is part of a great whole. It is notice to the country that unless our industrial leaders "beat labor to it" by proposing and putting into effect the correct solution of the labor problem, labor itself will force a solution. That solution will be to labor's own liking, and the welfare of industry and of our national life will have no consideration in the deliberation and conclusion.

WHAT IS ITS SIGNIFICANCE TO THE BUSINESS PRESS?

What does this mean to the business press? The business press is the representative of industry. It should be the leader in devising ways and means of industrial co-ordination. It should set the necessary broad-gage policy toward labor.

If the business press does not do these things—help to raise the efficiency of industry, help to co-ordinate as Germany is co-ordinated—it will not merely lose an opportunity; it will be signing its own death warrant. Already the newspapers of the country have declared that the business press is a more or less useless activity; that the newspapers of the country can adequately and fully serve the business man.

The day of muckraking has passed. The salacious story does not attract even morbid interest on the part of the public compared with a little time ago. During all the period of muckraking and salacious stories on the part of newspapers and magazines the business papers have stood for constructive effort. It should be the first concern of the business press to make this idea known to the industrial world. Magazines and newspapers are becoming more and more a part of the business of the country. They see that their own prosperity is bound up with the prosperity of the nation.

If, however, the business-press publishers will fully realize the import of what is now going on, will decide broadly what policy is proper, and will bend every endeavor toward avoiding the crash that is otherwise inevitable by getting industrial leaders to accept this broad and sound solution, they need have no fear that the wish of the newspapers will be realized.

IN THE CENTER OF ITS FIELD

In order that the business paper may exercise this broad and beneficent influence it must be in the center of its field. Its position must be such that no important move will be made without the paper being in the inner council. The paper can perform two functions:

1. With its grasp of the field, it can gage the reception a proposed step will receive. Moreover, because of its semi-detachment, it is able to estimate the effect of a policy better than those who see the business from only one angle.

2. With its knowledge of the psychology of the field, and its knowledge of publicity, the paper can best advise as to the way the most can be made out of a certain bit of information, the announcement of a new movement or policy.

Nor is it sufficient for the editor to get the data second-hand. He must know not only the outstanding facts, but the entire background. Knowing the whole situation fully, few men are better qualified than the editors of the business press to counsel and advise the leaders of an industry.

The Editor Must Be Broad

Manifestly this gives high position to the editors of a business journal. The corollary of that proposition is that the editor himself must be a man of broad caliber, large enough in his views, firm enough in his convictions, able enough to command the respect of the leaders in his field.

With editors of the right caliber, with a broad policy, fundamentally right, which takes account of all the factors in our industrial situation, which sees into the future, which avails itself not only of all of our own experience, but that of England and of Germany, the business press will make for itself a place in our national life impossible of attainment by any other medium, or possibly any other agency. If we have but the foresight and the ability, we shall be the main directors of the industrial and commercial policy of this nation. The opportunity is there, the situation is a pressing one at the present minute. What is needed is an adequate grasp of the situation by our business publishers and a persistent, firm determination to play our part in the great game in a big way for the benefit of all that is best in our national life.

Gage Measures Rail Wear on Sharp Curves

Simple Device Proves Useful in Helping Get Maximum Service from Short-Lived Rails Without Overstepping Safety

By J. T. BOWSER
Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

THE comparatively long life of rail on tangents, the character of the wear and the conditions which must be considered when determining the necessity of renewal rarely make it possible for such rail to be retained in the track long enough for the wear to pass the point of safety. The economical maintenance of track usually requires the renewal of such rail before the wear becomes so great. On the sharper curves, however, the life of rail is rarely longer than one year, and under very heavy traffic is sometimes only a few months. The nature of the wear of rail on curves is essentially different from that on tangents, so that the safety point of wear may be easily passed long before the economical maintenance of track may require renewal. But while there must be an ample margin of safety allowed, the extremely short life of rail on curves makes it doubly necessary that the maximum safe service be obtained. Some sort is desirable to see that this maximum is not exceeded.

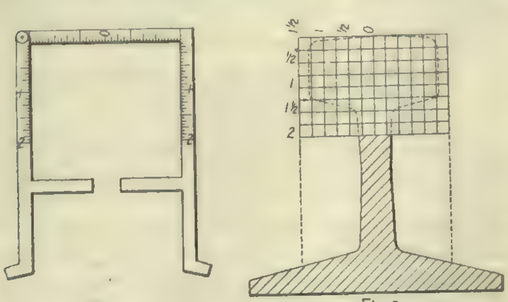


Fig. 1 Fig. 2

RAIL GAGE AND DIAGRAM FOR RECORDING WEAR OF RAIL

Careful Inspection Necessary

In order that the requirements of both safety and maximum wear may be obtained, frequent and careful inspection is absolutely necessary, and on railroads having a large number of curves these frequent inspections cannot usually be made by the higher officials of the maintenance-of-way department who would ordinarily make the inspections of rail and recommend renewals. This duty then devolves on the minor officials—the track supervisors, etc.; and since the individual judgment of these men may vary so widely, it is quite likely that rail will be left in the track after the wear has passed the margin of safety, or that in some instances it will be removed before it has given the maximum safe service. It is therefore obvious that to obtain both safety and economy some definite standard must be adopted as the maximum permissible wear, and some means provided by which the wear may be accurately measured.

The Gage and Its Use

Fig. 1 represents a gage which may be effectively used in measuring flange wear. The graduations on this gage, it will be seen, readily permit measurements to be taken, from which the cross-section of the rail may be plotted. Fig. 2 shows a drawing on which the cross-section of the rail may be plotted if a report of the conditions found is required. This drawing will be found especially useful in determining the maximum allowable wear if a standard has not already been set for this.

If such reports are not required and a standard for wear has already been adopted, then it is only necessary to obtain by means of the gage the measurements at predetermined points on the graduation and check these against the measurements at similar points on the standard, and the approach to the maximum wear is determined.

It is, of course, hardly possible for any-one to fix absolutely the point at which the wear of rail passes the margin of safety, but on rails of A. S. C. E. section (on which the drawing in Fig. 2 is based) it is very probable that this point will be reached when the center of the arc of the curve on the inside of the ball passes the plane of the inside of the web produced.

Portable Plant Makes Bituminous-Pavement Patches

Recent Street-Repair Work in Charlotte, N. C., Cost 60 Cents per Square Yard—Wood Preferred to Coal for Heating

By SAMUEL H. LEA
City Engineer, Charlotte, N. C.

FOR making patches in bituminous pavements the portable repair plant shown in the accompanying illustration has been adopted in Charlotte, N. C. The city has about 30 miles of bituminous pavement, comprising an area of 485,000 sq. ft. The older pavements have gone out of guarantee and the burden of maintenance of quite a large area of bituminous pavements rests upon the city.

The writer has devoted much time and thought to the matter of paving repairs, and different methods have been tried, including cold patching. A home-made heating kettle was used, but after performing useful service it was discarded for the portable repair plant shown in the picture. The complete outfit comprises one Hooke portable asphalt repair plant, one mule and wagon, three laborers, tools and appliances.

PORTABLE PLANT FOR BITUMINOUS-PAVEMENT REPAIRS IN CHARLOTTE, N. C.

Plant Details

The asphalt repair plant consists of a portable heater with a pan of about 21 cu. ft. capacity. The firebox is at the rear end and the asphalt kettle at the front end. The following tools are used with this outfit: Two shovels, 2 rakes, 1 potato hook, 2 smoothers, 2 iron tampers, 3 galvanized iron buckets, 2 asphalt axes, 2 stable brooms, 1 pick and 1 house broom.

The asphalt mixture used in making the patches is of about the following proportions: Sand, 75 per cent; Portland cement, 10 per cent; asphalt, 15 per cent. A batch of the mixture is composed of the following ingredients: Sand, 16 cu. ft.; Portland cement, 2 sacks; asphalt, 190 lb.

In operation the pan is charged with sand and the asphalt is placed in the kettle at the front end. Fire is made in the firebox and the sand is heated until thoroughly dry. In the meantime the asphalt is being melted in the kettle. Dry pine is used for fuel. This is more satisfactory than coal, although the latter may be used.

After the sand has been sufficiently heated, two sacks of cement are added and well mixed with the sand by the workmen, who stand on running boards at the side of the pan. After thorough mixing dry, the melted asphalt is poured into the pan. The whole mass is then thoroughly mixed until all the grains of sand are coated and the mixture appears black throughout.

The holes to be repaired are made ready by having the edges carefully trimmed with

an asphalt axe, leaving the sides of the cut vertical. The bottom and edges are painted with the melted asphalt to insure a bond between old and new material. The hot pavement mixture is applied in a single layer of such thickness that, when thoroughly compressed with the tamper and finished with the smoother, the surface will be uniform with the surrounding pavement. After the new work has been finished with the smoother a small quantity of Portland cement is applied to the surface and the surplus swept off with a broom, leaving just enough to show the cement color.

COST

The actual cost of work recently done with this plant is as follows, one day's work comprising a number of widely scattered patches:

COST OF PATCHES IN BITUMINOUS PAVEMENTS

36 cu. ft. of screened sand	$1.20
4½ sacks of Portland cement	2.58
450 lb. of asphalt, 60 to 65 penetration	4.95
One-horse team	2.00
3 laborers	3.75
Fuel	.72
Depreciation, etc.	.50
Total	$15.70

Area covered by patches, 26 sq. yd.
Unit cost, $0.604 per square yard.

Heavy Street Grades Cut Down in San Francisco

One Intersection Lowered 14 Feet—Switchback Scheme Resorted To to Reduce a 20-Per Cent Grade

TO make certain sections of San Francisco more accessible, street regrading has lately been undertaken at many points where it was feasible to make the change at low cost. No standard plan has been adopted, a study being made of each case independently. In fact, with grades ranging up to 55 per cent, a wide variety of remedial measures is required.

In the Hayes Street regrade, shown in the accompanying illustration, it was found feasible to cut the roadway down between curb lines for a maximum of 15 ft., thereby establishing a 10.909-per cent grade instead of the 14.54-per cent grade previously existing. This involved lowering one street intersection an average of 14 ft. Retaining walls were built at the curb lines to form the sides of the cuts, and stairways were provided at intervals connecting the street with the sidewalks at the upper level. Sewers and public-utility conduits were placed under the sidewalks.

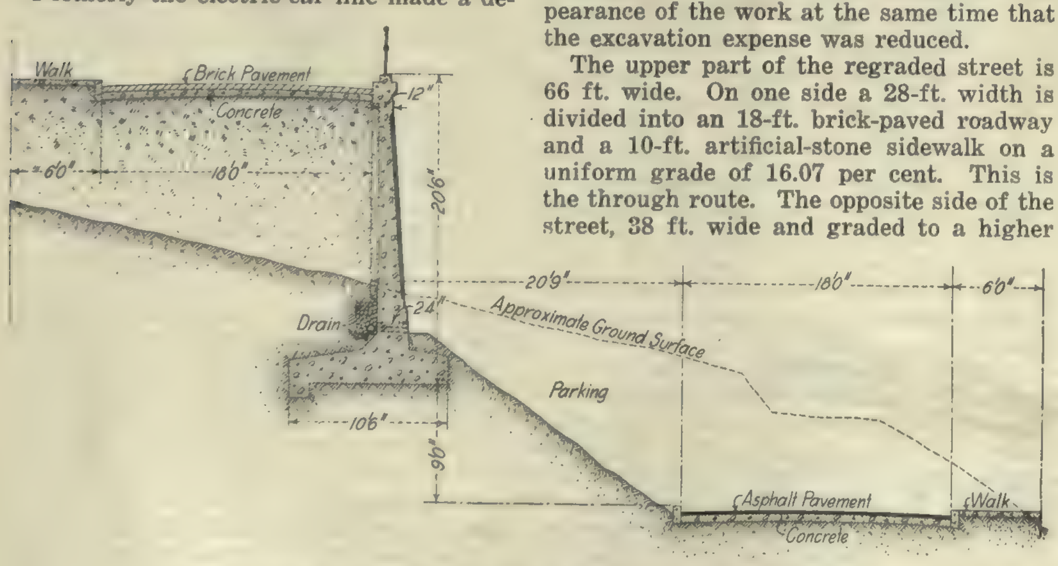
ON HAYES STREET A 15-FOOT CUT REDUCED THE GRADE 3.5 PER CENT

Formerly the electric-car line made a detour at this point to reach the district beyond. Since the regrade the car line continues directly over the hill through the cut, this effecting a considerable saving in time and power. On this work 11,500 cu. yd. of excavation was made by the street-railway company and the city paid $16,000 for the remainder of the improvement.

REDUCE 20-PER CENT GRADE

In another case property owners in a residence district applied for a regrade on two blocks on which the grade was reduced from 20 per cent to a maximum of 16 per cent. Here it was found desirable to provide an indirect route, so the roadway went west a few hundred feet on half-street width and then returned east on the opposite half of the street, the two grades being separated by a reinforced-concrete retaining wall. After gaining a rise of about 30 ft. by this method the roadway makes a right-angled turn into another street, where a continuation of the same grade brings the roadway to the next crossing without doubling back. It was, however, found desirable to divide the street at the upper end into two grades, separated by a retaining wall as before. This gave convenient access to residences on the upper end of the regrade over an easier gradient than the through route and secured a much better general appearance of the work at the same time that the excavation expense was reduced.

The upper part of the regraded street is 66 ft. wide. On one side a 28-ft. width is divided into an 18-ft. brick-paved roadway and a 10-ft. artificial-stone sidewalk on a uniform grade of 16.07 per cent. This is the through route. The opposite side of the street, 38 ft. wide and graded to a higher elevation, has grades varying from 4.37 to 10.92 per cent. A 28-ft. width is paved for vehicles. The sidewalk for the through route follows this higher level and descends a drop of about 30 ft. across the "switchback" by a series of stairs located where the crossing is most convenient.



CROSS-SECTION AT MAXIMUM GRADE DIFFERENCE ON SWITCHBACK

COST OF IMPROVEMENT

The cost of this improvement was paid entirely by the owners of property fronting on the two streets affected by the regrade. On one street the assessment was $16.31 per front foot and on the other $20.29 per front foot. The property values were about $115 per front foot before the change and are now rated at about $250 per front foot. The total cost of this work was approximately $30,000.

The work is handled entirely by the engineering department of the city under the direction of M. M. O'Shaughnessy, city engineer.

Old Roads Maintained with Roller and Scarifier

Cost of Keeping Up Macadam Highways in Putnam County, Indiana, with Simple Power Equipment

By GEORGE E. MARTIN
Assistant Professor of Highway Engineering, Purdue University, Lafayette, Ind.

PUTNAM COUNTY, Indiana, has a very large mileage of macadam roads. Many of these roads were built with but little attention to grades or drainage. Greencastle, the county seat, is in the center of a region producing a good grade of road-building limestone, and comparatively large amounts of stone have been placed on the roads of the vicinity.

Last year the county purchased a steam roller with a scarifier attached to it. This outfit has been used to dress up the roads at the following costs for operation:

	Total cost per day	Coal cost per day	Miles operated	Days operated	Cost per mile
May	$6.56	$1.23	16.75	23.6	$9.24
June	6.69	1.54	19.50	25	8.56
July	7.25	1.35	27.75	25	6.84
August	6.43	1.85	30.25	25	5.35
Average	6.73	1.49	23.56	24.65	7.50

These costs are based on coal at $3 per ton; wages of roller operator, 30 cents per hour; wages of helper, 25 cents per hour; and teams for hauling coal, 35 cents per hour.

The roads were about 12 ft. wide. In most cases they were both graded and rolled at this cost. About 50 per cent of the mileage was scarified and 12 miles were rolled only.

The work was done under the direction of Alva E. Lisby, Putnam County road superintendent, who collected the data quoted.

Chlorine Eliminates B. Coli from Chicago Water

Only 0.28 per cent of the samples of Lake Michigan water collected by the Chicago Board of Health from the various pumping stations during the first eight months of 1916 showed B. coli in 1 cu. cm. Similar samples for the five years previous show a gradually diminishing number. The percentages are 18.1, 11.3, 5.3, 4.5 and 2.7 per cent in 1915.

Chinese Build Reinforced-Concrete Warehouses

Mixing Done on Floor Being Poured—20,000 Square Feet in Month Good Progress—Design Dispenses with Mechanical Equipment

By E. PARK
Formerly Assistant Engineer, Chinese Government Railways

REINFORCED-CONCRETE building construction is gaining favor in China, and a number of warehouses of this type, of considerable size and weight, have been built in Shanghai and other trade centers. The building of the Chinese government railway has furnished a good school in construction work for Chinese contractors, and there are a number now in business able to undertake any sort of building construction and perform it with skill. Although electric power is available in several cities, mechanical construction plant is practically unknown, being unable to compete in cost with human labor.

Human Conveyors Use Stairways

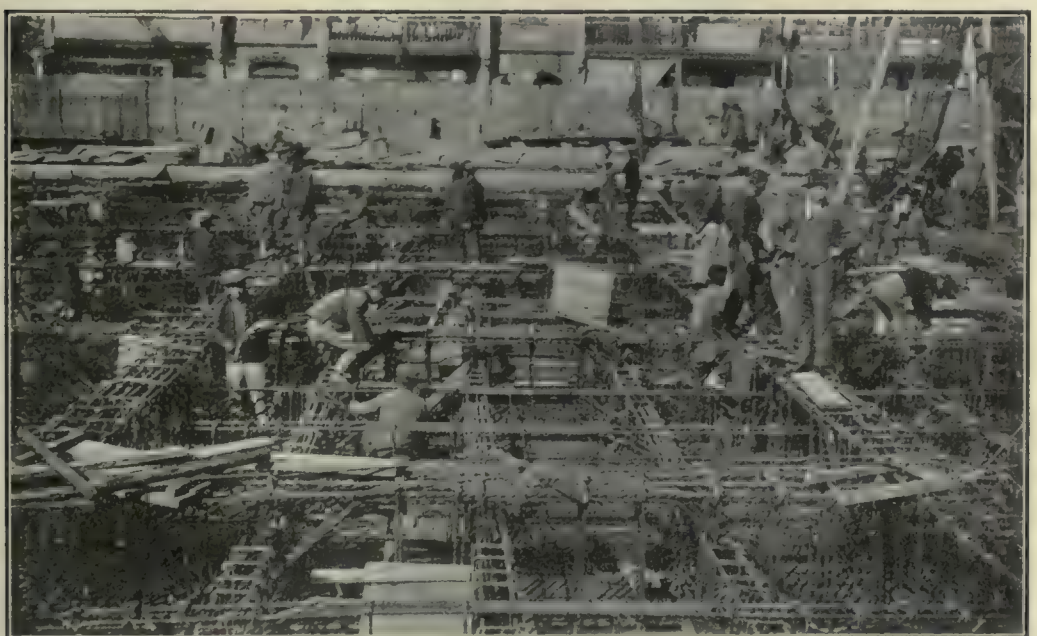
The photograph shows construction in progress on a group of warehouses four and five stories high at Hankau. The floors are of the beam-and-girder type; the columns are square. One building is floated on a heavily reinforced concrete mat, the construction of which was faultlessly executed by the Chinese contractor.

The most noticeable feature of the design of these buildings is the absence of elevators and of any mechanical conveying equipment. The upper floors are reached by external stairways with steps having 11-in. treads and 4½-in. risers. Everything is carried from warehouse to warehouse or from warehouse to ship by coolies. Several hundred of them moving in long lines carry the heavy bags of goods, and form a most effective conveyor. It is economical to carry bags weighing 192 lb. to floors 70 or 80 ft. above the ground in this way.

In constructing these warehouses the stone, sand and cement used were carried separately almost to the point of concreting and mixed on board platforms resting on the reinforcing steel. The concreting of a single floor slab 100 x 200 ft. will keep the contractor busy for two weeks or more, and little effort is made to strip forms and re-erect them for the next floor until the one on which the work is in progress has been completed. Perhaps this is because labor of all sorts is plentiful, and there are no union carpenter organizations whose members must be kept busy continuously if the contractor is to hold enough of them to finish his job.

Formwork Heavy

The tendency as yet seems to be to make the formwork heavier than necessary, the contractor for one of these buildings having used 3-in. Oregon fir for lagging, even after the engineer had told him that it was far heavier than was required. Chinese fir is used to some extent for forms, though the wood behaves something like hemlock and cannot be used for exposed surfaces where good appearance is necessary. The Chinese carpenters are good workmen, and the centering is well fitted and accurately placed.



DIFFICULT JOB OF PLACING STEEL FOR HEAVY MAT FAULTLESSLY EXECUTED BY CHINESE

The same may be said of the reinforcing, most of which in the buildings mentioned was secured together with wires. An idea of the care with which this work was done may be gained from the photograph of the reinforcing for the concrete mat under one of the warehouses. This steel was all bent on the job by hand, using home-made benders.

In the erection of exterior trim the Chinese, having a plentiful supply of bamboo for scaffolds, possess a considerable advantage over American contractors. All of their scaffold work is lashed.

The contract price of reinforced-concrete work of this class in Hankau was about 50 taels per 100 cu. ft., including cement, sand, stone, labor and formwork, but not the reinforcing material. This corresponds to about $9.45 per cu. yd. Although this may be high in view of the low cost of labor, it must be remembered that Oregon fir in China costs more than $40 per thousand and that cement is at least as expensive as elsewhere.

The writer has never seen in use in China a concrete mixer, buggies, chutes, hoists or any other mechanical equipment for handling concrete. The freight on tools of this sort makes their cost very high, and they cannot compete with hand labor even where electric power is available, as at Hankau.

Makes Cost Comparison of Sewage Treatment

Harrison P. Eddy Gives Data on Activated Sludge Versus Imhoff Tank-Trickling Filters Plant for Fitchburg

INITIAL costs of an activated-sludge plant are less per capita and per 1,000,000 gal. than the Imhoff tank-trickling filter method, but the operating expenses are so much higher that the balance is distinctly in favor of the latter method. This was the conclusion reached by Harrison P. Eddy, consulting engineer, Boston, in a paper presented Oct. 16 to the Western Society of Engineers. Other considerations, such as available space, less chance of nuisance and future reductions in operating costs (he figured power at 1 cent per kilowatt-hour), may make the activated-sludge method a closer competitor under changed conditions.

Comparative Data

The 5,500,000-gal. Fitchburg plant was taken for comparison purposes. It was built to serve 55,000 persons, although at present only 32,500 persons are connected with the system. On the basis of 55,000 persons the older method cost $7.85 per capita and the 1,000,000-gal. cost was $78,500. Corresponding figures for an activated-sludge plant were given as $5.71 and $57,100. The estimated annual costs of a typical Imhoff tank-trickling filter plant are $8.50 per 1,000,000 gal. treated and 31 cents per capita. For the activated sludge the costs are $20 and 73 cents respectively. Figuring interest at 4 per cent and a depreciation sinking fund at 2½ per cent, the total annual costs are $21.84 and $29.85 per 1,000,000 gal. for the trickling filters and activated-sludge plant respectively. Per capita the corresponding costs are 80 cents and $1.09. Adding the capitalized expenses at 4 per cent to construction costs the difference in favor of the trickling filter plant is $284,170.

Sludge Used on Plant Grounds

With reference to the disposal of sludge of the Fitchburg plant, now in operation two years, Mr. Eddy stated that there had been a number of applications from farmers to haul it away, but that the surrounding grounds of the plant were so much in need of enrichment it will be several years before any outside means of disposal will be sought. The operation of lifting the sludge by means of an air pipe simply tapped into the side of the vertical sludge-removal pipe has worked out satisfactorily. Contrary to expectations, the air does not collect in large volume behind a solid mass of sludge, but mixes with it in fairly small globules. The flow can easily be regulated to deliver an even stream without any spurting.

To Divert Lincoln Highway from Nevada "Mud Flats"

A way has been found to bypass the Lincoln Highway away from the famous "mud flats" in central Nevada, the improvement for which Eastern donations have been made recently. The proposed change will carry the road north from the present right-of-way over what is known as the Stillwater cutoff, 30 miles east of Fallon on the Carson Sink. While no longer than the existing route, it will provide a more scenic drive on high ground.

General Track and Building Plan for Chicago Union Station Is Made Public

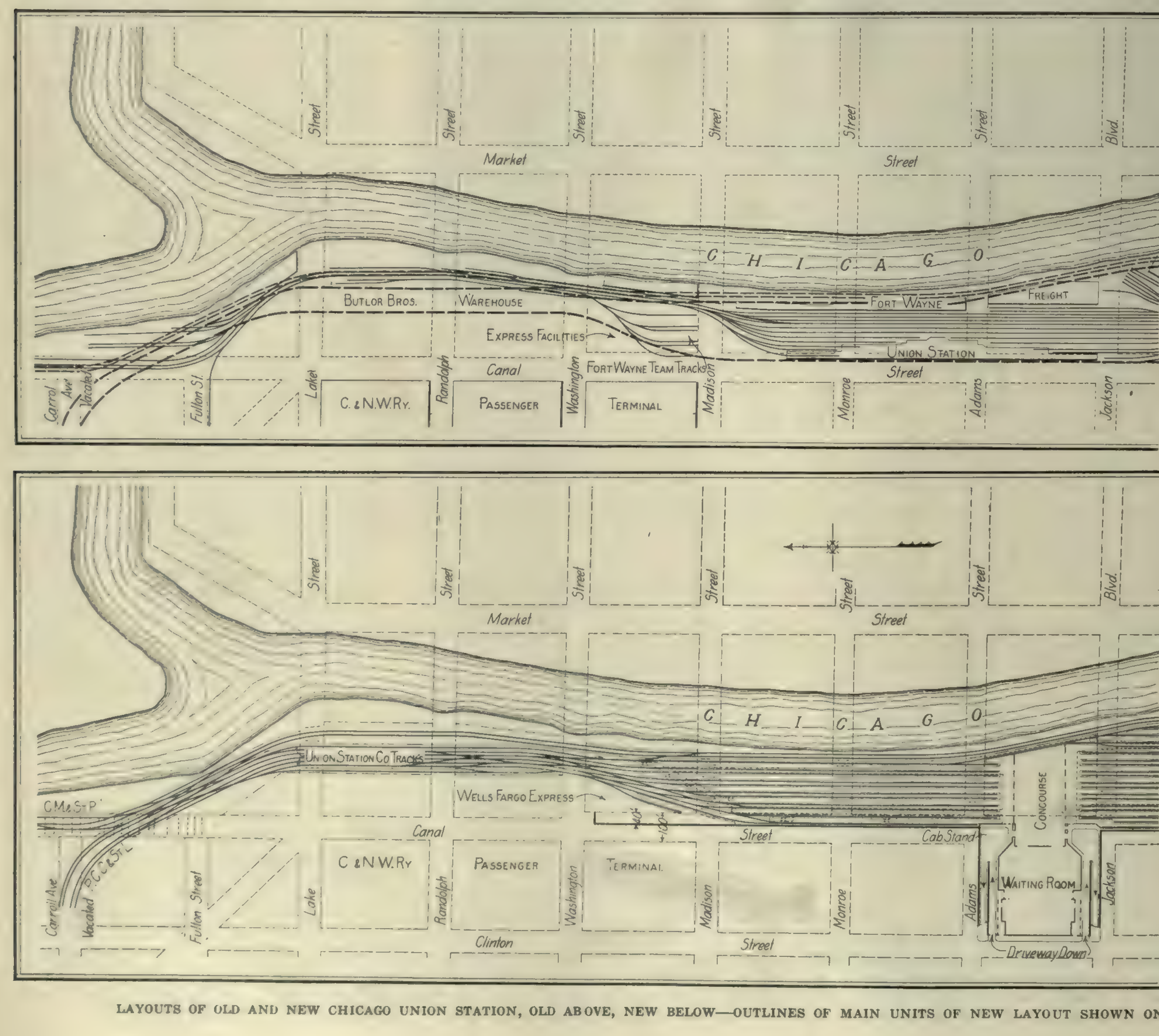
Stub Tracks Will Run Each Way from Concourse Between Adams Street and Jackson Boulevard—All Facilities for Traveling Public on One Level

A MAIN station building west of Canal Street, leaving the entire space between Canal Street and the Chicago River free for tracks and mail and express facilities; a passenger concourse running across from the main building nearly to the river, two sets of stub tracks, one running north and one south from the concourse, and three through tracks along the river for interchange purposes—these are the essential features of the general plan for the Chicago Union Station, adopted in July and now made public. The station building will occupy the entire block bounded by Clinton, Adams and Canal Streets and Jackson Boulevard. Some of the platforms will run north beyond Madison Street and south nearly to Harrison Street, giving an overall length of 2900 ft. A basic idea of the development was that of providing all of the facilities for serving the public on one level, and this will be accomplished by sinking the general waiting room and concourse to the platform level. Features of the improvement include high platforms and a system of longitudinal and diagonal baggage tunnels reaching the far end of each platform. Incidental to the improvement are the relocation of extensive freight facilities to make room for the expanded track layout. The broken profile of Canal Street will also be greatly improved, and the street will be widened from 80 to 100 ft. The adjustment of cross-streets and reconstruction of viaducts to the new profile and the reconstruction of sewers are of scarcely less importance.

OLD STATION OUTGROWN

The old Union Station, which has been far outgrown by the traffic, was built about 1880. Until acquired by the new Union Station Company it was owned by the Pittsburgh, Fort Wayne & Chicago Railway (Fort Wayne) of the Pennsylvania Lines West of Pittsburgh. It was and is used jointly by that company, the Chicago & Alton, the Chicago, Burlington & Quincy, the Chicago, Milwaukee & St. Paul and the Pittsburgh, Chicago, Cincinnati & St. Louis (Panhandle) of the Pennsylvania system, the other four roads being tenants on long-term leases. The main building is located on the east side of Canal Street north of Adams Street. The tracks occupy a strip of ground less than 100 ft. wide, extending from Madison Street on the north to about Van Buren Street on the south. The Fort Wayne, Alton and Burlington enter from the south over a four-track line located on property formerly owned jointly by the Fort Wayne and the Alton. The Panhandle and the St. Paul enter from the north on a two-track line owned jointly by the Fort Wayne, the St. Paul and the Chicago & North Western. The station is a combination through and stub type, but the through tracks are so short that long trains frequently occupy the full length of the tracks both north and south of the axis of the station, and consequently the capacity of the station is greatly limited.

While the station has been badly overcrowded and congested for many years, it was so surrounded by freight terminals as to make expansion of the present site impossible without extensive readjustment of



LAYOUTS OF OLD AND NEW CHICAGO UNION STATION, OLD ABOVE, NEW BELOW—OUTLINES OF MAIN UNITS OF NEW LAYOUT SHOWN ON

the freight terminals; and on the other hand the companies using the station did not care to surrender a site so convenient to the business center of the city for one less restricted but farther away. Readers of the technical press are probably familiar in a general way with the negotiations, extending over a number of years, to remedy the situation, these negotiations culminating in the Union Station ordinance passed March 3, 1914. Since then the Union Station Company has been formed, the necessary exchanges of land between the individual companies and the new company have been made, much additional land has been acquired, a large freight terminal for the Pennsylvania lines has been brought nearly to completion and a considerable amount of the underground street work has been done. Nothing has as yet been done on the station proper, as it was only last July, as previously stated, that the general plan was adopted, and the architectural design of the station, as well as many details of the whole terminal, are yet to be worked out.

Relative Size of Old and New Layouts

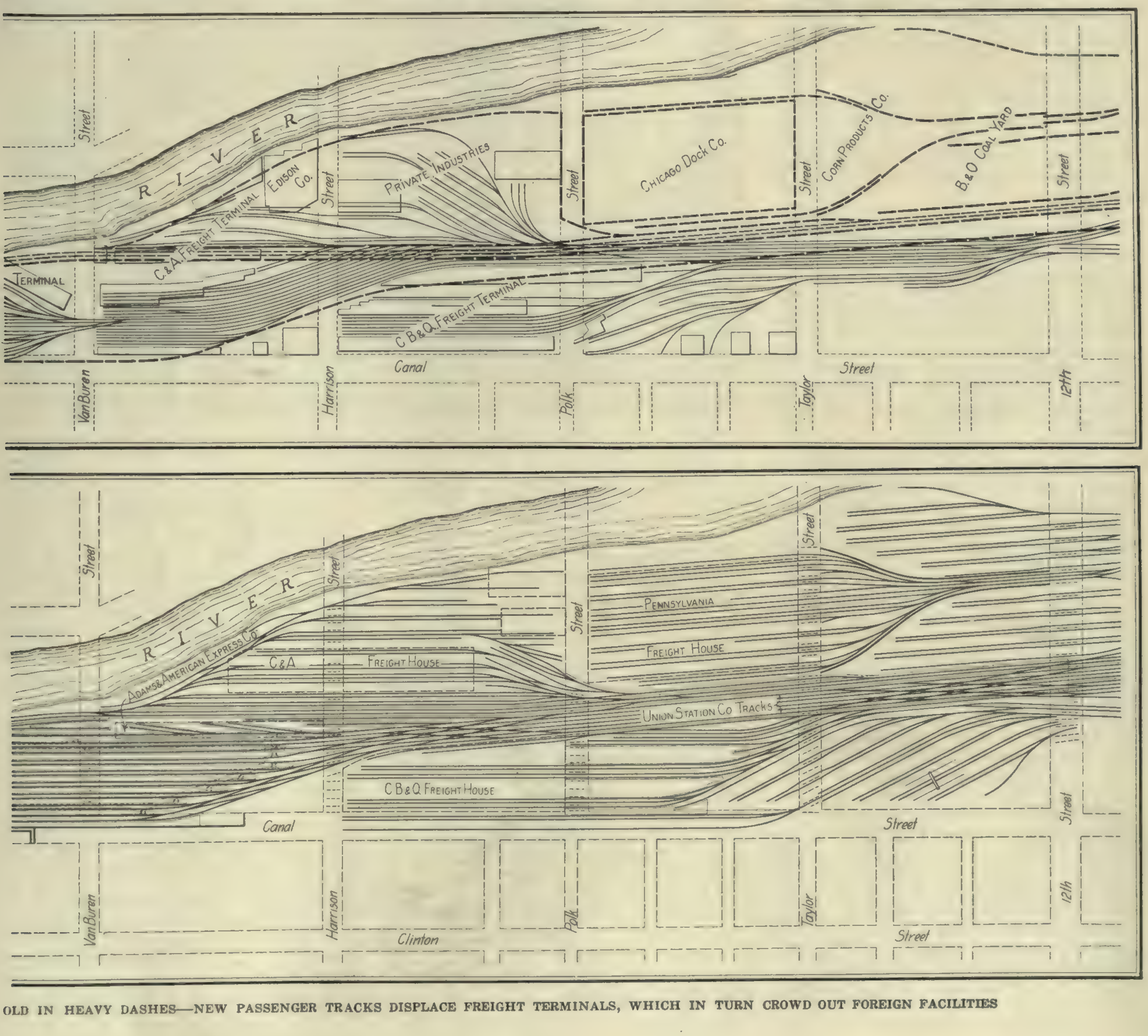
The accompanying plan of the old facilities, with the outlines of the new superimposed thereon, gives a good idea of the relative size of the old and the new layouts. More will be said later of the freight facilities displaced by the new station and its approach tracks. Suffice it to say here that the new layout occupies the entire space between Canal Street and the Chicago River from Madison Street to Harrison Street, with the exception of two run-around tracks along the waterfront, and in addition will occupy widened rights-of-way north and south of these respective limits.

The removal of the station building to the west side of Canal Street, together with the removal of the Fort Wayne freight house along the river opposite the present station, gives room for the eleven tracks needed by the Panhandle and the St. Paul in the north unit of the station; while space for the fifteen tracks required for the Fort Wayne, Burlington and Alton is attained by moving the headhouse a block to the south and taking advantage of the bend in the river to the east. An additional width is attained by carrying the tracks under 40 ft. of the width of Canal Street.

The main-floor level of the station and concourse is El. 9 above city datum, or about 17 ft. below the level of Canal and the east-and-west streets. The main entrance to the station will be on Canal Street, but entrances will also be provided on each of the other streets. The entrances to the concourse from the streets will be at the four corners; that is, two on Canal Street and two near the river. Cabs and other vehicles will reach the station level by two ramps running down as shown on the plan from Clinton Street to stands at the northeast and southeast corners. These ramps will turn on themselves and continue down to the baggage room, which will be under the main floor and also extend under the concourse.

Two Sets of Stub Tracks

In the north section of the station there will be nine passenger tracks having a combined capacity length of 10,070 ft., two mail tracks with a capacity length of 1450 ft., and two express tracks with a capacity of eleven cars. In the south unit there will be thirteen passenger tracks with a combined capacity length of 15,065 ft., two mail tracks provided with crossovers so that a few cars can be switched without disturbing the entire track, and eight stub tracks having a capacity of from two to twelve cars each for the express companies. The station tracks will be alternately on 13 and 27-ft. centers, giving platforms 16 ft. 3 in. wide. These platforms will be level with the car floors, being the first high plat-



OLD IN HEAVY DASHES—NEW PASSENGER TRACKS DISPLACE FREIGHT TERMINALS, WHICH IN TURN CROWD OUT FOREIGN FACILITIES

forms to be used in any Western terminal. They will be of reinforced-concrete slab construction, and the space under them will be utilized for piping and other station necessities. One of the south platforms will be 680 ft. long. The other platforms in both yards will vary in length from 800 to 1400 ft.

Each yard will be reached by six approach tracks instead of the smaller number now available. As the plan shows, two ladders will serve the north yard and three the south, and the numerous crossovers and slip switches are expected to give the desired flexibility of operation. With the exception of a few specials all turnouts and slips will be standard No. 8s.

ELABORATE BAGGAGE TUNNEL SYSTEM

A feature of the layout is the system of baggage tunnels. A longitudinal tunnel along each side of each yard, with diagonal tunnels connecting the far ends as shown, and elevators from the diagonal tunnels to each platform provide access to each platform for baggage trucks at two points.

The general plan contemplates two express buildings, one for the use of the Adams Express Company and the American Express Company, serving the Pennsylvania, Burlington and Alton; the other for the use of the Wells Fargo Express Company, serving the St. Paul. The former building will be located south of Van Buren Street and east of the station tracks and will be a two-story structure about 56 ft. wide, extending from Van Buren to Harrison Street, served by a driveway 40 ft. wide for the full length of the building. The Wells Fargo building will be located facing Canal Street between Washington and Madison Streets.

UNBALLASTED TRACK IN STATION

A concrete track construction for the station tracks is to be used, the rails resting on tie plates and felt pads, fastened to 7 x 9-in. by 2-ft. 6-in. creosoted blocks by screw spikes. The blocks will be embedded in concrete and will rest on a reinforced-concrete base, with provision for drainage in the center of the track. The ladder and approach tracks will be of ballasted construction.

The tenant companies are taking advantage of the crowding out of their freight facilities by the Union Station layout by constructing larger and more modern terminal plants. Along the river between Madison and Harrison Streets three freight houses of the Fort Wayne and two of the Alton had to give way to the passenger development. The Alton is removing a third and building a new plant partly on the ground it retains north of Harrison Street and partly on new ground acquired south of that street.

The Pennsylvania found it necessary to seek a new site. Land was acquired for a new terminal between Jefferson Street and Des Plaines Street, south of Van Buren Street, with an elevated connection to the main line. This plan was vigorously opposed by business interests of the city, and was therefore abandoned in favor of the Polk Street site. The mammoth terminal is located between the Union Station tracks and the river, south of Polk Street. The site for this had to be acquired, mainly from the Chicago Dock Company and the Baltimore & Ohio. On the land of the former were tracks and large warehouses. On that of the latter were an engine house, coach yard and coal yard, which had in turn to be relocated farther from the Baltimore & Ohio terminal. The new Pennsylvania freight terminal will serve both the Fort Wayne and the Panhandle.

The Burlington was also obliged to surrender some of the land occupied by its freight terminal, west of the main tracks and south of Harrison Street. It also will reconstruct its terminal on a much larger scale.

MUCH WORK FOR THE CITY

Aside from the work on the freight terminals, most of the actual construction that has been done thus far is on the work for the city. The stipulations of the ordinance include the raising of Canal Street to a smooth profile; the widening of this street from 80 to 100 ft.; the elevation of the street to carry it over the Panhandle tracks at Carroll Avenue, the grade crossing on the low level being at the same time retained; the reconstruction of all east-and-west viaducts across the tracks, which are now at various elevations, most of them narrowing down also from the full width of the street, and the reconstruction of all sewers emptying into the Chicago River within the limits of the improvement. These sewers will be intersected by a sewer on the west side of Canal Street, emptying into the river at Washington Street and at Harrison Street. Most of the work done to date is the underground work.

Equal parts of the stock of the new Chicago Union Station Company are held by the Pennsylvania Company, the Pittsburgh, Cincinnati, Chicago & St. Louis Railway, the Chicago, Burlington & Quincy Railroad and the Chicago, Milwaukee & St. Paul Railway. The Chicago & Alton Railroad will be a tenant. The total estimated cost of the improvement is $47,000,000, of which about $32,000,000 is for land. Thus the estimated cost of construction is $15,000,000, and of this $4,500,000 is for the city's improvements, such as viaducts, street changes and property damages, leaving $10,500,000 for strictly railroad facilities.

The design and construction of the terminal are under the direction of Thomas Rodd, chief engineer of the Union Station Company, with office at Pittsburgh. J. D'Esposito, assistant chief engineer, is in direct charge at Chicago. Graham, Burnham & Company, of Chicago, are the architects for the station building.

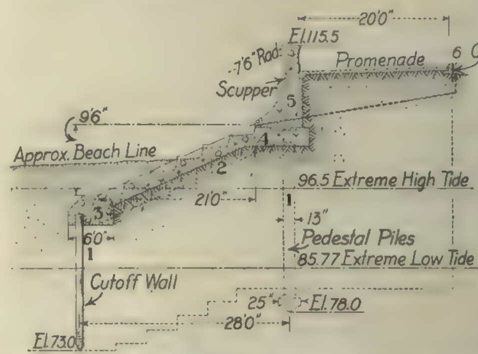
City Engineering Department Forms Engineering-Library Club

Members of the city engineering department of Dallas, Tex., have formed an engineering-library club composed of 60 per cent of the office force. The dues, which are fifty cents a month, are used to buy works on engineering. Members may suggest a book to the secretary, who posts on the bulletin board the name and author of the proposed volume, with a "yes" and "no" column underneath, a vote being taken either for or against purchasing the book. The club has been organized about four months. Eighteen books have been bought. Most of them are on civil engineering, although other technical fields are covered. The books are kept in a desk in one corner of the office and may be taken without signing for them. No book may be kept out longer than overnight. The club is now considering subscribing for a number of engineering magazines.

San Francisco Will Protect Beach with Bleachers

Monolithic Concrete Type of Construction Is Designed to Preserve Wide Beach—First Section Cost $90 per Foot

THE WIDE STRETCH of sandy beach just south of the Cliff House at San Francisco has long been regarded as one of the city's valuable assets, because it affords a conveniently accessible playground on the shore of the open sea. Though this may be a scenic advantage, the fact that it is unprotected from the open sea has endangered the permanency of the beach. Winter storms carry away the sand, and last winter the action of high waves even cut the bank behind, which had hitherto remained untouched since the city was founded. Realizing how much damage a continuation of this erosion would cause, funds were appropriated by the city for a concrete structure to protect the beach.



CROSS-SECTION OF BLEACHERS—NUMERALS INDICATE CONSTRUCTION ORDER

Contracts were then awarded for 670 lin. ft. of monolithic construction resembling bleachers, which is designed to withstand the attacks of storms.

In general, the structure consists of five steps, or bleacher seats, with a minimum concrete thickness of 12 in. The seats rest on sand overlaid with 18 in. of solidly packed clay. The plane of these bleachers is inclined at about 25 deg. to the horizontal. At the bottom they rest on a cutoff wall of concrete piling extending 13 ft. below extreme low tide. Supporting the bleachers transversely at 20-ft. intervals, except at stairways, where they are on 10-ft. centers, are H-beams 20 x 43 in. in section and 27½ ft. long. These beams support the intermediate slabs by means of keyways, which served as forms when the slabs were poured. At the upper end of the inclined plane support is provided by pedestal piles 13 in. square, with pedestals 3 ft. square. These piles are 24½ ft. long and are spaced on 10-ft. centers.

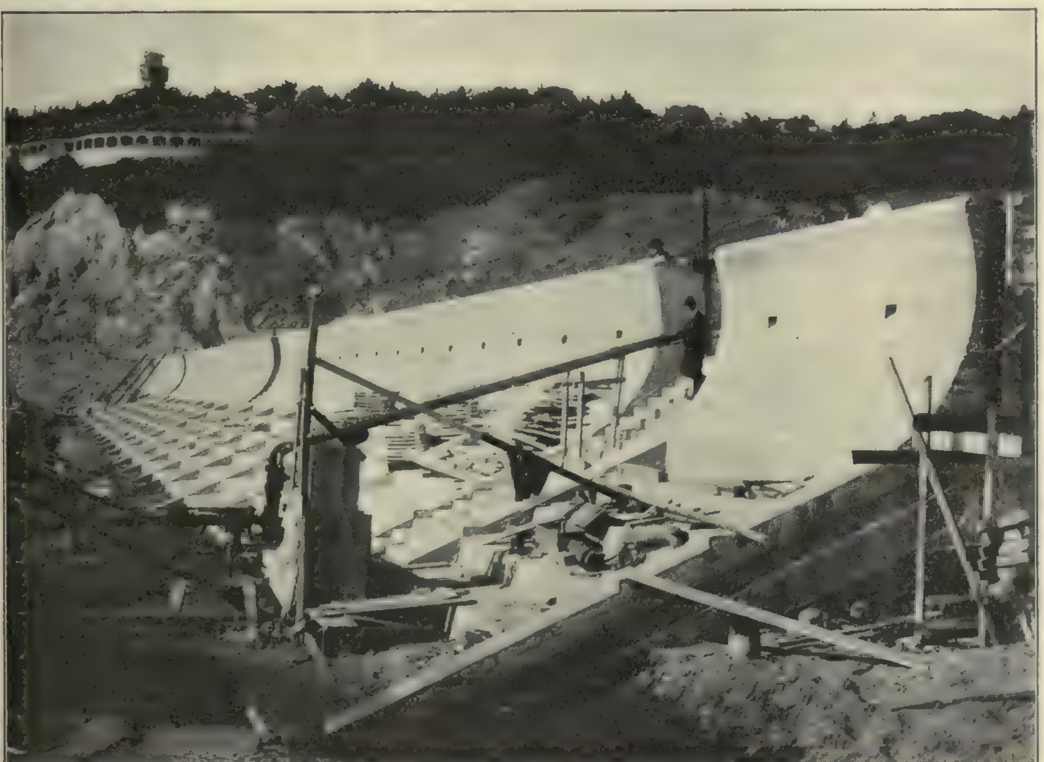
CUTOFF WALL OF CONCRETE PILES

The cutoff wall at the toe of the structure consists of concrete piles, 20 ft. long and 10 in. in thickness, interlocked by steel sheet-piling connections. The sheet piling and pedestal piles were first jetted down and then the heavy H-beams were placed and supported temporarily on falsework. Forms were built in which concrete was poured so as to unite into a monolithic structure the H-beams, sheet piling and pedestal piles, reinforcing rods having been left projecting for this purpose. The slab uniting the sheet piling and the inclined plane is 4 x 6 ft. in section and carries heavy reinforcing.

After the removal of the forms from this

work other forms were placed for three inclined transverse ribs in each panel, 16 x 18 in. in section, and between these the ground was leveled off and a blanket of clay solidly tamped in place so that the final slab of concrete could be poured with but slight additional formwork. The bleachers were thus formed as a slab between H-beams and the upper and lower lines of piling. After the completion of the slabs, forms were placed for a curved capital at the top of the structure, which serves the double purpose of an ornamental finish and a protection against the high waves of storms.

The mix in the sheet and pedestal piles, as well as in the H-beams, was 1:1½:3. In decks and capital the mix was 1:2:4. All the piles were precast at or near the site and allowed to season forty days before using. After the completion of the concrete work a 13,000-cu. yd. fill was scraped up from the sand and used to fill in back of the concrete to bring the level up to that of the adjacent boulevard.



THE CURVED CAPITAL WILL GIVE THE BLEACHERS A DISTINCTIVE APPEARANCE

On top of the fill, and immediately behind the capital, a 6-in. concrete paving will be placed for a width of 20 ft. This will provide a promenade and at the same time prevent any water which overtops the structure from seeping into the fill behind it and weakening the foundations. The 20-ft. pavement slopes toward the capital, through which there are scuppers at intervals. The 670 lin. ft. of the work is expected to be completed by Nov. 1, in time to protect the beach against this winter's storms.

The work is being carried out under the direction of M. M. O'Shaughnessy, city engineer, the contract for the construction being held by J. D. Hannah. The contract for the first 500 ft. was completed for a price of $89.50 per foot, but in the 170-ft. section that was added later the price was $136 per foot.

Plan Three Concrete Bridges a Year

The first reinforced-concrete bridge to be constructed in Morrow County, Oreg., was recently completed over Rhea Creek. The county has resolved to construct about three bridges of this type each year.

Is Utility Regulation on the Right Basis?

Instead of Protected Monopoly, We Need Competition—No Commission Should Be Empowered to Stop Anyone from Entering Into Any Business

By J. D. GALLOWAY
Of Galloway & Markwart, San Francisco

[*This article is commented upon in the editorial pages of this issue.*—EDITOR.]

AMID the major distractions of the time, of wars great and small, politics and other more or less important events, notice occasionally finds its way into print regarding the progress through the national legislature of certain bills for the regulation and administration of water powers subject to the control of the government at Washington. Occasionally there are meetings in some Western city of associations of men who voice their opposition to existing policies of government control of water power, and who appeal to the nation at large for relief from oppressive restrictions, interferences and domination by the bureaus at Washington. At one such recent congress held in Oregon the idea was expressed that the control of water powers should be turned over to the state government.

In order to show what relief may be obtained by transferring such control to the states it is of interest to review what has been done by the state of California, the home of hydroelectric development. In doing this, some comment is offered upon the general tendencies of the time, and as a basis for such review and comment it is necessary to examine certain fundamental principles of government and the conduct of affairs. Interference by government, whether state or national, with private individuals seeking to develop water powers for the benefit of the communities served is really a phase of a nation-wide tendency toward governmental interference with, and restriction of, all individual activity. Such a tendency, if unchecked, promises to bring to a complete stop the development of this country and to transform us from a nation with its face to the future into a people with their faces to the past. Hence engineers are interested in the subject from two standpoints, the technical one of their immediate occupation and as citizens of the nation.

Two Opposing Principles of Government

In the history of the world two mutually antagonistic principles have ever manifested themselves in human affairs, and between them there is no compromise. One has in view the dominance of one selected class over the other. Taking the form of an autocracy led by a king and buttressed by ecclesiastical organizations, the selected class has claimed for itself all special privileges, has monopolized the sources of wealth and has battened itself upon the mass of the people; securing its control by restrictions, rights, privileges, monopolies and all of the thousands of methods by which the free spirit of the individual could be repressed, hampered and restrained. Opposed to this has been that principle that expresses itself in complete freedom of all individuals, that recognizes no rights of power of any kind and which holds as its chief tenet an equality of men before the law.

The pages of history are filled with the records of bloody revolutions of the peoples against the real and imaginary restrictions of their ruling classes, and the contest is still on. Under one régime the individual exists for the state, to be used as the state may direct, and to contribute to the state all of his earnings except those sufficient for existence. If examined, the state is found in this case to be a ruling class whose business it is to dominate the classes ruled. It was epitomized in the saying of Louis XIV, "L'état! c'est moi." Under the opposing plan, the state exists for the individual and is limited to certain definite functions, such as securing equality of opportunity, protection of property and the administration of justice. Free to exercise his native abilities in any direction consistent with the rights of his neighbors, the normal individual may pass his lifetime without coming into any contact with the government, whose activities are reduced to an extreme minimum.

This latter has been the American plan, and under it the Americans have developed their land unrestrained by the trammels of an arbitrary and restricting government.

In doing this they have developed under private initiative an efficiency of construction and administration undreamed of by any other nation, ancient or modern.

Defects of Individualism

It is not to be supposed that any form of human organization is without defects. The unrestrained individualism of America has placed power and wealth in the hands of men who have immediately endeavored to secure to themselves the privilege of power by instituting monopolies, by securing control of the government and by usurping its functions, even as an aristocracy does.

This result of unrestrained individualism becomes immediately antagonistic to the

individual, and hence any aggregation of men who attempt to monopolize any source of wealth or to secure to themselves any of the functions of government becomes thereby opposed to the interests of the individual. They are thus subject to all the criticism advanced against any ruling class, whether it be aristocratic, ecclesiastical or financial.

Growth and Defects of Regulation

In many states, and also in the national government, the exercise of arbitrary power by corporations, together with the concomitant corruption of all the functions of the state which usually go with arbitrary power, led or is leading to political revolt. In California an upheaval took place some years ago which had the effect of largely eliminating corrupt influences from the politics of the state and of placing a group of honest and capable men in charge of affairs. The gradual elimination of such influences from the national government is known to all.

It is, however, a good illustration of the inconsistency of the works of men that many, if not all, of the efforts of those whose business it was to reform abuses have brought about, or are seeking to bring about, conditions that effectually perpetuate the abuses of the past and which more and more restrain, hamper and discourage that private initiative which has created this country. Yielding to that demand for a state guarantee of any monopoly which comes from those who enjoy the fruits of the monopoly, or in a futile attempt to control existing monopolies, state commissions of all kinds have been formed. State commissions in California control the actions of your barber or dictate where you shall hunt or fish. In California a commission has control of all waters above the ground or under it. The State Railroad Commission is apparently unlimited in its control over all forms of corporate or individual activities which relate to that elastic term, the public service. More and more commissions are proposed, such as one to regulate and control the sale of the products of the soil. Such tendencies grow by what they feed upon, and under this extension of powers of government the individual disappears.

Several bad results flow from the development of the functions of the state. Its immediate effect is to hamper and restrain the individual. With our rapidly increasing population it is becoming more and more difficult for any individual to make his way or give scope to his talents. The way should be cleared of every obstacle it is possible to eliminate from the path of native ability. Yet the formation of state commissions, with rules, regulations, fees, hearings, examinations, reports and all their attendant functions, serves only to restrain and obstruct the normal man, for whom there are already a sufficient number of obstacles. No matter how much any government might ever reduce its functions, it could never act as other than a deterrent upon individual initiative.

Certificates of Monopoly

The most important result of the activities of government commissions is, however, the virtual confirmation by the state of existing corporations, thus making them monopolies. Going beyond the usual restrictions, the California Railroad Commission has, in the case of hydroelectric companies, taken the stand that it may debar any given corporation from a designated territory. This it has done, in at least one case. The net result has been that those corporations which existed at the time of the formation of the commission have practically received a state certificate of monopoly, and that over most of the state no new corporation can be formed to develop its abundant water powers.

The plea is made that this is done for the benefit of society in reducing competition and duplication of physical properties, with a resulting reduction in price of service. This is a theory much talked about and believed in by those unfamiliar with that basic natural law of competition in all things which is the order of the world. A transient success is sometimes attained by individuals or by states in the efforts to stifle competition, but the final result is usually a violent break up of the suppressed activities or the death of the thing suppressed. No society can long survive the lack of active competition in all its elements, and any government or division of government which attempts to eliminate the beneficial and life-giving effects of competition is but hastening the ultimate death of the society which it was formed to protect.

The Inspiration of Competition

Competition in the physical world results in the adoption of new apparatus and the rejection of the old, a constant striving for betterment, the discovery of new principles of nature and the invention of new devices. The restriction of competition by governmental authority or otherwise carries with it a satisfaction with things as they are, the retention of old devices and outworn apparatus, a suppression of the new and generally a wasteful and expensive method of accomplishing a given result. In the intellectual world the one is the inspiration of never-ending youth, with an ever-widening horizon into the unknown domain of nature that leads on and on into the future; the other is that satisfaction with the accomplished fact, the setting of a limit to endeavor—an old age that presages extinction. It is of far more importance to preserve the spirit of youth and adventure in a nation than to set limits and bounds to the individuals in order that duplicate installations of certain physical plants be avoided and "society" be saved some money.

That any money is ever saved by the creation of monopolies by government is much to be doubted. By restriction of the rate of return to a definite sum based upon the value of the physical plant involved, commissions have taken from corporations all incentive to better their plants and eliminate waste. The writer once suggested to a corporation president the elimination of four separate small and wasteful plants and the substitution of one new plant to perform the same service. Immediately came the reply that from his standpoint nothing would be gained, as the commission in charge would merely make a corresponding reduction in his rate, leaving him with nothing but added financial responsibility for the cost of the new plant.

The Specific Case of Hydroelectric Development

The generation of energy from falling water, its transmutation into electric energy and the transmission over long distances to the place of use originated in California and rapidly spread over this country and the world. The men who initiated and constructed the first experimental plants and by their vision, energy and daring demonstrated the feasibility of the idea contributed thereby to humanity such signal service that it can only be compared to that rendered by the inventors of the steam engine or the builders of the first railroads. It was one of the great mechanical achievements of all time. By the power developed in the distant mountains, cities are lighted, houses warmed, urban and interurban traffic is carried and flooded lands are drained or dry lands are irrigated. In short, the diversified life of a modern community exists with hydroelectric power as one of the vital elements. Nothing has been destroyed; the water still falls, and will fall when those who have strived to prevent this development will have passed away.

A Mark for Abuse

Yet with all the benefits conferred and recognized, the corporations generating and distributing hydroelectric power became the mark for all phases of that unintelligent and unrestrained abuse so common to American life. No name was too harsh, no strictures were too severe for those who, under the existing laws, had appropriated and used the waters of mountain streams and made them serve mankind. According to some, the people of the country had been robbed of their birthright. The water powers of the country had been absorbed by the money trust. All the benefits arising from the use of water had accrued to the corporations and no benefit whatever rendered to the people.

Departments of the national government vied with each other in compiling statistics as to the extent and magnitude of the robbery, and legislation followed, with the states doing their share. The reader may recall how Mr. Roosevelt, early in his first term, vetoed a bill that permitted the building of a power plant on the James River, and thus saved the power for the people. One who takes second thought may be led to inquire as to the many thousands of tons of coal which have since been burned to furnish the equivalent of that energy, and which can never be regained. Possibly the plant was built in later years, but the example is typical. The point to be held clearly in mind is that unless one follows blindly the teachings of a state socialism, all of this outcry was a cry of wolf when there was no wolf, and the net result is disastrous.

California's Requirements for Water-Power Development

To appreciate the extent to which governmental control and restriction can go, one must pass in review the procedure necessary in order to establish a hydroelectric power company in California.

1. The issuance of securities, a vital concern with any project, is directed and controlled by the state commissioner of corporations under the "Blue Sky Law."

2. Most of the water powers of the state lie in mountains covered by the reserves of the national forests. The national government does not control the water, but it does own the land, and nothing but a permit can be obtained for rights-of-way. This permit compels the company to submit to restrictions as to rates charged and conduct of its affairs in parts of the state not subject to the jurisdiction of the United

States, and the permit for rights-of-way can be revoked at any time by the Secretary of Agriculture.

3. Outside of the national forests there is usually a fringe of United States lands in control of the Land Department. Rights-of-way can be obtained only by permit through a procedure similar to that of the Forest Service, and the permit can be revoked at will by the Secretary of the Interior. A permit given to the city of San Francisco by one secretary was revoked by another.

CONTROL OF WATER

4. The control of water rests with its owner, the state of California. A water commission has been formed having full control. Any company desiring to use water in the development of a hydroelectric power plant applies to the commission and receives, not a permit to use the water, but only one to build the plant. After having built the plant, the company again applies to the water commission for a license to use the water, which the commission may refuse or, if given, revoke at any time.

There is some doubt as to this latter point, as a member of the commission has expressed the opinion that the license must issue. That the reader may judge, the following extract is taken from the law creating the commission:

"Said license shall be in such form as may be prescribed by the state water commission under the provisions of this act. But if the said commission shall find, upon inspection and examination of the works constructed, that the construction and condition of said works are not in conformity with the law, the rules and regulations of the state water commission, the terms of the approved application and the terms of the permit, then and in that case the said commission may, after due notice in writing and in the manner provided in sections 1011, 1012 and 1013 of the Code of Civil Procedure to the applicant or the holder of the permit, and a public hearing thereon, refuse to issue said license."

In case of such refusal, an appeal can be had to the courts.

Be this as it may, it can readily be seen what uncertainty lies about the building of a power plant. Rarely does any project of moment involve an expenditure of less than $5,000,000, and no one can be found to advance money for such construction when the right to the use of the water can be obtained only after the plant is built, and possibly after a vexatious lawsuit. Other burdensome restrictions are incorporated in the law, such as that of sharing a constructed power station with a competitor if all the water in the stream is not used.

BROAD POWER OF STATE COMMISSION

5. Probably the chief deterrent to the building of new power plants in California is the State Railroad Commission, which has almost unlimited power over all public-service corporations. In the law forming the commission it is specifically exempted from the provisions of the state constitution, and as the law was approved by the people in referendum, it is supreme. Acting under the provisions of this law the commission has denied a certain power company the right to sell electric energy in one part of the state. The case was carried through the courts and determined in favor of the commission. It being possible for the commission to restrict the activities of any new company, and there being no restraint upon the caprice of a body the personnel of which changes from time to time, no one can venture to initiate any new enterprise.

DEVELOPMENT AT A STANDSTILL

This then represents in detail how governmental restraints have practically brought to a complete stop all new enterprises of the type in question and have thereby given the certificate of monopoly to those corporations which the accident of prior construction has placed in a controlling position. No one can be found who will venture the necessary funds for new plants when four separate governmental bodies, two national and two state, have the power to revoke permits, any one of which will compel a cessation of business. To those who think that state control will bring relief from national control the proceedings of California are offered as a subject for reflection.

It may be claimed that the existing companies can supply all necessary power for the future and that others are therefore unnecessary. To this the reply can be made that it is given to no one, least of all a government commission, to read the future and to determine in advance what the course of events will be.

An example will suffice. California is an agricultural state and even now needs artificial fertilizers, some of which can be produced by the electric process. Less than 10 per cent of the available water power is developed for use, and it is conceivable that, were the governmental restrictions removed, this much needed industry might be started. Under existing conditions, for any new company to start such an industry is practically impossible.

This is a criticism of measures and not of men. The men in charge of the various governmental bureaus are capable, honest and obliging, and their procedure is reasonably efficient. They, and all who favor them, are the victims of a false theory which has no basis in human experience. They have created a Frankenstein that apparently is now beyond the control of any one.

THE REMEDY

In order that these notes be other than expressions of discontent, it is necessary to set forth a different course to be pursued. Either the national forests should be removed from the control of the national government and given over to the states to which they belong, or the national government should submit to state laws in the same manner as any other owner of land. The former is preferable, as it would thereby reduce the powers of the national government in a domain where such reduction is vitally necessary. In any case, whether national or state, the permit system, with the right to cancel the permit resting in the hands of an official subject to no one, should be eliminated everywhere.

The lease of lands or water rights should be made the subject of a contract over a definite term and longer. This would remove the uncertainty which comes from the possibility of individual caprice. No land or water right should ever be granted in perpetuity to any one. The state should retain its eminent domain, but if it desires to grant the use of such properties it should do so in good faith and not, while seeming to grant rights of use, actually prohibit the use by the insertion of burdensome and unnecessary restrictions.

Finally, the power to stop any one from entering into any business should be taken from all commissions on the grounds that it is dangerous to American liberties to intrust such power to groups of public officials, however well intentioned. The commissions should use their powers and efforts to secure justice and fair treatment to all and not seek to establish and confirm monopolies by the suppression of competition.

GOVERNMENT AND THE MAN

Unfortunately the same tendency to resort to the government for a solution of all problems becomes more and more apparent in America. The flaccid tenets of socialism, by which men are taught to look to the government for all things, seem to be breaking down the self-reliance of the nation. The principle that no government can do as well for any man as that man can do for himself seems to have been lost sight of. All government is parasitic in its nature and those who labor for it produce nothing. As the powers of government are extended the privileges of the strong and powerful are confirmed as monopolies, the restraints and prohibitions upon the individual are multiplied and his struggle for expression and the right to live is everywhere opposed. From the restrictions of other individuals he may free himself, but from those of his government there is no appeal.

A final thought is that all this investigation, valuation and regulation produces little or nothing. Rarely are rates lowered, service bettered or financial dealings made more secure. Here and there some abuses are corrected and the tiresome procedure of law courts replaced by the more open forum of the commission hearing. The negative result is the diversion from real creative effort of the energies of the number of earnest men engaged in such profitless work, for it must always be borne in mind that except in such rare cases as the Panama Canal or the Reclamation Service no government ever created anything of value to humanity, being by its very nature restrictive and not creative.

Believing these things to be true, that present extension of governmental powers is inimical to all that represents progress in American life and that danger lies ahead on our present course, this article is written as a protest and a warning.

Experiment with Western Wood for Manufacture of Paper

A study of methods of barking, chipping, screening and baling chips was recently completed at the U. S. Forest Products Laboratory at Madison, Wis. Certain Western woods are said to be adapted for manufacture into pulp. It is estimated that some of these can be cut into chips which, when dried and baled, can be delivered to the mills in Wisconsin at a small advance over the cost of chips from local timbers. One of the serious problems connected with the drying of Western woods, particularly sugar pine, is a peculiar brown stain which develops during seasoning. In an effort to establish some method of kiln drying whereby this difficulty would be eliminated the laboratory secured a carload of sugar-pine logs and made test runs. The results indicate that a solution of the problem has been found.

Formulas for Width of Base of Gravity Retaining Walls

Neat Dimensions and Width of Footings Determined for Various Cases Based Upon Middle Third and Overturning Limits

By T. A. SMITH

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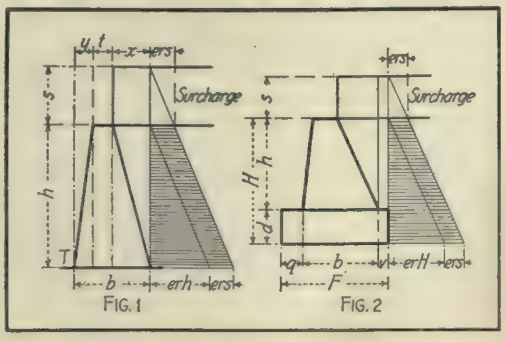
NO FORMULAS are in general use for determining the width of base for gravity retaining walls, some cut-and-try process usually being applied—a process which is slow and unsatisfactory unless the designer has had considerable experience in such work. The formulas presented herewith are practical expressions which can be applied to cases of walls on rock foundations or to footing courses on hard foundations in which the toe pressure is easily resisted by the foundation. These formulas can be applied directly and eliminate the use of approximate methods.

Safe design of an ordinary gravity retaining wall requires that the width of the base should be such that the following two conditions will be fulfilled: (1) The line of resultant pressure must fall a certain generally accepted safe distance back of the toe; (2) the unit bearing under the toe must not exceed the safe bearing resistance of the underlying material.

A wall may fulfill either one of the above conditions and yet fail if it does not fulfill the other. For example, a wall may rest on rock that has a high bearing resistance and yet fail on account of crushing of the toe if its base is not of such width that the resultant line of pressure falls some appreciable distance back of the toe. On the other hand, it is quite common to assume that a wall is safe if its resultant line of pressure falls within the middle third of the base. This, however, is not always the case, as the toe pressure under a wall with a comparatively soft foundation may be great enough to cause failure even though the resultant falls inside the middle third.

It can be seen offhand that a gravity wall on a rock foundation will fulfill the second condition if it fulfills the first, for, in any wall in which the resultant line of pressure falls an appreciable distance back of the toe, the toe pressure will be less than the bearing resistance of rock. The same is true for that portion of any wall above its footing course, because the footing course can be considered as a rock foundation for the portion of the wall above the footing. It follows, then, that in designing a wall on a rock foundation or the neatwork of any wall that has a concrete footing, it is necessary to fulfill only the first condition, and the second one will be satisfied automatically.



NOTATION FOR RETAINING-WALL FORMULAS

FORMULAS FOR TYPICAL GRAVITY WALLS

Fig. 1 shows a typical cross-section of the neatwork of a gravity retaining wall, the cross-hatched area back of the wall representing horizontal earth pressure. The method of applying earth pressure is adopted from the recommended practice of the American Railway Engineering Association, Vol. 10, Part 2.

Using the notation indicated on the figure, and letting c be the weight of concrete per cubic foot, e the weight of earth per cubic foot, and r the ratio of horizontal earth pressure to vertical pressure, formulas have been derived and tabulated in Table 1 for the case where the resultant pressure falls at the limit of the middle third. In Table 2 are presented the formulas for the case where the righting moment is made equal to twice the overturning moment. In both tables the thickness of the wall at top t and the batter on one face is assumed and that for the other face computed, using constants which are evaluated for several of the most usual conditions, as indicated in the tables.

The condition that the resultant line of pressure must pass through the edge of the middle third requires a somewhat wider base than is usually provided for the neatwork of a gravity wall or for a wall on a rock foundation. The condition that the righting moment about the toe must be equal to twice the overturning moment gives results more consistent with common practice.

WIDTH OF FOOTINGS

The foregoing methods may also be applied, with certain modifications, to the determination of the width of footings. Fig. 2 shows a typical cross-section of a gravity

Case	Numerical Values Used	Amount of Batter y on Face of Wall given. $x=\frac{1}{2}(\sqrt{A^2+4B}-A)$ Width of Base $b=y+t+x$	Amount of Batter x on Back of Wall given. $y=\frac{1}{2}(\sqrt{C^2+4D}-C)$ Width of Base $b=y+t+x$	Amount of Batter y on Face of Wall given. $x=\frac{1}{2}(\sqrt{A^2+4B}-A)$ Width of Base $b=y+t+x$	Amount of Batter x on Back of Wall given. $y=\frac{1}{2}(\sqrt{C^2+4D}-C)$ Width of Base $b=y+t+x$
1	General	$A=\frac{chy+2e(h+2s)(y+t)}{e(h+s)}$ $B=\frac{h[erh(h+3s)-c(y^2+3ty+t^2)]}{e(h+s)}$	$C=3t+x+\frac{2ex}{c}+\frac{4esx}{ch}$ $D=\frac{e}{c}[rh(h+3s)-x(x+2t)-\frac{sx}{h}(x+4t)]-t^2$	$A=\frac{3(y+t)[h(c+e)+2es]}{h(c+2e)+3es}$ $B=\frac{h[2erh(h+3s)-c(2y^2+6ty+3t^2)]}{h(c+2e)+3es}$	$C=3(t+\frac{x}{2}+\frac{ex}{2c}+\frac{esx}{ch})$ $D=\frac{e}{c}rh(h+3s)-\frac{1}{2}(3t^2+3tx+x^2)$ $-\frac{ex}{2c}(3t+2x)-\frac{3esx}{2ch}(2t+x)$
2	c=150 e=100	$A=\frac{3hy+4(h+2s)(y+t)}{2(h+s)}$ $B=\frac{h[2rh(h+3s)-3(y^2+3yt+t^2)]}{2(h+s)}$	$C=3t+\frac{7x}{3}+\frac{8sx}{3h}$ $D=\frac{2}{3}[rh(h+3s)-x(x+2t)-\frac{sx}{h}(x+4t)]-t^2$	$A=\frac{3(y+t)(5h+4s)}{7h+6s}$ $B=\frac{h[4rh(h+3s)-3(2y^2+6ty+3t^2)]}{7h+6s}$	$C=3t+\frac{5x}{2}+\frac{2sx}{h}$ $D=\frac{2}{3}rh(h+3s)-\frac{1}{6}(9t^2+15tx+7x^2)-\frac{sx}{h}(2t+x)$
3	c=150 e=100 s=0	$A=\frac{y}{2}+2t$ $B=rh^2-\frac{3}{2}(y^2+3ty+t^2)$	$C=3t+\frac{7x}{3}$ $D=\frac{2}{3}[rh^2-x(x+2t)]-t^2$	$A=\frac{15}{7}(y+t)$ $B=\frac{1}{7}[4rh^2-3(2y^2+6ty+3t^2)]$	$C=3t+\frac{5x}{2}$ $D=\frac{2}{3}rh^2-\frac{1}{6}(9t^2+15tx+7x^2)$
4	c=150 e=100 y=0	$A=\frac{2t(h+2s)}{h+s}$ $B=\frac{h[2rh(h+3s)-3t^2]}{2(h+s)}$		$A=\frac{3t(5h+4s)}{7h+6s}$ $B=\frac{h[4rh(h+3s)-9t^2]}{7h+6s}$	
5	c=150 e=100 y=0 s=0	$A=2t$ $B=rh^2-\frac{3}{2}t^2$		$A=\frac{15}{7}t$ $B=\frac{1}{7}(4rh^2-9t^2)$	
6	c=150 e=100 x=0		$C=3t$ $D=\frac{2}{3}rh(h+3s)-t^2$		$C=3t$ $D=\frac{2}{3}rh(h+3s)-\frac{3}{2}t^2$
7	c=150 e=100 x=0 s=0		$C=3t$ $D=\frac{2}{3}rh^2-t^2$		$C=3t$ $D=\frac{2}{3}rh^2-\frac{3}{2}t^2$

TABLE 1—RESULTANT LINE OF PRESSURE AT EDGE OF MIDDLE THIRD TABLE 2—RIGHTING MOMENT IS TWICE OVERTURNING MOMENT

Assume or Determine Numerical Values for the Following: c e r h s d H L g b P		
Case	In addition to the above, assume value for v.	In addition to the above, assume value for q.
1-Resultant Falls at Edge of Middle Third.	$A=\frac{4[L+ev(h+s)]}{cd}+2(b+v)$ $B=\frac{2L(b+v-3g)-ev(h+s)(4b+v)+erH^2(H+3s)}{cd}-(b+v)^2$ $q=\frac{1}{2}(\sqrt{A^2+4B}-A)$	$C=2\frac{[cd+2e(h+s)](g+b)-L}{cd+e(h+s)}$ $D=\frac{2L(b-3g-2q)-cd(q+b)^2+erH^2(H+3s)}{cd+e(h+s)}$ $v=\frac{1}{2}(\sqrt{C^2+4D}-C)$
	$F=q+b+v$	
	$P_t=2\left[\frac{L+ev(h+s)}{F}+cd\right]$	
	If P is less than P_t Apply Case 2. If P is between P_t and $1\frac{1}{2}P_t$ Make no Change	If P is greater than $1\frac{1}{2}P_t$ Apply Case 3
2-Toe Pressure Limited to P lb. per sq.ft	$A=2\left[\frac{L+ev(h+s)}{P-cd}+b+v\right]$ $B=\frac{2L(2b+2v-3g)-ev(2b-v)(h+s)+erH^2(H+3s)}{P-cd}-(b+v)^2$ $q=\frac{1}{2}(\sqrt{A^2+4B}-A)$	$C=2\frac{[P-cd+e(h+s)](q+b)-2L}{P-cd-e(h+s)}$ $D=\frac{2L(2b-q-3g)-(P-cd)(q+b)^2-erH^2(H+3s)}{P-cd-e(h+s)}$ $v=\frac{1}{2}(\sqrt{C^2+4D}-C)$
	$F=q+b+v$	
3-Righting Moment about Toe Equals Twice the Overturning Moment.	$A=2\left[\frac{L+ev(h+s)}{cd}+b+v\right]$ $B=\frac{2erH^2(H+3s)-6L_g-3ev(h+s)(2b+v)}{3cd}-(b+v)^2$ $q=\frac{1}{2}(\sqrt{A^2+4B}-A)$	$C=2(q+b)$ $D=\frac{2erH^2(H+3s)-6L(g+q)-3cd(q+b)^2}{3[cd+e(h+s)]}$ $v=(\sqrt{C^2+4D}-C)$
	$F=q+b+v$	

TABLE 3—FORMULAS FOR WIDTH OF RETAINING-WALL FOOTINGS

wall with a footing course. The following notation, in addition to what has already been given and shown on the figures, is used: L is the weight falling within the base of the neatwork; g, the distance from the toe of the neatwork to the center of gravity of vertical loads on base of neatwork; P, the allowable unit bearing under the toe of the footing; P_t, the actual unit toe pressure obtained by formula; W, the total bearing on base of footing; and Q, the distance from the toe of footing to the resultant line of pressure.

The formulas in Table 3 have been derived for three cases, as there noted. It must be remembered that v and q are dependent upon each other. In solving for the footing offset at the toe, a numerical value must be assumed for the offset at the heel, or, if the offset at the toe is fixed, say by a property line or street line, the numerical value of q is assumed and the value of v found, after which the total width of footing is obtained.

If P_t is found to be greater than the allowable soil bearing, the footing must be made wider. On the other hand, if P_t is found to be less than the allowable bearing, the footing can be made narrower; but this is not to be recommended unless the foundation is rock or a soil that has a safe bearing resistance at least 50 per cent greater than P_t. In this case the same rule can be applied to the wall that has been applied to the neatwork—that is, the footing should be made wide enough so that the sum of the righting moments about the toe is equal to twice the sum of the overturning moments.

After having determined the dimensions of the neatwork by the use of Table 1 or Table 2, a trial width of footing and the corresponding toe pressure may be found by the use of the formulas under Case 1, Table 3. If the toe pressure varies much from the allowable safe toe pressure P, recalculate the width of footing, using the formulas in Case 2 or 3, according to the directions under Case 1. The footing must then be investigated for strength against bending under the edge of the neatwork. Steel reinforcing may be required or it may be necessary to make the footing thicker. If it is made thicker, the width will probably have to be recalculated.

The formulas in Table 3 can also be applied to abutments and to reinforced-concrete retaining walls. Any irregularity in size or shape of neatwork is taken care of automatically in calculating the values of L and g.

Government Survey to Be Made on Pacific Coast

The government will begin next year a resurvey of the Pacific Coast from Mexico to Alaska, extending at some points 10 miles from shore, according to recent announcements made in San Francisco through the coast pilot section of the Coast and Geodetic Survey service. The survey will probably include wire-drag work in the smaller harbors of the coast for uncharted rocks. It is primarily a hunt for submerged valleys and pinnacle rocks, it is stated. Particular attention will be paid to waters along the Mendocino coast in northern California, where there have been found many abrupt holes 300 fathoms or more in depth on a bottom otherwise 40 to 60 fathoms below the surface. The work will be directed chiefly from the Coast and Geodetic Survey steamer "Surveyor," which is to be sent around from the Atlantic Coast early next year.

Reports on Year's Operation of Fitchburg Sewage Works

F. W. Jones, Chemist, Gives Experiences in the Maintenance of Imhoff Tanks and Sprinkling Filter

THAT the sewage-treatment plant at Fitchburg, Mass., consisting of Imhoff tanks and sprinkling filter, is turning out a good effluent and is fulfilling the purpose for which it was designed is the conclusion reached by Frank Woodbury Jones, supervising chemist, in his latest annual report to David A. Hartwell, chief engineer of the Sewage Disposal Commission. The report covers operation for the fifty-two weeks beginning Dec. 4, 1914, and ending Dec. 2, 1915. The Fitchburg plant was described in the Engineering Record of June 7, 1913, page 633. Extracts from Mr. Jones' report on operation follow:

SCREENINGS

The bar screen at the siphon chamber with a clear space of 1⅝ in. has been in use during the entire year. It is raked twice daily, and once each week the accumulated material, consisting largely of paper, rags, fruit skins, offal, etc., is measured, taken from the chamber and buried near-by. A total of 510 cu. ft. was collected and removed. Calculations during dry-weather-flow periods show that the screenings amount to 0.5 to 0.6 cu. ft. per 1,000,000 gal. of sewage screened.

The disposal works proper have been in operation a total of 321 days, leaving 43 days when the whole plant was shut down, the reasons for this being: (1) Repairs to the blow-off valve, which required a wait of 10 days; (2) connection for the Bemis Road siphon and alterations to the dosing tanks taking 29 consecutive days; and (3) high storm flows at various times aggregating 4 days.

IMHOFF TANKS

All the Imhoff tanks were in use until May 14, when with the coming of warm weather it seemed advisable to operate but two tanks at one time, since the flow of sewage was not large enough to insure a nonseptic effluent. This policy was continued throughout the rest of the year. The period of detention has varied therefore from 10 hours or more to about 3 or 4 hours.

To insure the intended working of the tanks it is found necessary to poke the slots for a short time daily to provide free travel for the sludge to the digestion compartment. If this is done regularly there is no trouble, but if neglected the tanks become unsightly with patches of floating sludge.

The scum in the side walls varied in depth from nothing to 6 ft. When noted in any large amount it was agitated with a stream of water or plunger and thus kept from becoming hard and impervious. Gas rises constantly, but not vigorously, and as yet there has been but little foaming, and then only in one tank.

The surface of the sedimentation chamber is kept as free as possible from floating grease balls, etc., by frequent skimming, and to prevent clogging of the nozzles by material which escapes by the scum boards, screens made of cellar window wire, ¼-in. mesh, were placed at the outlet ends of the tanks on March 9. While not eliminating nozzle clogging, these screens have proved of sufficient value to warrant continued use.

The direction of the flow was reversed six times, and the sludge, from measurements taken by means of a small pitcher pump coupled to a 1-in. hose calibrated in 1-ft. lengths, has been found to assume a fairly uniform depth in the digestion compartment.

A total of 725,355,000 gal., a daily average of 2,261,800 gal., has been treated in the Imhoff tanks giving an average removal of 70.2 per cent of the total suspended matter, or 97.6 per cent of the settleable solids. This amounts to a total of 459.4 tons of dry solids deposited in the tanks. The sewage is largely domestic, the principal trade waste being a small quantity of settled wool scouring liquor. The total fat in one week's composite was 59.8 parts per million in the crude sewage and 38 parts in the Imhoff tank effluent.

Sprinkling Filter

During the 316 days the sprinkling filter has been in operation 671,889,000 gal., a daily average of 2,123,500 gal., of settled sewage has been filtered. This is practically 1,000,000 gal. per acre per day, or 62.4 gal. per cubic yard of stone per day. The difference between the amount treated on the filter and in the Imhoff tanks is due almost entirely to storm conditions when the settled sewage was bypassed wholly or in part.

The dosing cycle, with a rate of 3,500,000 gal. per day, is about 36 minutes. This gives two doses of 5½ minutes each and two rest periods averaging 12½ minutes each.

The distribution has always been good, but was decidedly improved by the alterations to the dosing tanks. Besides the increased efficiency of distribution, as a result of the added head a quantity of sewage sufficient to prevent ice formation now reaches the points farthest from the nozzles. Last winter the filter had only an open ring in extreme weather; but this winter the bed is almost free from ice except for a crater around each nozzle.

There has been comparatively little trouble with clogged nozzles, as the obstructing material is removed as soon as noted. In all 5969 nozzles, a daily average of 19, were reported cleaned, the material removed consisting mostly of small grease balls, matches, leaves, grass and growths. Many other substances are taken out at times, however, varying from rats and toads to feathers and buttons. The number of nozzles cleaned varies with the seasons and weather conditions. In times of storm, matches and grease balls predominate; in the fall dead leaves and bunch grass blow into the channels and dosing tanks in spite of the covering; and in the early and late winter considerable quantities of growth become detached from the distribution pipes and fill the orifices. Last winter only twelve nozzles were frozen.

The surface of the bed has shown very little tendency to pool; in the early spring some growth appeared and small ponds began to form, but by picking the stones at these places no permanent pooling resulted. This care takes very little time, adds to the appearance of the filter, and is necessary for only a short part of the year. During the summer the top stones were covered with green growth, but at all times 4 in. or less beneath the surface the stones were clean and healthy and coated with a gelatinous film swarming with small white worms.

On Feb. 25 the first white flies were noticed, and from then until the latter part of May they were much in evidence, creating a considerable nuisance even in the laboratory. About June 1 they disappeared and a small black fly came instead. These flies remained on the bed until the plant shut down in September, and were not troublesome.

The distribution pipes have been drained three times onto the sand filter south of the stone filter. This cleans the pipes of all stagnant sewage and whatever sludge has accumulated in the invert. The underdrains have been flushed but once, and then to dislodge the dust that was washed from the stones.

The filter stored up solids until about the middle of April, when the unloading began. This continued up to the last of September, the greatest amount of suspended matter appearing in the effluent during May, June and July. Only 11.5 per cent of the suspended matter applied to the filter has been permanently disposed of in the filter.

Secondary Tanks

The secondary or post-filter tanks have been in operation in conjunction with the sprinkling filter except for short periods of cleaning, when one or more tanks were shut off. At Christmas time in 1914 the surface of the tanks froze over, but the operation was not interrupted. The tanks were first cleaned in June and again in July and September. The sludge, which flowed readily, had an odor characteristic of humus sludge and a consistency similar to that of soft whipped cream. The specific gravity of the liquid sludge averaged 1.034, and the average per cent of total solids at each pumping was found to be 10.56, 10.22 and 7.74 respectively. Each tank was completely emptied and thoroughly washed before operation was resumed. Owing to difficulties with the pump caused by boys throwing stones and wire into the tanks, it was impossible to pump all the sludge into the Imhoff tanks. Since the novelty of the plant has worn off this trouble has lessened. The effluent from the secondary tanks contains but little suspended matter, has a sparkle and after splashing down the steps reaches the river as a clear stream.

Sludge Disposal

The first sludge was drawn from the Imhoff tanks on June 14, and the eleven beds have been filled three times and cleaned twice. July and August were such wet months that sludge drying was practically impossible. A total of 274,838 gal. was pumped from the Imhoff tanks, representing a total of 157.9 tons of dry solid matter. The total solids in the sludge as pumped were as follows: Tank 1, 9.48 per cent; tank 2, 11.86 per cent; tank 3, 14.11 per cent; tank 4, 13.89 per cent; tank 5, 16.79 per cent; average, 13.23 per cent. The volatile or organic matter in the dry solids averaged 44.61 per cent of the total in the sludge removed from tanks 1, 2, and 4.

The sludge as pumped onto the beds varied in depth on different beds and on the same bed, as for the most part it was thick and did not flow freely. The average depth, however, may be taken as 6 to 8 in. On first appearance the sludge had a distinct tarry odor, but close inspection showed that digestion had not been complete. No objectionable odor was noticed except from the sludge of one tank, which created a nuisance for about a week. This tank had not received any humus sludge and the lack of digestion was very apparent. Another tank, which also had received no secondary tank sludge, pumped later in the season, showed progress in the digestion of the sludge which gave rise to no objectionable odors. It might be noted at this point that for a sewage-disposal works there has been little nuisance caused by bad odors. During the hot weather some odor developed, but, except for the case mentioned, there has been no more than could reasonably be expected at a place where human waste from the whole city is concentrated.

The sludge as it reaches the bed contains air and gas in considerable amount and readily rises in a graduate cylinder, leaving clear water at the bottom. On the bed the sludge rises, then falls, leaving a spongy mass, which cracks and dries into a porous cake.

The shortest period between pumping and removal from the bed was 27 days. The sludge was then a dry odorless cake, easily forked into the sludge cars, and contained an average of 62.73 per cent solids, or 37.27 per cent moisture.

Typical Results of Sludge Disposal

The following data show typical results of sludge disposal: On July 13, 16 and 17, 33,164 gal. of sludge, specific gravity 1.034, having an average content of 11.86 per cent total solids, containing 44.29 per cent volatile or organic matter, was pumped from Imhoff tank 2 onto five beds. The average depth on the beds as pumped was 6 to 8 in. On Aug. 26 this same sludge, reduced to an average depth on the beds of 1¾ in., was removed, requiring 59 1-yd. car loads with an average weight of 1260 lb. per yard and a moisture content of 45.09 per cent. Some of the sludge taken from the beds was used for filling a washout in the bank near the car dump and the rest was spread on the slopes and around the shrubs. The cost of removal from bed to sludge dump in cars averaged 14 cents per yard load, and that of hauling from the dump to points of disposal about the works 40 cents per yard load.

The compressed-air lift operates satisfactorily and under normal conditions uses about 8 kw. per hour in delivering about 8000 gal. of sludge.

How University-Extension Service Does Engineering-Promotion Work

For the last three years the Wisconsin University extension service has maintained a municipal and sanitary division. The growth of the work is indicated in a recent report by George R. Bascom, engineer in charge. The number of communities served for three consecutive years was 11, 27 and 36; subjects treated, 13, 42 and 53, and trips made, 4, 13 and 11 respectively.

The problem of popularizing the engineering features of a public improvement and stimulating the public to action is a matter of promotion and publicity rather than of engineering. The end of a preliminary survey marks the line between promotion services and engineering services. The selection of an engineer is handled by the service furnishing a list of all similar utilities in the state, with the advice to write to any or all of the places for detailed information regarding the engineers who had charge of the work, what the results were and for any other data leading to the selection of a competent engineer.

THREE INTERCONNECTED CONCRETE PLANTS BUILD ELEVATOR UNIT OF 104 CELLS

Run of 1200 Yards in Twenty Hours Made with Conveyor System for Concrete Aggregates

Gravel and Sand Came in Bottom-Dump Cars—Cement Handled Directly from Cars to Three Mixer Units Building Large Grain Elevator

A RECORD of 1200 cu. yd. of concrete deposited in twenty consecutive hours was made Aug. 23 on the new 6,000,000-bu. grain elevator which the Chicago & North Western Railway Company is building for the Armour Grain Company at 124th Street and the Calumet River, Chicago. There are in the storage portion being built at present 104 circular bins, 105 ft. high and 22½ ft. in diameter. They are being constructed by the continuous rising-form method. The entire bank of 104 tanks, aggregating 168 yd. per vertical foot, was under construction when the record was made. Sand and gravel were supplied to the mixers by mechanical equipment that eliminated all hand work, and to this fact the contractor attributes the success of the concrete plant. Belt conveyors carry the aggregate from the bins into which bottom-dump cars discharge to the charging bins over the mixer, but there is an intervening "storage reservoir" of 2800 yd. capacity between the cars and the mixer, so that any temporary irregularity in the supply of material is equalized.

CONCRETE-SUPPLY PLANTS

There are three complete concrete plants erected in a line at the south end of the bank of tanks. Parallel with this line and 150 ft. farther to the south is the "reservoir," a 200-ft. length of material bins supplied at the west end by a track running north and south. A cross belt conveyor connects the storage bins with a conveyor running over the top of each individual mixer storage bin. A track with a continuous platform along the line of the mixers enables the supply of cement to be maintained with little use for the small 600-bbl. sheds placed for emergency near each plant.

HANDLE BOTTOM-DUMP CARS QUICKLY

Beginning at the aggregate end bottom-dump cars, three at a time, are hauled up a slight incline by a one-drum 22 hp. electric hoist over four hoppers. From one of them the material drops directly on to a 315-ft. 24-in. conveyor delivering to the storage bin. This runs at 300 ft. per minute up an incline on a 20-deg. slope and has a capacity of 200 yd. per hour. The three other hoppers under the cars feed a belt running parallel with the track and discharging on the main supply conveyor. Two cars may be dumped at one time, and as many as five cars have been unloaded per hour. The heat was so intense this summer that a shed had to be built over the unloading outfit.

The belt over the storage bin is 36 ft. above ground level and a traveling tripper works back and forth distributing the sand and gravel evenly over the length of the respective bins. The gravel bin holds 1800 yd. and the sand bin 1000 yd. A second belt, 4 ft. above ground, draws from the storage bins, which were built entirely above ground on account of the boggy nature of the site, and discharges on the cross-conveyor. The latter elevates the material about 40 ft. and discharges it either directly into the central-plant hopper or onto belts running to the plants at each end of the line.

Each concrete unit consists of a 140-ft., two compartment tower, a 1-yd. Marsh-Capron mixer, and a system of chutes with a swivel leg and balanced cantilever discharge spout reaching a maximum of 100 ft. from the tower. Aggregate bins of 40 and 80-yd. capacity for sand and gravel respectively deliver into the mixer through measuring chutes, and in less than a minute a bucket of concrete is mixed and shot up the tower at the rate of 300 ft. per minute by a 90-hp. special Thomas elevator hoist.

Water for the mixers was supplied from the river by means of a 4-in. triplex pump driven electrically by a starterless Wagner motor controlled by an Anderson automatic cutoff switch. The service was such as to start the pump operating every few minutes to keep up the required 80-lb. pressure.

DISTRIBUTION OF LABOR

The distribution of men engaged in the concreting process is as follows: Eight men unloading cars, three men attending to the conveyor belts, six men handling cement; and for each plant in use two men manipulating levers for aggregate and water; one man on the hoist; and one man at the top of the tower. The number of men handling chutes, spreading concrete and manning the jacks to raise the forms varied too much to give accurately.

It is to be noted that the 1200-yd. record was made with only one mixer outfit, which operated continuously two 10-hour shifts, or a total of 20 hours.

During the extreme dry and hot weather the 315-ft. main supply cotton belt stretched to an extent which could not be compensated for by the take-up and which proved a source of annoyance. To obviate this difficulty wetting of the under side of the belt with a hose was resorted to. This proved efficacious, and thereafter the belt was thoroughly wetted every three days for a period of two hours. The conveyor system was furnished by the Stephens-Adamson Manufacturing Company.

The whole job is operated by electricity, a temporary transformer station to bring the 12,000-volt current of the Commonwealth Edison Company down to 220 volts being erected just outside of the limits of the work. A switchboard backed by asbestos, controlling all circuits, is located in the same shed with the central concrete elevator hoist. The entire installation was designed by the contractors' organization and installed by the Thomas Elevator Company, which furnished the hoists for the concrete towers and the car puller.

The Witherspoon-Englar Company and Grant Smith & Company are the general contractors for the elevator.

THREE MIXER PLANTS WITH WHICH 1200-YARD RECORD WAS MADE SUPPLIED CONTINUOUSLY BY EXTENSIVE CONVEYOR SYSTEM

Railway cars at right unloaded into hoppers feeding belt under track. This belt discharges on inclined conveyor *B*, which loads large storage bins *C*, A belt under these bins feeds the inclined cross-conveyor *D*, which delivers material at the center concrete plant *E*, for use there or to be conveyed to the west plant *F*, or the east plant, out of sight behind the right corner of the tanks. Cement is handled on the runways *G*.

Literature

For the Civil Engineer and Contractor

New Publications

BUILDING ZONE MAPS OF NEW YORK CITY. Three bound volumes; 35 sections each; 19½ x 28½ in. New York, Joseph Haig, secretary, Board of Estimate and Apportionment, Municipal Building. $1 each, $3 per set; 5 cents per section.

Each volume is confined to one set of restrictions, one showing the use districts, one the height districts and one the area districts. Each sheet, to the scale of 1000 ft. to the inch, covers about 9000 acres.

HANDBOOK OF ROCK EXCAVATION METHODS AND COST. By Halbert Powers Gillette, managing editor of *Engineering and Contracting*. Flexible leather, 5 x 7½ in.; 825 pages; illustrated. New York, Clark Book Company, Inc. $5 net.

VOCATIONAL PSYCHOLOGY. By H. L. Hollingworth, associate professor of psychology, Columbia University. Cloth, 5 x 8 in.; 308 pages. Issued as one of the "Conduct of Mind Series," edited by Joseph Jastrow. New York, D. Appleton & Company. $2 net.

U. S. GEOLOGICAL SURVEY BULLETINS. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.
THE CHISANA-WHITE RIVER DISTRICT, ALASKA. by Stephen R. Copps. No. 630, 130 pages.
ANTIMONY DEPOSITS OF ALASKA. By Alfred H. Brooks. No. 649, 67 pages.
BIBLIOGRAPHY FOR NORTH AMERICAN GEOLOGY FOR 1915. By John M. Nickles. No. 645, 144 pages.
SPIRIT LEVELING IN GEORGIA, 1896 TO 1914 INCLUSIVE. No. 635, 60 pages.
SPIRIT LEVELING IN ARKANSAS, 1896 TO 1915 INCLUSIVE. No. 636, 56 pages.
SPIRIT LEVELING IN NEW MEXICO, 1902 TO 1915 INCLUSIVE. No. 638, 112 pages.

NEW CHART OF PASSAIC AND HACKENSACK RIVERS, NEW JERSEY. No. 287, U. S. Department of Commerce. Scale 1:20,000 (3.2 in. to the mile). 28½ x 40¾ in. Washington, Government Printing Office. 50 cents.

This new chart, on a large scale, includes both rivers from their junction at the head of Newark Bay up as far as the cities of Passaic and Hackensack.

WATER SUPPLY PAPERS, U. S. GEOLOGICAL SURVEY. Paper, 6 x 9 in.; illustrated. Washington, Government Printing Office.
SURFACE WATER SUPPLY OF THE UNITED STATES, 1914. Part 4, St. Lawrence River Basin; No. 384, 128 pages: Part 7, Lower Mississippi River Basin; No. 387, 60 pages.
COLORADO RIVER AND ITS UTILIZATION. By E. C. La Rue. No. 395, 230 pages.

Books Reviewed

Stresses in Structures

Author, A. H. Heller, C.E., late professor of structural engineering, Ohio State University. Third edition. Revised by Clyde T. Morris, professor of structural engineering, Ohio State University. Cloth, 6 x 9 in.; 374 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $2.75 net.

Those who are familiar with the previous editions of Heller's textbook on "Stresses in Structures" will recognize that several improvements and additions have been made by Professor Morris and the publishers in this (the third) edition. While little change will be found in the first four chapters, in many places the concise explanations in the original edition were found by experience in the classroom to be difficult for students to understand, therefore Professor Morris has expanded these explanations and added numerical examples to illustrate the methods.

An explanation of the Bow notation for graphical diagrams has been included, and a new article giving the analytic solution for stresses in a derrick introduced. In the chapter treating stresses caused by uniform loading solutions have been added for deck Pratt, subdivided Warren, Whipple and Pettit trusses, and for skew bridges. In Chapter 13 a complete solution for stresses in a Pratt truss railroad bridge for Cooper's E-40 loading has been given, and a moment table for this loading added. In Chapter 14 a more complete explanation is presented of the solution for stresses in bridges with curved track. Many of the illustrations have been redrawn and a large number of new diagrams included.

A special feature of this book, which teachers who may not be familiar with it will find helpful and suggestive, is the great number of questions and problems listed at the end of each chapter to cover the subject treated. The typographical work is fully up to standard, and difficult mathematical solutions of the problems effectively reproduced.

Centrifugal Pumps and Suction Dredgers

Author, E. W. Sargeant. Cloth, 6¼ x 9 in.; 188 pages; 160 illustrations; 14 folding plates. Philadelphia, J. B. Lippincott Company; London, Charles Griffin & Company, Ltd. $3.25 net.

REVIEWED BY A. G. HILLBERG
Hydraulic Engineer, New York City

The author of this book has based his work upon an experience of more than thirty years in the field of the design and construction of all classes of centrifugal pumping machinery. Realizing that most books on the subject deal with the theoretical side, and that there was a distinct need of a treatise dealing with the practical details of the design, the author has written a book that will be of service to designers, draftsmen and operating engineers.

After dealing briefly with the evolution of the centrifugal pump, the author explains in an elementary way the fundamental principles underlying and governing the action of such pumps. Three chapters entitled "Principles of Design" show how the necessary computations are made. Chapter 6 treats the forms of pump casings, and completes the theoretical part of the book.

The more practical subjects presented in the following chapters are: Pattern making; molding and machinery used in manufacture; various types of pump casings; operation of pumps, and the relative merits of pumps in series and in parallel. Chapter 12 explains the use of high-capacity pumps on low heads, such as are encountered in irrigation and drainage work. The next two chapters are devoted to priming, or charging, as the author calls it, which deals with automatic priming.

Testing of centrifugal pumps is discussed in the next chapter, four different methods for measuring the discharge being explained. One method, however, is not mentioned—the chemical method, in which a small quantity of concentrated salt solution is injected into the suction pipe and the degree of dilution determined at the delivery end. Chapter 16 explains piping arrangements and valves, with a design for the friction loss in feet head for each 100 ft. of pipe. The use of centrifugal pumps and installations for drainage, irrigation, sewage and for salvage of wrecks and fire pumps are discussed in several chapters.

An important chapter entitled "Centrifugal Pumps Driven by Steam Turbines" is followed by one on rating air pumps and their applications to condensers. One of the fields in which the centrifugal pump has proved very successful is the dredging of sand, mud, silt, light clay, gravel and stones from the bottom of rivers, docks and harbors. Several forms of such pumps are described, with details, and several forms of suction dredges shown. The following chapter is a continuation of the same subject, but confined to the details of cutter gears.

The last two chapters deal with dredgers of simple design—that is, the arrangement of small plants satisfactory to meet simpler demands and which can be mounted on ordinary barges; and transporter dredgers—dredgers designed to discharge hopper barges. An appendix contains useful tables, such as dimensions, horsepowers, discharges, costs, etc.

The author has succeeded in writing a very interesting volume that should appeal strongly to engineers engaged in manufacturing, installing and operating centrifugal pumping machinery. The illustrations have been selected carefully and add materially to the value of the book. The volume should also appeal to students, as it is clearly written and easily understood.

Transportation Rates and Their Regulation

Author, Harry Gunnison Brown, assistant professor of economics, University of Missouri. Cloth, 5½ x 8 in.; 347 pages; illustrated. New York, Macmillan Company. $1.50 net.

REVIEWED BY W. J. CUNNINGHAM
Professor of Transportation, Harvard University, Cambridge, Mass.

Professor Brown in this book deals with the subject from the point of view of national wealth, and by applying the test of general economic welfare. The question is not whether certain rate-making principles or practices are good for the railroads or whether they are good for the shippers, but rather whether they are good for the nation. The author aims to make clear the inner philosophy of rate-making and rate regulation and to show why certain practices are economically justified and others should be disapproved. He aims also to point out "the reasons of public policy which sometimes do, and which always should, lie back of and condition our legislation."

The first chapter deals with the cost of transportation and its relation to rates. His classification embraces four groups of expenses or costs: (1) Train expenses—those pertaining most particularly to the moving of goods. These tend to vary, but not directly so, with distance. (2) Terminal expenses, which vary with the volume of traffic, but bear no direct relation to the distance goods are carried. (3) General expenses, or preparatory or complementary expenses, which bear only a remote relation either to the volume of traffic or to the distance the traffic is transported. (4) Fixed charges, consisting of interest charges, rentals and the like. In including the fourth class under "expenses," Professor Brown departs from the commission's accounting principles, which differentiate between operating expenses and charges (deductions from income). But as the author uses the words "expenses" and "costs" interchangeably it is evident that he means "costs" in both cases. He is not so much at home in discussing the details of expenses as he is in dealing with rate theories

and economic principles, but the chapter on costs is illuminating and is a fitting prelude to the better chapters which follow.

These deal with (Chapter 2) competition of transportation companies, (3) transportation monopoly, (4) economically undesirable rate discrimination among places, (5) economically defensible discrimination among places, (6) relative rates on different goods, (7) discrimination among shippers, (8) steps in the development of rate regulation in the United States, (9, 10 and 11) rulings of the Interstate Commerce Commission on: (a) Reasonable rates, (b) discrimination among places, and (c) discrimination among different goods and among different shippers; and, finally, (Chapter 12) uneconomical government interference with, and encouragement of, transportation.

Professor Brown defines four classes of competition: (1) Of different companies, (2) of routes, (3) of directions and (4) of locations. Each class is clearly described, and his treatment of the economic justification of permitting uniformity in rates on both the long and the short route, of preferential rates for import and export traffic and of variation in rates between two opposite directions is particularly good. He defends, within certain limits, formal rate agreements and pooling between competing companies. He suggests that it would be advisable for the Interstate Commerce Commission to legalize rate agreements and pooling, when consented to and supervised by the commission. He criticises the "basing-point system" as a comparatively artificial selection, and a building up of wholesale or jobbing centers, as contrasted with a possible selection and development less artificial and more desirable which would not concentrate business at a favored point.

The chapter outlining the steps in the development of rate regulation in the United States covers the whole field in admirably condensed, yet well-balanced form. The same may be said of the three chapters which deal with the rulings of the Interstate Commerce Commission.

While the book is of prime value to students in economics, it is worthy of careful reading by railroad executives and traffic officials. To those railroad men who are not well grounded in economics the author's clear analysis of the underlying principles in rate making and rate regulation cannot fail to be helpful and broadening.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Manufacturers Should Tell What Parts Wear Out First

SIR: The writer has been interested in two letters which have appeared in your columns urging manufacturers to tell what parts wear out first, the first by Major Amos A. Fries, on Sept. 30, page 419, the second by J. P. Stone, Oct. 14, page 479. I wish to present the manufacturer's opinion of this question to a limited extent.

It is quite a customary practice among manufacturers of air-compressing and rock-excavating equipment to supply contractors and other users with stocks of repair parts, when their machinery is sold in quantities, especially when such shipments are to be made to remote points. As an example of such published lists I beg to call your attention to the catalog of this company on diamond core drills. You will find in this instructions for selecting drilling outfits and equipment, and lists with prices of various items of supplies most likely to be needed in a course of prolonged drilling operations. This is an example of a published list.

Competition in a good many lines is too keen to warrant a manufacturer in publishing abroad a list of parts which are likely to "wear out" on his machines. Such a list in the hands of a competitor would prove a useful weapon. Again, if the manufacturer were to recommend that the purchaser buy a long list of repair parts the purchaser's natural impression would be that he is likely to undergo considerable breakage and expense for repairs, and is very likely to place his order with some manufacturer who is less frank and contends that his machinery does not "break down or wear out."

In many cases, at the solicitation of the contractor or other purchaser, we are accustomed to make up such a list of spares as has been referred to by your previous correspondents. In fact, the customer with any familiarity as to machinery and its use usually knows enough to ask for such a list, after the sale has been consummated. The point I am trying to make is that if the purchaser puts it up to the manufacturer at the time the order is placed to furnish suitable supplies of spares for operation over a given period, the manufacturer is only too glad to recommend such a list, because it means an addition to his sale.

S. B. KING,
Sullivan Machinery Company.
Chicago.

Joints in Concrete Roads Laid Late in the Season

SIR: I have read with interest the article on the question of widening the joints of concrete roads laid late in the season, in your issue of Oct. 14, page 465.

The question of the width of joints has been discussed by a number of engineers, some of whom have expressed to me the opinion that they should be wider, especially on work done late in the season. My own opinion in the matter, however, is that the information now at hand is not sufficient to justify any conclusions at this time. The action of pavements where joints are built depends not only on the width of joints, but also on their spacing, and many factors must be considered.

The Illinois Highway Department this past year has constructed a number of stretches of roads without joints. The question to be answered is whether in the long run there is less expense and no greater inconvenience to traffic by leaving out the joints—thus avoiding their first cost of construction and their subsequent maintenance as compared with the maintenance expense that may be incurred on roads where joints have been placed.

These matters undoubtedly will be considered by the road committee of the American Concrete Institute, as well as by the subcommittee on tests for roads of the American Society for Testing Materials.

A. N. JOHNSON,
Consulting Highway Engineer.
Chicago.

Monolithic and Semi-Monolithic Brick Roads Both Satisfactory

SIR: I beg leave to correct certain errors in statement regarding the cement-sand bed construction of brick pavements which were made in the article on monolithic pavements, printed in the Engineering Record of Sept. 30, page 400. The author of the article probably was unacquainted with the history and development of the cement-sand bed type of construction, and erred unwittingly.

The use of the cement-sand bed in lieu of the old sand cushion was not a step in the evolution of the true monolithic pavement. It was a distinct type developed for city streets where the use of a template is not feasible. Its object is not merely to afford a uniform bearing surface for the brick surfacing; the cement-sand bed is converted into a mortar by means of thorough wetting after the brick are laid and rolled but before the grout is applied, and it sets up and effects a union between the brick surfacing and the concrete foundation, thus giving substantially a solid beam from surface to sub-base.

Since the true monolithic construction was perfected and introduced by W. T. Blackburn, consulting engineer of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio, the cement-sand bed type of construction has been known as the semi-monolithic.

So far is the cement-sand bed construction from being unsatisfactory, it is rapidly coming into general use in the large cities. Baltimore and St. Louis, after full investigation and experience, now use it exclusively for brick pavements; and out of fifty-eight streets in Cleveland paved with brick in 1916, not less than fifty-five were of the cement-sand bed type. R. Keith Compton, chairman of the Paving Commission of Baltimore, which city uses a large number of brick annually, says:

"I am more than ever pleased with the mortar (cement-sand) bed, as the superiority of our 1915 work over all previous work on a sand cushion is evident every time one rides over the streets, and I have yet to notice a serious shattering of the top grout in any of the work."

The cement-sand bed construction has stood the test of time. The Thirty-first Street and Thirty-third Street approaches to the Pennsylvania Station, New York, were paved with 2½-in. brick on a cement-sand bed in 1910. These pavements are in fine condition, although over them for six years the average weekly traffic has been about 55,000 vehicles, and a truck-and-wagon tonnage of 31,000,000 lb. exclusive of passenger vehicles.

These figures are based upon a traffic census taken for one week in May, 1916, under average traffic conditions, and reported in the Engineering Record of July 8, page 54.

Bay Street, the heaviest traffic street in Jacksonville, Fla., has a cement-sand bed brick pavement between car tracks several years old, and the pavement is in excellent condition.

These facts were evidently unknown to the writer of the article printed in your

issue of Sept. 30, but it seems to me that they effectually establish the fact that the cement-sand bed type of brick pavement is eminently satisfactory for the purpose for which it was designed, namely, a substitute for sand-cushion brick pavements on city streets.

For country highways, the true monolithic brick pavement, as perfected in design and introduced by W. T. Blackburn, is undoubtedly preferable to the cement-sand bed for economical reasons; but engineers are pretty well agreed that each type is highly satisfactory in its proper sphere, and a vast improvement upon the sand-cushion type of brick pavement.

William C. Perkins,
Chief Engineer, Dunn Wire-Cut Lug Brick Company.
Conneaut, Ohio.

How Can Drawings Be Protected Against Dampness?

Sir: The Board of Water Supply of the city of New York will in a short time hang drawings in underground chambers and it will be necessary to protect these drawings from dampness.

Eight or ten years ago a man called with a process for casting drawings in a transparent solid which apparently was neither celluloid nor collodion, although it looked somewhat like both. We had no use for his scheme at the time, but would like very much to try it now, so we would be very glad to hear from any of your readers who have run across this process or a similar one.

The drawings will be in some cases larger than 36 x 48 in. and should be made rigid enough to hang on a wall.

C. F. Bell,
Assistant Engineer in Charge of Drafting, Board of Water Supply.
New York City.

Answers Query as to Grouting Rock Under Ripogenus Dam

Sir: Referring to the letter of H. A. Rands, published in the Engineering Record of Oct. 14 last, the following account of the methods adopted for grouting the rock underlying Ripogenus dam is submitted:

In the core drilling for pressure grouting under this dam (described in the Engineering Record of Sept. 2, page 280) the holes were spaced 6 ft. 8 in. on centers, this apparently arbitrary spacing being adopted to accommodate other conditions. As the air compressor did not arrive until long after the drilling was begun there were quite a number of holes ready for grouting before any was done.

These holes were first tested with a pressure pump and it was found that some showed leaks of much greater magnitude than others. Water under pressure from the regular water supply was then used for thoroughly washing out the holes through a hose run to the bottom, and then applied as a pressure line to the top of each hole. This developed that the holes were not all connected by open seams, but in most cases water was forced out of several holes, and in some cases at quite a distance from point of application. Grout was then applied to those holes which appeared the nearest tight, with the idea of first making these tight, and thus dividing the total space into sections for better treatment.

This having been accomplished, the holes in each section were taken in order and grout applied under 150 lb. air pressure as long as it was possible to force any more into the hole. The last application of air was held on the hole for several minutes to insure the grout being thoroughly driven in, when the hose connection was removed and the pipe capped, as it was found that otherwise the application of pressure to the next hole was liable to drive the grout back out of the one just grouted.

Plugging the cracks penetrated by the various holes required varying amounts of grout, running from 2 to 13 cu. ft. more than the capacity of the drill hole. On the first few applications of grout vents were easily observed in the next holes and for a considerable distance away coming up through the ledge. These gradually subsided until no further escape could be detected, although usually considerably more grout could be forced into the drill hole after this stage was reached. In only one case was any considerable flow of ground water encountered, and this readily yielded to the treatment described and was forced to the surface outside the dam.

For various reasons contingent upon the construction work no test holes have been drilled within the grouted area to ascertain, if possible, the results and effectiveness of the foregoing work, but it seemed to be quite evident that it was at least decidedly beneficial. Experience seemed to indicate that hard ledge with fairly open seams worked much better here than where the seams were filled with softer, crumbling rock or muddy materials.

The rate of drilling is also quite dependent on these same characteristics. This ledge, which is conceded to be one of the hardest, drilled normally in the sounder portions at about 1 ft. per hour with a shot bit, 3 in. in diameter, while a crumbling section or seam would sometimes delay progress for several hours. The amount of shot required was largely determined by the same conditions, but normally from 2 to 3 lb. was consumed per foot drilled in the sounder rock.

E. W. Prouty,
Resident Engineer, Ripogenus Dam.
Kokadjo, Me.

American Engineers for Canadian Work

Sir: The editorial in your issue of Sept. 23, page 369, with regard to the circular sent out by the Canadian Society of Civil Engineers, has been read with much interest, inasmuch as the writer is a member of the Canadian society on exactly the same basis on which a large number of American engineers have joined that organization.

After an experience of more than fifteen years near the international boundary I have reached the conclusion that the Canadian engineers are very shortsighted in their attitude. A very large percentage of Canadian engineers find employment on the American side and no discrimination is exercised against them, but it is quite the reverse when an American engineer, even though he be a member of their society, desires employment in Canada. There are on my desk at the present time two applications from Canadian engineers for positions, and seldom a week passes that one or two do not drop in looking for employment. Our city engineer here in Seattle is a Canadian, and there are many other engineers in various employments who are Canadians.

Without any idea of retaliation, but simply to demonstrate to our Canadian brethren the injustice of their attitude, it would seem to me desirable that the four large American engineering societies take a census of the Canadian engineers who are employed throughout the United States and settle once and for all this mooted question of nationality.

Charles Evan Fowler,
Seattle. Consulting Engineer.

Paving Petitions—The Right Kind

Sir: Your editorial of Oct. 14, page 458, entitled "Paving Petitions—The Right Kind," is very timely. It calls attention to a practice which has been prevalent in some communities for a considerable time—that of having a type of pavement selected by petition.

The selection of a pavement involves considerations of such a technical nature that it should be left entirely to the expert. No layman is in a position to advise properly on this matter. Where a selection of particular kinds of pavements is asked for in a petition, it hampers the freedom of judgment of the engineer who makes it his business to know about these things.

It has often happened that people have, owing to the pressure of special interests, petitioned for a type of pavement about which they know very little, and not examining the subject thoroughly, have been led into recommending something which may require the taxpayer to pay heavily for the mistake.

E. W. Stern,
Chief Engineer, in Charge of Highways, Department of Public Works, Borough of Manhattan.
New York City.

Sir: Your editorial on "Paving Petitions—The Right Kind" is extremely pertinent and important.

In a city of several hundred thousand, within 100 miles of New York, I encountered one piece of street with three kinds of pavement in as many blocks. Besides being æsthetically ridiculous, such an arrangement was very hard for horses hauling the heavy loads which went over that street. A horse gets accustomed to a certain type of surface, and I have repeatedly seen one slip so as nearly to fall when a new variety of pavement was encountered.

City charters should invariably leave matters of pavement selection to professional experts. Petitions should ask only for a pavement, the type to be determined by the proper authorities, and after such petition is filed, no opportunity should be given to modify it. This recommendation is known to be drastic, but as soon as it was understood that steps once taken were irretrievable, care would be exercised at the start, which is the proper time.

E. P. Goodrich,
Consulting Engineer.
New York City.

New California Oil Wells

Sixteen new oil wells were "brought in" in California during the week ended Oct. 21, according to a report by the state oil and gas supervisor. The total number of new wells drilled since Jan. 1, 1916, is 586. A considerable number, however, have been abandoned during this time.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Belt Conveyor Deposits Wet Concrete Into Sewer Forms

UNSTABLE banks and a shallow cut which brought the arch of a large sewer in Chicago near the surface gave a slope too flat for spouting and led the contractor to use a belt-conveyor attachment to carry the concrete from the mixer to the forms. The job, Section 4 of the Calumet intercepting sewer system, includes 8700 ft. of trunk sewer near 103d Street and the Pullman Railroad, over which the contractor brings in his supplies. The horseshoe section is 16 ft. 6 in. wide, 13 ft. $2\frac{1}{2}$ in. high and 23 ft. wide over all on the base. The thickness at crown and invert is 18 in. For 3400 ft. the grade makes a very shallow trench, 18 ft., which brings the crown nearly to the ground surface. The remainder will require a trench about 30 ft. deep. The clay is not very stable and some caves have occurred. Therefore a concrete outfit was sought which would not be so heavy as a portable tower plant, but which could deliver over the arch forms into the far side. The belt-conveyor idea, worked out as shown in the photograph, was proposed by W. B. Louer, who sold the contractor the concrete plant.

BELT CONVEYOR DELIVERS CONCRETE HORIZONTALLY INTO SEWER FORMS

The conveyor, which was made by the Weller Manufacturing Company, is 30 ft. long, but the wooden frame can be extended to any length desired. The inner end is supported by a series of overhanging channels bolted to the mixer platform. Supporting the outer end are uprights carried by a small car running over a 24-in. gage track laid on the finished work at the back end and at the forward end over the steel forms. The uprights are bored to permit raising and lowering the end of the conveyor. Three 18-ft. sections of this track are provided. The belt is gear driven from the countershaft of the mixer and discharges onto a flipflop, which directs the concrete to either side of the crown. When the concrete nears the top of the forms two men are employed to spread it. The invert is placed in advance of this work by a second mixer through a 30-ft. chute.

Material is supplied to this plant from a siding at one end of the 3400-ft. section, where elevated bottom-discharge bins of 300-yd. capacity have been erected over a narrow-gage track. Cars are unloaded into the bins by a derrick car operating a $\frac{3}{4}$-yd. Owen bucket. Along the narrow track, but between it and the standard-gage siding, is the cement shed holding four carloads. Batches are proportioned at the siding. The contractor has four horse-drawn six-car trains of 1-yd. Koppel cars, with gage marks for broken stone and sand. After loading with the latter the cars are pulled opposite the cement shed, in the side of which are six tilting chutes, on each of which may be emptied two sacks of cement.

At the sewer the standard-gage track on which the mixers run is 33 ft. from the center line of the sewer. The narrow-gage material track is 7 ft. farther away to enable the cars to dump directly into the loader, which was specially built low and wide to permit the cars to dump clean without raking. The two Chain Belt mixers, which have reversible traction and flanged car wheels, are attended by push cars carrying coal and water. Five 25-ft. sections of Blaw steel forms are used. To facilitate setting the forms and aligning them the concrete is brought up 4 or 5 in. above the invert at the sides.

The Calumet intercepter system is being built by the Sanitary District of Chicago, for which George M. Wisner is chief engineer. The design and construction are under the immediate charge of Langdon Pearse, assistant engineer, assisted by R. H. Burke. J. P. Gallagher is resident engineer and Nash Brothers are the contractors.

Portable Motor-Driven Saw Cuts Off Wood Piles

ONE of the methods devised to cut to grade the 17,000 piles under the 6,000,000-bu. grain elevator being built for the Chicago & North Western Railway Company in Chicago, and described on page 567, is shown in the photograph herewith. The motor drives a vertical countershaft which carries a swinging boom on the outer end

CIRCULAR SAW, DRIVEN BY MOTOR, USED ON JOB WHERE 17,000 PILES WERE CUT OFF

of which is mounted the saw. The saw is held against the piles by two men with holding rods. To get an even bearing a plank track was laid over boards placed diagonally on top of the piles, which had already been cut off.

The contractors on this work were the Witherspoon-Englar Company and Grant Smith & Company, Chicago.

Tubing Wound on Reel Without Detaching—No Couplers Used

By W. H. HYDE
Contractor, Pittsburgh, Pa.

IN DRIVING two tunnels through a rock fault in the mine of the White Oak Fuel Company, Whipple, W. Va., an unusual method of using tubing is employed. To keep a circulation of fresh air at the face, remove rock dust while drilling and the smoke after shooting, 8-in. Flexoid tubing is wound and unwound on a drum before and after the shot is fired. Just before shooting, the fan is shut down and the tubing collapses flat. Two men put a drill through a center hole in a light wooden drum, making a reel, and wind up the tubing without detaching it. After the shot, they run up to the face, reeling off the hose as they go. The first sections of the tubing have been in daily and nightly use for five weeks and are still performing their duty satisfactorily.

Instead of using couplers, which are awkward on the reel, the ends of the sections are telescoped in the direction of the air current, sewed with fine wire and covered with a short section of the tubing. In each case the tubing is coupled to a Buffalo No. 3 volume blower direct-connected to a 3-hp. Peerless electric motor. These blowers are set in the main entries adjacent to the tunnels. The tubing extends around a corner, along the floor of the tunnel; near the face the end is raised and hung so that it points to the roof close to the face of the heading. This arrangement seems to work best for clearing the face of the rock dust while drilling.

The tunnels are 6 ft. high, 10 ft. wide and 400 ft. long. The drilling of the hard fine grained sandstone is done with Jackhamer drills. The dynamite used is of the 60-per cent gelatin grade. An unusual amount of dust is present because of the dry nature of the rock.

Derrick Chair Takes Superintendent with Broken Leg to Work

THAT there are ways to get around over a subway job even with a broken leg was proved a short time ago by John T. Prior, superintendent for Smith, Hauser & Mac-

CHAIR TAKES INJURED SUPERINTENDENT TO SECOND-STORY OFFICE

Isaac, Inc., of the section of the subway under William Street, New York City, which that firm is building. The superintendent's office, on the second floor of one of the shaft houses, and the construction work underground would seem to be safe from invasion by a man with a broken leg. Not to be kept at home by a plaster cast, however, when he was needed at the work, Mr. Prior had a chair built in which the shaft derrick could hoist him from the street to his office.

Ordinary Valve Used as Shock Absorber in Pump Discharge

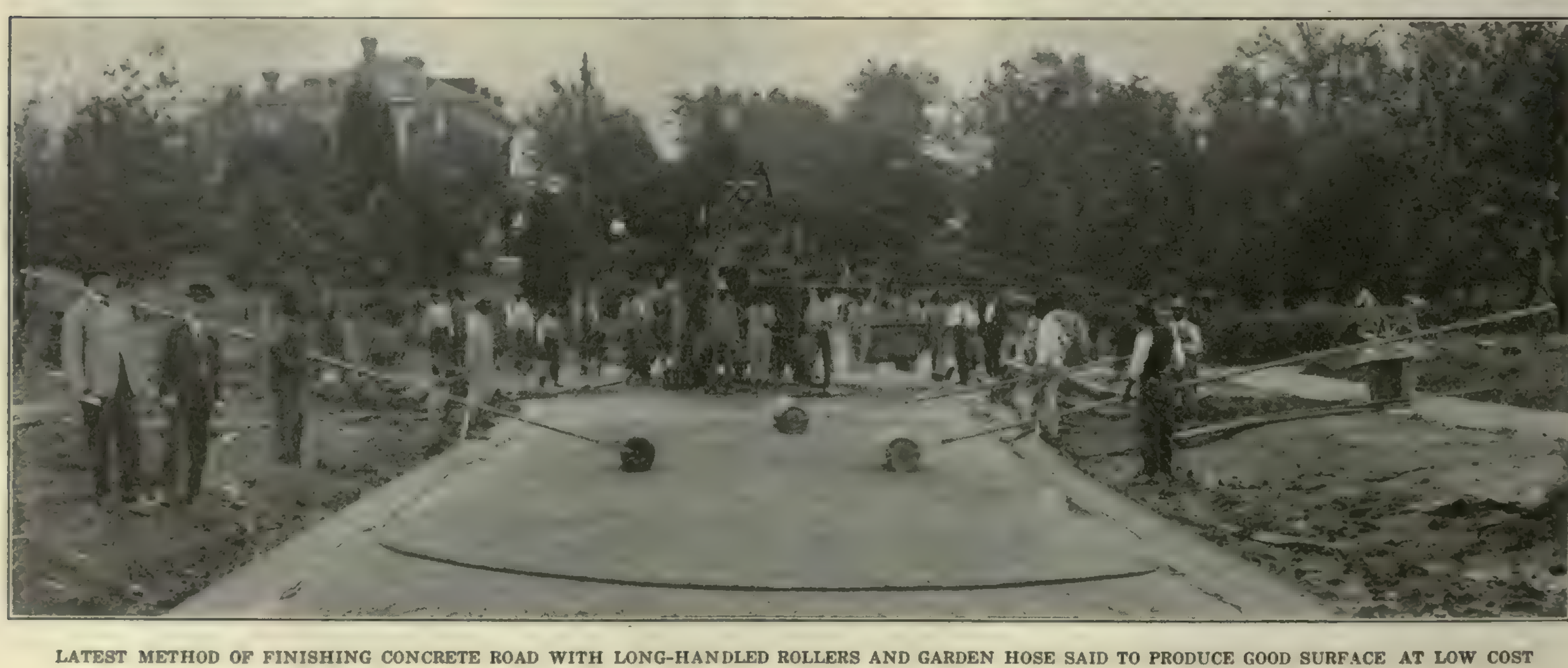
By GEORGE W. McALPIN
New Richmond, Ohio

PRESSURE release for the discharge line of the piston pump supplying water to one of the concrete mixers in use at the government dam under construction at New Richmond, Ohio, was provided by inserting a T in the line, to which a nipple, a valve and a short length of vertical pipe were fitted. The pump ran continuously, while the discharge line would often be shut off abruptly at the mixer. The back pressure produced in this way was bad for the pump, and to relieve it the outlet was put in.

To maintain a constant pressure, which would keep the pump running at constant speed, a plain piece of pipe reaching just above the elevation of the discharge at the mixer might have been used, but would not have been convenient. The same result, however, was accomplished by putting in a shorter piece of pipe with the valve and partly closing the valve until it required a little more pressure to force water out of the relief pipe than to raise water to the mixer. The "shock absorber" in this case was made of 1½-in. pipe and valve, and was in a discharge line of the same size from a 5 x 3½ x 6-in. pump. The valve was adjusted so that no water was forced out of the vertical pipe when the discharge line was open.

Use Rubber Hose to Finish Concrete Road

IN FINISHING the surface of a concrete road in Myers Park, Charlotte, N. C., W. C. Campbell, of the Hardaway Contracting Company, of Columbus, Ga., used long-handled rollers and rubber hose. The photograph shows how the work was done. The hose was 1 in. in diameter, rubber on woven fabric, while the rollers were made of wood covered with 24-gage steel sheets. It is claimed that labor costs have been reduced by employing this equipment.



LATEST METHOD OF FINISHING CONCRETE ROAD WITH LONG-HANDLED ROLLERS AND GARDEN HOSE SAID TO PRODUCE GOOD SURFACE AT LOW COST

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Lump-Sum Contract Not Favored by Texas Society

"Cost Plus" System Preferred—Tentative Engineer's License Bill Will Be Drawn Up—Officers Elected

The annual convention of the Texas Association of Civil Engineers was held in Dallas Oct. 20 and 21 with about fifty members present. The opening address was given by President C. H. Chamberlin, chief engineer of the Texas & Pacific Railway, who indulged in reminiscences, beginning with his entrance into the engineering field in 1881. He also pointed out the great progress made in civil engineering in the South during the last 30 years. Then followed discussions of the Texas cement industry, lump-sum contracts and an engineer's license law.

During a general discussion it was pointed out that although the five cement mills in Texas produce 3,750,000 bbl. annually, and Texas uses 2,500,000 bbl., only 2,000,000 bbl. used in the state were produced by the Texas companies. The matter was referred to the board of direction for investigation.

Want Lump-Sum Contract Abolished

John B. Hawley, of Fort Worth, summarized the work of the Texas division of the National Industrial Preparedness Board. F. A. Jones emphasized the great service rendered by the engineers of the country in a work to which they unselfishly gave their time and more than a quarter of a million dollars. Mr. Jones also presented a paper on the "Honor System in Contracting," in which he strongly advocated the "cost plus" system. As reasons for his attitude he cited cases from his experience of fifteen years with both forms of contracting. The general sentiment of the meeting seemed to be for abolishing the lump-sum system.

The first paper of the afternoon session was "Engineering Human Problems," by E. B. Gore, of the Texas board of water engineers. He mentioned the engineering problems connected with irrigation on the lower Rio Grande River, calling attention to the difficulties of seepage and silt-deposit prevention. He was of the opinion that these problems were simple when compared with those of preventing water waste by the settlers.

E. C. Woodward, of the Dallas City engineering department, presented a paper on "Building the Maintenance Into the Pavement." C. R. Chamlin, of the Trinity Portland Cement Company, discussed "Concrete as Specified and as Laid." The last paper read was by J. B. Hawley, on "Notes on Sewer Construction."

The following officers were elected: J. H. Howe of Houston, president; R. C. Gowdy of Fort Worth and R. J. Potts of Waco, vice-presidents.

Will Prepare Tentative License Bill

After the banquet at the Oriental Hotel the advisability of putting through the engineer's license bill at the next legislature was discussed with keen interest. While the general sentiment of the association seemed to be that some sort of regulation was required, no definite agreement was reached as to just what form it should take. A tentative bill will be submitted to the members for a letter vote. If approved, the committee will take the bill to Austin with power to alter it in any way it sees fit in order to get it through the legislature.

Wall Collapses—Four Boston Buildings Wrecked

Structure Being Remodeled—Wall Had Been Reported Unsafe—Cause a Mystery, Although Explosion Is Suggested

Four buildings in Portland Street, Boston, were reduced to a mass of wreckage the night of Oct. 26 when a wall collapsed in one of the two structures being remodeled. Several weeks ago a complaint had been filed with the building department that the wall in question was "too thin, unsafe and a menace." A report from the inspector, however, stated that there was no danger of collapse.

Twin Six-Story Buildings Fail

The building, a twin six-story affair, was numbered 21-29 and 31-39 Portland Street. The front and rear walls had been removed and a new concrete foundation laid. A wall in the building numbered 21-29 is believed to have caused the collapse. The entire framework of this structure, in which were two heavy iron beams, crashed against its twin structure numbered 31-39 and wrecked it.

The six-story wall was flung across an areaway in front of No. 19 Portland Street and pounded into the center of the northerly wall of the three-story brick building at No. 17 Portland Street. The impact crushed the second floor of the structure and it crumpled.

The cause of the accident has not been definitely determined at this writing, although an explosion is said to have caused the wall to collapse.

Waterworks Men Gather Nov. 15 at Wilmington, Del.

The next meeting of the "four-state" section of the American Waterworks Association will be held Nov. 15 at Wilmington, Del., in the Hotel DuPont. The morning will be devoted to an inspection of the new reservoir and filtration plant now under construction. A short business session will be held in the afternoon.

The "four-state" section includes southern New Jersey, Delaware, Maryland and eastern Pennsylvania.

Railroad Inquiry to Begin November 20

The joint congressional inquiry into the general railroad situation is scheduled to begin Nov. 20 at Washington, D. C. The resolution under which the investigation is to be held calls for a report to Congress not later than the second Monday in January. Senator Newlands, chairman of the committee, states that the committee desires to give ample opportunity to all interested to express their views, but would like early notice of the subjects to be discussed, so that there may be an orderly sequence of subjects.

Road Congress Dec. 7 at Chicago

The Northwestern Road Congress will hold its third annual meeting Dec. 7 and 8 at the Hotel Sherman, Chicago. Among the papers to be presented is one by W. D. Uhler, chief engineer, Pennsylvania Highway Commission, on handling state maintenance problems, and another by Logan Waller Page, director, U. S. Office of Public Roads and Rural Engineering, on "Federal Participation in Road Work."

Prices of Materials—Page 181

Report Radical Advances in Water Sterilization

Engineers at American Public Health Association Convention Discuss Sanitary Problems of Water, Sewage and Garbage

Activated sludge results, river cleaning, sterilization of water with chlorine and ammonia, color removal and a discussion of garbage specifications were the more important topics discussed by the sanitary engineering section of the American Public Health Association at its annual convention in Cincinnati, Oct. 25, 26 and 27.

The officers of this section elected for next year are: Theodore Horton, chairman; George S. Webster, vice-chairman; H. D. Pease, secretary; and Paul Hansen, associate secretary. For the laboratory section Dr. Henry Albert was made chairman and Dr. Charles Krumwiede, secretary. Dr. W. A. Evans was elected president of the association and Selskar M. Gunn was retained as secretary.

Water Sterilization

Capt. Joseph Race, city bacteriologist, of Ottawa, gave information relative to improved sterilization methods using 0.23 part per million of available chlorine from bleach and 0.12 part of anhydrous ammonia. The chloramine formed is not consumed nearly so fast as chlorine, hence less is required. The process becomes economical when the price of hypochlorite exceeds about 2 cents per pound, and ammonia containing about 10 per cent NH_3 can be purchased for 2½ cents per pound. One precaution is to introduce the ammonia a minimum of time before introduction into the water supply. The process has worked out satisfactorily in swimming-pool sterilization, where bleach treatment could not be used on account of the large amounts required.

The water, sewage and garbage plants in Cincinnati were described by J. W. Ellms, W. E. Sullivan and W. C. Folsom, respectively. H. W. Streeter and W. C. Purdy, of the Public Health Service, gave reports on the investigation of the pollution of the Ohio River which the service has been carrying out.

In discussing the report of F. F. Longley on water supply, W. L. Stevenson, of Philadelphia, stated that he has been using liquid chlorine and lime to make a bleach solution for sterilizing sewage filter effluents. The amounts employed were 6 lb. and 8 lb. respectively, to 1,000,000 gal.

Relative to dual water connections Paul Hansen said Rockford, Ill., had a sad experience—10,000 cases of enteritis and many cases of typhoid. In Philadelphia all dual connections have been ordered out.

Rapid Filter Sludge a Problem

The problem of the disposal of sludge from mechanical filters followed R. W. Pratt's paper on the Cleveland water purification plant. W. H. Dittoe said the removal would be necessary if discharged into the river bed. He also cited a case at Columbus where from 1 to 2 ft. of sludge had accumulated in the river below the filter plant for a distance of a mile or more. The State Board of Health had made requirements at Cleveland for drying the sludge and it could be drained to 98 per cent moisture and then shoveled and dumped. The discharge of such sludge may become a nuisance as important as a question of sewage disposal. The question of the disposal of wash water is less important. Theodore Horton stated that on the Niagara River there were two plants at Niagara Falls, one of which was

located above the other and discharged the sludge into the intake of the lower works. No serious results had occurred. A uniform discharge was desired. It was considered legitimate in his opinion to return wash water to a stream or lake from which the supply was taken and the sanitary question involved was of no importance.

The question was brought up as to the effect of wash water on city sewers and their maintenance. Mr. Stevenson stated that at Philadelphia the upper Roxborough filter discharged through a small drain to an intercepting sewer and that the fine sand which was carried over required constant maintenance of the sewer.

Color Removal Hard

"Colloidal Chemistry in the Removal of Color and Turbidity from Water," a paper by George F. Catlett, defined the nature of color and turbidity. He said that it was generally agreed that aluminum sulphate was the best means of removing color. He briefly reviewed Professor Whipple's paper of several years before on color removal and added that the use of an excess of alum dosed into part of the supply, the dosed waters then being mixed with the rest of the water, was very successful. This has been applied in Massachusetts at Springfield and also at Wilmington—at the latter place by adding the excess in one basin (see Engineering Record, June 3, 1916, page 741). Acid helps in the removal of lead acetate or tannin. Colloidal precipitation is thereby produced and an alkalinity of 9 parts per milion may be neutralized with a color of 250 and the color removed. The use of 6 gr. per gallon of alumina sulphate in such a case may not be sufficient for complete precipitation of the color. Apparently the basic salt worked better than salt containing hydrate. Some alkalinity should be present but not enough to neutralize all the aluminum sulphate.

Professor Whipple commented on the fact that the electrical charge of the color may be either positive or negative. The addition of carbonic acid may intensify the action or even reverse it.

Captain Race stated that the Ottawa River water had been experimented upon in bottles and that 40 p.p.m. of color could be removed with a good floc when alum was added in just sufficient amount to react with the alkalinity. In his opinion the color removal was due to the coagulation of negative particles of color. An alkalinity of 24 was reduced to 12. Less alum may be required if the alkalinity is reduced to 0. In Ottawa if the color is high an excess of alum is required, but if the addition of alum is not sufficient to reduce the isoelectric tension to zero, the excess has no value. Aeration promotes coagulation.

Fewer Water Analyses Recommended

In his paper on "Fallacies in the Investigation of Water Supplies," H. A. Whittaker pointed out that it is important to include in the routine of a state board of health the personal inspection of all water supplies passed upon. In Minnesota for fifteen years such field surveys have been required. Sampling equipment is not provided for local authorities despite their criticism. A table submitted indicated that unless field inspection was made, there is a chance for 40 per cent of doubtful analyses to be approved. In the discussion it was brought out that the sources of pollution might be obscure and that consequently analytical results are valuable to check up.

Mr. Hansen pointed out that in the past a great deal of useless analytical work has been done on account of popular demand. In New York Mr. Horton stated that the inspection of the ground was always required. The laboratory analysis, in his opinion, had less value than a good sanitary survey. The survey has materially reduced the number of analyses and instead of making one a month, as was done in Massachusetts, Mr. Horton makes four analyses a year and recommends a yearly field examination.

Harrison P. Eddy, chairman of the committee on sanitary control of waterways, summed up progress and pointed to the need of economy and the distribution of equities on a scientific basis. There should be no nuisance in the stream, neither should disease be spread. The removal of floating matter is important and at times the settling suspended solids in river cleaning is very important.

After George W. Fuller had stated that the report contained nothing to which exception might be taken, Mr. Hansen suggested that he was adhering to the belief that the courts are the best method of adjustment as to the relation of sewage treatment, water supply and the like. He held that stream pollution has a comparatively small effect on the public health. Mr. Messer stated that in Virginia the problem of the oyster beds and industrial pollution was raising the question of the adjustment of values.

A paper on "The International Joint Commission and Pollution of Boundary Waters" was read by Prof. Earle B. Phelps. The discussion brought out the need of a balance between water supply and sewage. The analysis of the fact should be carefully considered with due attention to all equities and an authority should be present to enforce a decision.

The report of the committee on sewerage works operation was read by W. L. Stevenson, who stated that in his opinion a general blank could not be prepared that was applicable to all cases.

The reports of the three committees are to be printed and left open for adoption at the next meeting.

R. W. Pratt's paper on "Activated Sludge Work at Cleveland" was short, giving much valuable data resulting from experience with the operation of a plant having an aeration capacity for 1,000,000 gal. per day and a settling capacity for 500,000 gal. per day. A reasonably stable effluent was produced with ¾ cu. ft. of air per gallon of sewage and 2 hours' aeration, using 25 per cent of activated sludge. The temperature was stated to have little or no effect. A number of attempts to prevent the sludge from decomposing and smelling had been tried out, but no final results had been attained. With electric current at ¾ cent per kilowat-hour the power cost for air amounted to $7.50 per 1,000,000 gal. of sewage. The labor cost at the Cleveland plant amounted to $15 per 1,000,000 gal., but could probably be reduced for larger units.

The annual report of the committee on refuse collection and disposal by S. A. Greeley, chairman, was limited to a review of events of particular interest during the past year in the line of sanitary engineering work. The committee report was amplified by papers presented by Rudolph Hering and William F. Morse.

Wants Saner Refuse Plant Specifications

Dr. Hering's paper on contract plans and specifications for refuse incinerators pointed out clearly the extremes found in present practice. On the one hand were the carefully worded specifications requiring extreme guarantees on the part of the contractor. These specifications, because of the guarantee required, resulted in two court cases. At the other extreme are a large number of garbage furnaces and refuse incinerators which are purchased under almost no specifications at all. In these cases the lack of attention to details during construction has resulted at times in unsatisfactory operation. It was suggested that more attention should be given by city engineers to the preparation of plans and specifications for construction, thus securing better work and relieving the contractor in part from the burden of extreme requirements of the guarantees. In addition, the paper called attention to the need for considering the refuse problem as a whole, including the house treatment and collection as well as the disposal.

The paper by Colonel Morse included a compilation of statistics resulting from inquiries to 201 cities and towns relating to the practice and cost of refuse collection and disposal. The organization of departments in the work, the methods used and cost figures were tabulated and summarized.

A report by the committee on street cleaning, of which S. Whinery was chairman, went into considerable detail regarding the effect of street-cleaning work on the health of men engaged in street cleaning and also on the health of those living in the neighborhood of dumps or other centers of activity of street-cleaning work.

California Railroad Commission Declines to Investigate Terminal Questions

The Railroad Commission of California recently decided that it has jurisdiction within the city of Los Angeles over the construction of union passenger and freight railroad terminals, over the elimination of grade crossings and the safety of such crossings. The commission declined, however, to make an investigation into these matters or to formulate a general plan for them, and has ordered the inquiry carried out by the railroads and the city of Los Angeles, unless the commission is otherwise directed by the Supreme Court of California.

This decision was rendered in a consolidated proceeding against the Southern Pacific Company, the Atchison, Topeka & Santa Fé and the San Pedro, Los Angeles & Salt Lake railroads, undertaken as a result of seven complaints filed with the commission by the Municipal League, the Central Development Association and the Civic Center Association, all of Los Angeles and the cities of Pasadena, Alhambra, San Gabriel and South Pasadena. The complainants asked that the railroads be directed to construct a union passenger and freight station in Los Angeles. They also asked the commission to direct the railroads to reconstruct their tracks running to and from this terminal station so as to eliminate grade crossings.

New England Waterworks Men Meet November 8 in Boston

The November meeting of the New England Waterworks Association will be held next Wednesday at the Hotel Brunswick, Boston. The executive committee will hold a session in the morning. The afternoon will be devoted to discussion of F. A. Barbour's paper, which was postponed from the Portland convention, the report of the committee on meter rates, water loss by leakage and non-registration of meters. S. A. Agnew, superintendent of the Scituate (Mass.) Water Company, will give an illustrated lecture.

The nominating committee, at its Oct. 21 conference, prepared the following list of nominations: President, Caleb Mills Saville; vice-presidents, C. E. Davis, S. E. Killam, H. V. Macksey, F. A. Barbour, P. R. Sanders and Thomas McKenzie. Willard Kent is nominated for secretary and Lewis M. Bancroft for treasurer.

Select Nominees for Offices in Civil Engineering Society

The list of nominees for offices in the American Society of Civil Engineers as it will be presented at the annual meeting Jan. 17, 1917, is as follows: President, George H. Pegram, chief engineer, Interborough Rapid Transit Company and Rapid Transit Subway Construction Company, New York City; vice-presidents, George W. Kittredge, chief engineer, New York Central Railroad, New York City, and George S. Webster, director, Department of Wharves, Docks and Ferries, Philadelphia; treasurer, George W. Tillson, consulting engineer to borough president, Borough of Brooklyn, New York City. Alfred D. Flinn and Lewis D. Rights of New York City, William R. Hill of Albany, Arthur P. Davis of Washington, W. L. Darling of St. Paul and R. H. Thomson of Seattle are the nominees for directors of districts 1, 3, 5, 7 and 12 respectively.

Announce Tentative Valuations of Two Railroads

Tentative valuations of two railroads have just been submitted by the Interstate Commerce Commission in connection with the federal valuation of the carriers. The two railroads are the Atlanta, Birmingham & Atlantic and the Texas Midland. The former, with a mileage of 634 and a capitalization of $54,571,176, is given a reproduction cost new of $24,154,998, and a reproduction cost less depreciation of $19,408,810, the figures being exclusive of land, which is valued at $2,291,413. The Texas Midland, with a mileage of 111 and a capitalization of $2,112,000, is given a reproduction cost new, excluding land, of $3,382,004, and a reproduction cost less depreciation of $2,527,417. Lands used for transportation purposes are valued at $236,690.

Original cost is not reported complete for either road. For the Atlanta, Birmingham & Atlantic it is dismissed with the statement that "original cost of property could not be found." In the case of the Texas Midland it is stated that the result of an attempt to show the original cost to date of each piece of property has not been satisfactory, and that a statement would be entirely misleading. Figures are given for the original cost of equipment and of land.

Nothing is allowed either property for other values or elements of value. Even development expenses are apparently denied, and no mention is made of contingencies.

The reports are addressed to the U. S. attorney general, to the governors and public service commissions of the states in which the properties are located and to the railroads. They are required to file any protests within thirty days from Nov. 1.

What Engineers and Contractors Are Doing

WILLIAM A. DUFF, formerly engineer of bridges for the Canadian Government Railways, at Moncton, N. B., has been appointed assistant chief engineer. He will continue to discharge his duties as bridge engineer and will have charge of the Halifax ocean terminals.

LEWIS WARRINGTON BALDWIN, formerly general manager, and who was recently made vice-president of the Central of Georgia Railway, obtained his first experience in the engineering department of the Illinois Central Railroad. He was graduated from Lehigh University in 1896, in which year he entered the employ of the Illinois Central as chainman. His advancement was rapid and at the time of his resignation in November, 1915, he was general superintendent of that road's southern lines. Mr. Baldwin left the Illinois Central last year to go to the Central of Georgia as general manager.

GEORGE D. BROOKE was recently made superintendent of the Cumberland division of the Baltimore & Ohio Railroad. Two years after graduation from the Virginia Military Institute in 1900, Mr. Brooke entered the engineering department of the Baltimore & Ohio. He had risen to the grade of assistant engineer in 1904. In 1911 he was made assistant engineer in charge of the operating department and a year later was appointed superintendent of the Shenandoah division. At the time of his recent promotion Mr. Brooke was superintendent of the Ohio division.

HARRY O. COLE, who became associated with the Guggenheim interests last month as assistant engineer, has been made assistant construction engineer. Mr. Cole will have his headquarters in New York City, as before.

SYDNEY B. WILLIAMSON, who resigned early this year as chief of construction for the U. S. Reclamation Service to become chief of the field forces of the Guggenheim interests, has been made construction engineer. He will continue with headquarters in New York City.

CHARLES JOSEPH CARROLL, civil engineer, of Towanda, Pa., has been appointed assistant chief engineer of the railway to be built in China by the Siems-Carey Railway and Canal Company. Mr. Carroll has been engaged in engineering practice since graduation from Yale University in 1899, when he entered the service of the Mexican International Railroad. He was made assistant chief engineer of that road in 1906 from which position he resigned in 1907. For three years he practised consulting engineering at the end of which period he was appointed superintendent of construction for F. V. Lister & Company on the National Railway of Mexico. He resigned in 1911 to again engage in private practice.

R. E. ANTHONY has left the employ of the Bethlehem Steel Company, where he was transitman on the plant enlargement at Steelton, Pa. He is now with the New Jersey Zinc Company of Pennsylvania, with office at Palmerton, Pa.

GARVIN N. HOUSTON, consulting engineer, has reopened his office in the Equitable Building, Denver.

CHARLES G. THOMAS, formerly assistant on the engineer corps of the valuation department of the Pennsylvania lines west of Pittsburgh, has resigned to take a position with the Niagara Alkali Company of Niagara Falls, N. Y.

GARFIELD STUBBLEFIELD, consulting engineer, of Portland, Ore., is at Ontario, Ore., where he is engaged on preliminary engineering work for an $80,000 drainage district. It is proposed to use tile and treated concrete pipe instead of open drains.

C. P. COLLINS has resigned as sanitary engineer of Johnstown, Pa. He has announced no plans for the future. The sanitary work will be handled by J. R. Crissey, city engineer, until the services of another sanitary engineer can be secured.

JARED BOGARDUS, formerly assistant engineer on the Catskill Aqueduct, is now in Chile with the Braden Copper Company. He is located in a surveying camp in the Andes 100 miles southeast of Santiago, where he has had an opportunity of watching snow slides in midsummer.

L. W. HUTCHINSON has left the service of the Pennsylvania Railroad to join the engineering forces of the H. Koppers Company, with headquarters at Steubenville, Ohio.

HYNDMAN IRWIN, formerly editor of the *Canadian Engineer*, has sailed for England with a draft of the Canadian artillery. Mr. Irwin joined the staff of that journal in 1913, resigning early this year to enter the officers' training school at Toronto. He was graduated from the University of Toronto, class of 1909, after which he took a postgraduate course in civil engineering. He spent a year in the Great Northern Railway shops at Havre, Mont., and was subsequently power engineer for the Cottonwood Coal Company at Belt, and Stockett, Mont. He was also at one time power engineer for the Graves, Bigwood Lumber Company, at Byng Inlet, Ont.

CHARLES REED MARSH has resigned as superintendent of construction, U. S. Public Buildings, to become engineering assistant to the municipal architect of the District of Columbia. He will have charge of repairs and improvements of all municipal buildings in Washington. Mr. Marsh received his engineering education at the University of Pennsylvania and Cornell University. After a short experience with the Harris Engineering Company and Dodge & Day of Philadelphia, Mr. Marsh entered the service of the U. S. War Department as engineer and superintendent of construction in the quartermaster's department. Since early in 1911 he held the position from which he recently resigned.

ISAAC S. WALKER recently resigned as assistant engineer for Hering & Gregory, consulting engineers, of New York City, to take a position in the Bureau of Surveys of Philadelphia as assistant engineer in the Sewage Disposal Division. During the 6½ years Mr. Walker was associated with Hering & Fuller and Hering & Gregory he was engaged in the preparation of reports and plans for filtration, sewage-treatment, and refuse-disposal plants. Prior to that he was for nine years with the Philadelphia bureau of filtration on construction. For the last two years Mr. Walker has conducted evening classes in sanitary design at Columbia University. In his new position he has charge of the preparation of plans for the collection, treatment and disposal of sewage. He will report to W. L. Stevenson.

F. C. SCHUBERT, U. S. assistant engineer, Portland, Ore., and E. B. Clark, chief clerk of the Portland U. S. engineer's office, recently completed a tour of inspection of the Snake and Clearwater Rivers in the Lewiston, Idaho, district. A preliminary report is to be made relative to needed improvements, especially on the Snake River. It is intended to construct dams for the generation of electricity and make the Snake River navigable throughout the year.

C. W. WILEY, vice-president and general manager of the Seattle Construction & Dry Dock Company since it was taken over several months ago by the Todd interests, of New York City, has been elected president of the corporation, succeeding W. H. Todd, who becomes chairman of the board.

VICTOR CARLSON, contractor of Portland, Ore., who recently completed several large building contracts in Butte, Mont., has returned to Portland to re-engage in the construction business.

Obituary Notes

THEODORE N. ELY, who retired from active work in 1911 as chief of motive power of the Pennsylvania Railroad, died Oct. 28 at his home in Philadelphia. He was born in Watertown, N. Y., in 1846 and was graduated from Rensselaer Polytechnic Institute twenty years later. Soon thereafter he entered the service of the Pittsburgh, Fort Wayne & Chicago Railway as a member of its engineer corps. In 1869 he was made division superintendent for the Pennsylvania Railroad and the next year assistant general superintendent. His appointment as chief of motive power came in 1893 after many rapid promotions.

CHARLES W. HOTCHKISS, president of the Chicago Tunnel Company, and well known in railroad circles, is dead at Battle Creek, Mich. He was born in 1863 at Unadilla Forks, N. Y. His first railroad work in 1881 on the New York, West Shore & Buffalo Railroad was followed five years later by his appointment as assistant engineer for the Michigan Central Railroad. After 10 years with that line Mr. Hotchkiss resigned to become chief engineer of the Chicago Junction Railway, which position he held for two years. His appointment as chief engineer of the Chicago Transfer & Clearing Company preceded his election to the presidency of the Indiana Harbor Railroad by only a year. From 1906 until 1912 Mr. Hotchkiss was general manager of the Chicago, Indiana & Southern and the Indiana Harbor Belt railroads. Since the latter year he had been president of the Chicago Tunnel Company. He went to New York City in 1912 to become president of the Rail Joint Company of America and associated with various Staten Island properties. Mr. Hotchkiss was a well-known member of many engineering societies and a pioneer in the development of transportation in northern Indiana.

New Locomotive Is Light and Strong—Standard Design

A new type standardized steam locomotive has been designed by the Bell Locomotive Works, New York City. The machinery or engine parts are all confined to one unit so small and compact that it can be installed in the narrowest gage locomotive. In the new machines the designers have striven to perfect a locomotive that could be built in several sizes without extensive alterations to the power plant, that would burn all kinds of cheap fuel without emitting smoke and sparks and could be made narrow, short and low.

The engine unit is fitted with roller bearings and drop-forged parts. Oil-tight dust-proof cases inclose all working parts. The boiler is of the horizontal type, with shell and firebox head of one piece of pressed steel and smokebox head welded in. The shell is wound with several layers of piano wire to give it great strength without excessive weight. The tubes are expanded into the front and brazed into the rear head from the inside of the boiler by a patented process.

The fire is so distributed that it gives maximum heat to the lower tubes and only a comparatively low heat to the tubes above the center of the boiler, which are not under water. No stays, seams, or rivets are used. The boiler plant is easily cleaned and so designed that all the tubes may be removed and replaced in one unit, when necessary, in from one to two hours' time. A steam pressure of from 300 to 350 lb. is carried, at which the factor of safety is at least 10. The boiler may be fired from cold in 10 to 30 minutes, or instantly after a one or two hours' stand.

These features, say the manufacturers, give a locomotive that will run on any fuel—gasoline and kerosene to crude oil, coal or wood. The machine has the speed of the direct-connected combined with the power of the geared locomotive. These locomotives can now be built in sizes from 2 to 14 tons.

NEW LOCOMOTIVE DESIGNED FOR MAXIMUM COMPACTNESS AND FOR OPERATION ON CHEAP FUEL WITH NO SMOKE OR SPARKS. BUILT IN SIZES FROM 2 TO 14 TONS OR LARGER.

Form First Co-operative Company to Export Lumber

The formation of the first organization for co-operative selling to enable an American industry to compete with foreigners in foreign markets was recently announced by the Bureau of Foreign and Domestic Commerce. The organization is an export sales company, representing 80 per cent of the Douglas fir cut in this country. The bureau thinks that it will give American lumber a decided advantage in the trade struggle that will follow the war.

A statement issued by the bureau says: "It is expected without violating the present anti-trust law to give American manufacturers some of the advantages that were hoped for from the Webb bill, which the last Congress failed to pass."

Open New Waterworks Department

Everything that may be required in the line of waterworks supplies, except cast-iron pipe and meters, is now offered by the newly organized waterworks supply department of the Modern Iron Works, Quincy, Ill. The new department, plans for which were recently completed, was put in operation Nov. 1.

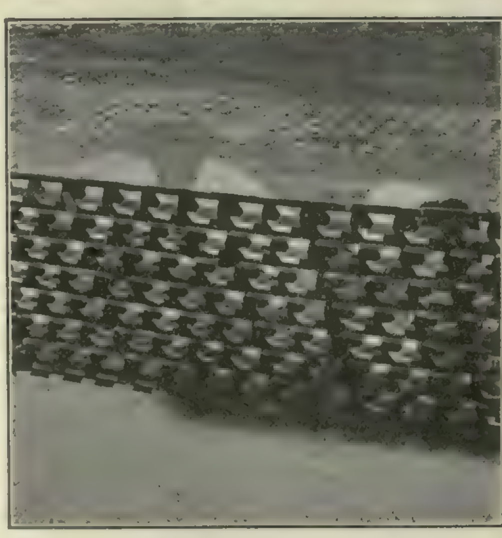
Turner Patents Defeated

Two patent cases involving Turner patents 985,119 and 1,003,384 were recently decided by the United States Circuit Court of Appeals. The case of Turner vs. Deere & Webber involved only the earlier patent. Judge Orr, following the ruling of the Circuit Court of Appeals of the Eighth District, declared claims 1, 4 and 6 of that document to be invalid.

In the case of Turner vs. the Lauter Piano Company both patents were involved. The decision would seem to settle, for all time, claims which Mr. Turner has made since his earlier losses in the courts. The recent decision by the New Jersey court is that both patents are invalid for lack of invention; that they are infringements on the Norcross patents owned by the Flat Slab Patents Company, Chicago.

Armored-Concrete Road Costs $2.06 per Square Yard

A steel road surface, called "armored concrete" by its inventor, J. F. Wixom, of Hammondsport, N. Y., is being tested by Charlotte, N. C. The cost of a trial section 80 ft. long covering 160 sq. yd. has been estimated at $2.06 per square yard. Concrete of 1:2:3 mixture, with ¾-in. stone, is laid 3 in. thick on a 4-in. stone base. The lugs shown in the picture are made by blocking out No. 11 gage steel in a pressing machine. Each section is 30 in. wide and 18 ft. long. Slots on the edge of one section take the lugs on the next.

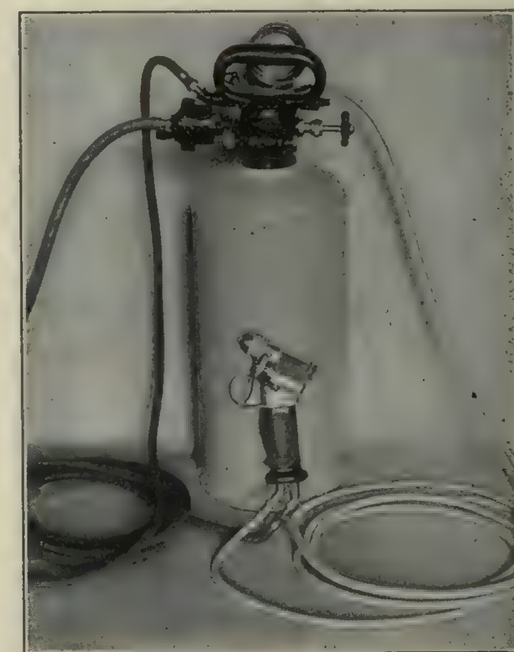


STEEL SECTION UP-ENDED

Paint Gun Used for All Kinds of Painting

A nozzle which has been in use for about three years for cooling ponds, sewage sprays and other work has been redesigned and fitted for use as a paint gun. The Spraco paint gun, as the new device is known, is manufactured by the Spray Engineering Company, 93 Federal Street, Boston, "for all kinds of painting."

The complete equipment consists of the paint gun proper connected by flexible hose to a portable unit combining in a compact, rugged form, the material container, air drier and strainer, pressure-control attachment, and pressure gage. After the portable control head has been adjusted to meet the conditions of air pressure, thickness of paint, etc., the operator has complete control of the outfit by means of the trigger on the paint gun proper. The unit is furnished complete ready for attachment by a single-hose connection to the compressed air supply, which should be from 35 to 75 lb. per square inch, depending on the nature of the material used and the degree of finish required.



PAINT GUN USED IN FIELD OR SHOP

The equipment is adapted for use in shop or field and may be adjusted for spraying the highest grade of varnishes and lacquers, as well as heavy asphaltum and structural paints. The manufacturer states that this gun produces surfaces without streaks or brush marks. It is also adapted to applying heavy durable coatings to rough structures and surfaces not easily reached with a brush.

Drill 36-Inch Hole in 3 1-2 Minutes

A 36-in. hole was recently drilled into igneous mica rock in New York City in 3 minutes 37 seconds. The 20-in. starter, 1¾ in. in diameter, was drilled in 2 minutes 7 seconds; the 16-in. hole, 1⅝ in. across, was made in 1 minute 30 seconds. "Hummer" drills, made by the Chicago Pneumatic Tool Company, were used. In another test a hole 10 ft. deep, varying from 2¼ to 1¾ in. in diameter, was drilled in 11 minutes 35 seconds.

Business Notes

The Sullivan Machinery Company, of Chicago, has transferred Burt B. Brewster from Juneau, Alaska, to Salt Lake City to take charge of that branch. Walter F. O'Brien will succeed Mr. Brewster at Juneau.

The Witherow Steel Company, of Pittsburgh, has opened a district office at 120 Broadway, New York City.

The Chain Belt Company, of Milwaukee, has appointed C. F. Messinger manager of the mixing department. He is a graduate of Yale University.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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Reduction in Page Size

BEGINNING with the new year, the Engineering Record's page size will be reduced to 9 x 12 in., the so-called standard for engineering publications. The publishers have decided to make the change in order to effect necessary economies and give the readers the paper in handier form. The smaller size will be more economical in paper and mailing. Moreover, since the McGraw Publishing Company issues four technical magazines of standard size—*Electrical World, Electric Railway Journal, Metallurgical & Chemical Engineering* and *Electrical Merchandising*—the reduction of the Engineering Record to the same dimensions will permit of printing-office standardization that will result in still further savings. These economies are essential in order that, in the face of greatly increased publishing costs, the standards which the Engineering Record has set may be maintained. The change is made, too, in full confidence that it will meet with the approval of the readers. Careful inquiry has indicated that a large majority of them will welcome the reduction. Ease in handling, convenience in filing, possibility of using standard shelving, all favor the 9 x 12-in. page. The publishers have long appreciated that these advantages inhered in the smaller size. Two of their other publications have for more than twenty years appeared in the smaller page form, but various considerations, not necessary to repeat here, made a change in the Engineering Record's page inadvisable until the present time. Outwardly, the Engineering Record will look slightly different. Inwardly, it will be the same Engineering Record—timely, comprehensive, thorough, unique in its presentation, vigorous in its editorials, having always the courage of its convictions. In other words, it will be the same Engineering Record in spirit, in aim, in policy—and in a more convenient form.

Electrolytic Sewage Treatment

SEWAGE treatment by electricity has long had an appeal to the scientific as well as to the engineering mind. But mere attractiveness does not satisfy in the present scientific times. Results and comparisons with other forms of treatment are demanded. The experiments on the electrolytic-lime treatment at Decatur, Ill., were excellent, but they did not go far enough. The skeptic wants to know what lime alone would have done, because Prof. Earle B. Phelps, during the Elmhurst controversy, held that lime alone would do practically the same work mechanically as lime and electricity. Now comes the climax at Decatur. Prof. Edward Bartow details it on page 596. The city ordered that the plant run a comparative test, and this was only well started when the company objected and ordered the plant dismantled. This is bad business procedure. If the company is more than a stock-jobbing proposition it must come out in the open and let the engineering profession know what goes on inside the electrolytic box. It must run comparative tests. It must tell how thin the plates become in a given time. The true experimenter tries, within reason and sometimes without reason, everything he can think of or that anyone suggests. When this is done with the electrolytic-lime treatment, and not until then, will the process have standing before the engineering profession.

The Right Type of Road

SALESMANSHIP in many lines of industry and engineering has been put upon fundamentally sound grounds. In the machine-tool field, for example, the time is long since past when a manufacturer would palm off on a customer machinery not adapted to his needs. Now the manufacturer investigates the prospective customer's requirements and—often as a result of careful engineering analysis—supplies him with equipment particularly adapted to the conditions which the customer must meet. Unfortunately, this wave of efficient salesmanship has not swept away all of the unsound promotion and selling practices in the highway-materials field. Reference is not made here to the criminal methods of road promotion which to some extent still persist. Of course, these underhand methods of selling very frequently are joined with the error here condemned—the selling of road materials for conditions to which they are not adapted. Nevertheless, even when the selling is not tainted by graft, this fault can be found with much highway promotion work. The results are patent on every side. Materials laid under conditions to which they are not suited are going to pieces and building up heavy financial burdens in the way of maintenance and reconstruction costs. And yet the promoters will not learn the lesson. They are proceeding on the theory, profitable temporarily perhaps, of "going while the going is good." Their policy is shortsighted. Their materials are being so soundly condemned that it will be many years before they recover from the effects of the criticism. Some interests, fortunately, are adopting the wiser course. Not only are they confining their promotion work to situations where the use of their material is entirely proper, but by careful inspection and insistence upon high standards are insuring that their products will render the best service of which they are capable. Such promotion methods must become universal, not for the sake of the material manufacturers, though they would be better served thereby, but in the interests of the public at large. The Engineering Record cares not if some of the companies ruin their businesses entirely. In fact, it believes that for the good of engineering and of the public it would be well if these shortsighted companies would be out of the field. This journal cares much, however, for the future of the road-building art, for the public attitude toward highways and highway officials, and for the efficient expenditure of the taxpayer's money. These interests demand that road-promotion work be put on an honest, on an engineering basis.

Quality of Concrete

STRIKING evidence of the danger to concrete structures from improper mixing and placing is afforded by the report of C. B. McCullough on the failure of the highway bridge at Independence, Ore., an abstract of which is printed on page 597 of this issue. Evidence of rank carelessness and of lack of adequate inspection is presented. The lesson to engineers is the old one, which in spite of continued reiteration appears to require new emphasis, that concrete is of great permanence and reliable strength only when the composite materials are properly placed. Perhaps the most potent force that can be brought to bear on contractors to insure the production of the best possible concrete with the materials available is that of economic interest combined with tests of the concrete actually going into the structure, as advocated by C. M. Chapman in the Engineering Record of July 8, page 49. He proposes that, instead of specifying the requirements for the materials used, which might exclude cheap available aggregates, the concrete actually placed in the structure be required to show a given minimum compressive strength when field samples are tested at a given age. Editorial comment in that issue pointed out the great influence that such a form of specification would have in improving the quality of concrete. With adequate inspection to make certain that this quality of concrete really gets into the forms, the profession would be insured against such failures as that just reported.

Filter-Patent Claims Invalid

A DECISION of considerable interest to waterworks men was rendered last month by Judge Hook of the U. S. Circuit Court of Appeals, Eighth District. By it

two important patent claims of Ira H. Jewell—for the central control of operating valves and for the use of a screen between the gravel and sand layers of mechanical filters—have been declared invalid. The decision was rendered in the case of Jewell against the City of Minneapolis, which, it will be recalled, completed and put into operation its large mechanical filtration plant in January, 1913. In regard to the central control feature, the Court pointed out that this principle has been far too common in other fields to admit of the validity of a patent claim. It has been employed extensively, for example, in hydraulic systems for closing bulkheads on ships and for operating hatches, ports, valves, etc. Speaking of the screen feature of the Jewell claims, the Court expressed the view that this feature did not "rise to the dignity of invention." The case is important, not merely because it frees Minneapolis from further litigation, but because it establishes a precedent applicable to a vast number of cities and towns in which mechanical filtration plants have been installed. The Jewell damage claims, according to a recent statement in the Minneapolis press, amounted to approximately $100,000, and the cost of litigation, according to Charles D. Gould, city attorney, was $28,000. By the recent decision, therefore, the city saved $72,000. It would appear from the Minneapolis case that the patent claims for central control and for holding-down screens have been set at rest. Certainly the case is ended for the particular circuit.

Foundation of Journalistic Influence

ELSEWHERE in this issue is printed a letter criticising the Engineering Record for publishing a communication claiming that a concrete road in Wayne County, Mich., had worn out. The letter criticised was written by an official of a paving company. Broadly stated, the Engineering Record conceives it to be the duty of a technical journal to open its columns, when claim of an error has been made, to any man of standing who believes he has controverting evidence—provided the prospective contributor does not conceal his identity and prevent the readers from weighing properly the value of the evidence presented.

The Engineering Record stated in an editorial in its issue of Oct. 7 that "No concrete roads in Wayne County have as yet worn out." A correspondent presented controverting evidence. Having taken advantage of the occasion to plead for his own special material, he presented the alleged controverting evidence, however, and pleaded his own product in an open and above-board manner. He signed himself as an official of an asphalt paving company. That is full notice that he is a partisan and that the partisan leaning must be taken into consideration in weighing the communication.

To have refused admission to the columns of the Engineering Record of the communication, and to adopt a general policy of excluding controverting evidence, would be to rob the Engineering Record of its reputation for fairness. If an error is made, the readers have a right to know that controverting evidence has been offered. To suppress it is to violate the covenant to tell the truth, which this journal makes with each of its subscribers. From the reader's standpoint therefore the publication of the letter was a matter not of choice but of necessity.

From the advertiser's standpoint, the publication was equally necessary. The value of the Engineering Record as an advertising medium rests upon its standing in its field, and that standing is predicated upon a well-won reputation for fairness, accuracy and fearlessness. Take these qualities from the Engineering Record and its influence would soon wane. With its disappearing influence would go its value as an advertising medium. From even the commercial point of view, therefore, the publication of Mr. Pierce's letter was sound policy—policy calculated in the long run to be a help rather than a detriment to the interests which Mr. Cameron represents.

There is room for difference of opinion regarding the admission to Mr. Pierce's letter of his plea for his own material. If the letter had not shown his connection with the Barber Asphalt Paving Company, it would have been a gross deception. Signed as it is, the letter is that of a special pleader, a fact that every reader will take into consideration.

Finally, it is entirely proper that anyone objecting to a communication such as Mr. Pierce's should voice that objection. It is with pleasure, therefore, that Mr. Cameron's letter is printed. We accord to his communication the same prominence given to that which he criticises.

Sanitary Control of Waterways

THE report of the committee on sanitary control of waterways, submitted to the sanitary engineering section of the American Public Health Association at Cincinnati, and printed on page 582 of this issue, indicates a crystallization of opinions, based upon economic, æsthetic and hygienic principles, which should have a marked effect upon regulations governing the pollution and use of streams.

To understand the report properly it is well to remember that the introduction of sewer systems about the middle of the nineteenth century, as the result of the investigations of the Health of Towns Commission, merely transferred the filth from the English towns to the watercourses. This abuse of the streams caused the appointment of the Rivers Pollution Commission, whose report led to the enactment of laws practically prohibiting the discharge of sewage as such into the streams.

Gradually from these opposite viewpoints reasonable opinions have been evolved, so that now sanitary engineers are able to recommend the economic treatment of sewage and the efficient purification of river water for public-water supplies, so as to provide for a normal use of streams and protect the public health. The report recognizes the impracticability of maintaining streams in their original purity, and that when properly carried out sewage disposal by dilution is a rational and suitable method.

One of the most difficult and yet important recommendations covers the requirements and the share of responsibility to be met by various users of streams. The adjustment of relations between sewage treatment, water purification and the shellfish industry comes properly under the jurisdiction of central authorities and the courts. The officials charged with administering such regulations should also consider the steadily increasing use of the streams, and define a policy which, while meeting present conditions, can be adapted to the more exacting demands of the future.

In the code submitted by the committee the æsthetic requirements are made that no objectionable deposits of local or general nuisance, due to excessive turbidity or odors, shall exist in streams, and the hygienic standard proposed would prevent undue burden upon water purification plants or potentially dangerous contamination of shellfish or bathing beaches.

The economic loss due to depreciated land values, and the necessary abandonment of streams for pleasure purposes, which result when a community allows its own sewage to foul its watercourses grossly, is becoming more evident to local authorities every year. The abatement of such conditions, from selfish motives, is easier to obtain than the prevention of pollution of streams at points beyond the interest of a town, but which prejudicially affects the comfort or health of users downstream.

This is where the central authority should intervene and require the proper use, and not abuse, of the stream, as recommended in the report. All those interested in conserving the natural resources which our watercourses provide should be governed in their actions by the principles enunciated in this report.

Mud-Dwelling Worms Suggest Sludge-Disposal Possibilities

ONE of the most interesting papers presented before the sanitary engineering section of the American Public Health Association at its recent convention in Cincinnati was that of W. C. Purdy, Plankton expert of the United States Public Health Service, on "Bottom Sediments." In connection with a study of the pollution of the Ohio River Mr. Purdy has investigated the bottom of the stream and found typical conditions of the sediments corresponding to the pollution of the water above them. He considers that the mud gives naturally an integration of the pollution conditions of the stream at any given point. Immediately below sources of pollution the mud was found to have a foul odor and a characteristic consistency, or pastiness, while farther downstream the odor improved and the mud became granular. Even more striking was the change in the number of mud-dwelling organisms —worms, insect larvæ and bivalves. In the pasty, polluted mud certain organisms, characteristic of pollution, were numerous, while in the granular deposits they were found in much smaller numbers. A count of the organisms, together with records of

the odor and consistency of the deposit, can be made to serve as a sanitary index of the condition of a stream at any point except that in rapidly flowing streams allowance must be made for the inability of the deposits to form.

In the Ohio River above Cincinnati the mud at the river bottom contained about 5 "pollutional organisms" per liter; just below the city there were 455; 123 miles below the city there were 40 per liter. Below Louisville the increase was slight because of the swifter current which prevented bottom deposits from forming.

Mr. Purdy gave an interesting description of Limnodrilus, a red mud-borrowing worm over an inch long. With head embedded in the mud and its posterior extremity waving in the water above the mud, taking in oxygen and ejecting excretal casts, this organism gets its food from the organic matter and converts the pasty mud into a granular deposit. It is estimated that a single worm may eject excretal casts aggregating a length of 69 in. a day, the diameter being 0.18 mm. Apparently this worm does for the bottom desposits what the earth worm does for the soil. Chemical tests of the excreted matter showed it to have an "oxygen demand" less than half that of the original mud.

Several thoughts naturally arise from this study. Obviously the worms cannot live if the dissolved oxygen in the water falls below a certain amount, which thus determines a critical condition in the stream, for without the worms granulation of the mud does not occur and putrefaction by bacterial action with gas production becomes the controlling process. It will be interesting to learn what part these worms play in the change in sulphur compounds.

At the present time the great stumbling block in the economical disposal of sewage sludge is the difficulty of converting the sludge from a pasty to a granular condition. Drying is expensive, because as long as the pasty condition remains the evaporation takes place only at the surface. In the Imhoff tank gas production tends to increase porosity, but this process is slow. The use of yeast to accelerate gas production is being tried experimentally with some prospect of success. In the light of Mr. Purdy's investigation the thought suggests itself that possibly advantage may be taken of the action of worms in the granulation of sludge. As a matter of fact, this action is already being utilized in trickling filters, where larvæ and worms of various kinds are found in enormous numbers and where the effect is also in the direction of granulation. Perhaps some way will be found to utilize worm growth in the granulation of sludge in tanks prior to the drying or pressing. Biological studies should be made with this end in view.

More and more it is becoming apparent that we have studied bacteria too exclusively and that studies of the larger organisms, both animal and vegetable, should be included in the investigation of sanitarians.

Comments on the Government's First Tentative Valuations

"ORIGINAL cost could not be found." Considering the vigorous attempts of some of the state railroad commissioners last January to convince the Interstate Commerce Commission that reproduction cost had been definitely rejected by the courts, and that no basis of value was left but original cost, the foregoing sentence, with which the federal board dismisses original cost in its first tentative valuation report, that on the Atlanta, Birmingham & Atlantic Railroad (see notes on both this report and that on the Texas Midland Railroad on page 598 of this issue), is interesting. Perhaps the persistent contention of the railroads that original cost cannot be found was something more than an evasion of the issue after all. Of course the estimate method can be used, applying to the same quantities as in reproduction cost unit prices as of the date of construction; but those who have objected to reproduction cost on the ground that it is an estimate, which to them means a guess, might have trouble squaring estimated original cost with their consciences. The most righteous argument against original cost is that it does not in any event represent present value. But for the unthinking, evidence that a thing cannot be done is useful.

Why Separate Land?

Like the California railroad commission, the Interstate Commerce Commission switches from "cost" to "value" when it comes to deal with land. Unlike the California board, it does not add in this value to cost figures to get a cost total, but gives two sums, "cost of reproduction of road and equipment excluding lands," and "present value of lands." In the Texas Midland report the commission explains that it interprets the Minnesota rate decision to prohibit any allowance above normal market value, where this far exceeds original cost, but the segregation of the land accounts seems to indicate that the commission realizes that it is not reporting reproduction cost of land. Would it not be better for the commission to face the issue squarely? The Valuation Act calls for the reproduction cost of the entire property, including land. Has the commission found the Valuation Act and the Minnesota rate decision mutually incompatible, and if so would it not be proper for the commission to say so in its report?

Intangibles and Overhead

Of "other values or elements of value" the commission will apparently have none. Even development expenses, which the carriers class in this group, but which this journal contends are definite construction expenses, get no recognition, nor do appreciation, contingencies or working capital. The Engineering Record will not mourn the denial of advantageous location and its ethereal sisters, but regrets that such obvious necessities as contingencies and working capital, or such evident additions to value as appreciation, should be disregarded. Likewise the allowance for general expenditures—figured as percentages in the one case, estimated in detail in the other—seem at this distance to be impossibly low. An allowance of $831 for the organization of a $3,000,000 property suggests that the commission regarded the organization of the Texas Midland well-nigh automatic.

Depreciation of Overhead

As the commission seems to be of open mind as to the correct way to figure reproduction cost new of general expenditures, it is apparently equally undecided as to the proper depreciation of overhead expenses. In the Atlanta, Birmingham & Atlantic report it depreciates all general expenditures, but not engineering; in the case of the Texas Midland engineering is depreciated, but none of the general expenditures are, except taxes and interest during construction. The deductions are explained, but considered together they do not quite harmonize. It would seem that one rule for the depreciation of overhead expenses should fit all railroads. It may be a coincidence that on the first two railroads reported on the conditions were so different as to necessitate disregarding in each case the conclusions reached for the same items on the other road; but there is unpleasantly suggested a lack of convictions on the part of the commission as to the proper handling of these items.

More Light Needed

The above-mentioned omissions and seeming inconsistencies appear from a perusal of the two valuations, without knowledge of the facts of the two railroads in question. Perhaps the commission has data to explain them away. Parts of the reports have already been discussed in informal conferences between the carriers and the commissions, and railroad valuation men have received through the Presidents' Conference Committee detailed criticisms by the companies involved, and by representatives of the committee. Objection is made to the programs of construction, the unit prices, the allowances for engineering and overhead, the omission of cost of acquisition of land and many other features of the valuations.

Probably some of the criticisms are prejudiced, but many of them look to be wholly justified. The carriers complain that the commission has not shown fully how it arrived at the figures it presents and that numerous figures required by the Valuation Act are missing. Under date of July 21 the Presidents' Conference Committee by letter urged the commission not to serve incomplete tentative valuations, but to consider the essential factors first. The commission declined the suggestion, stating that it had already considered these factors at several conferences, and had then announced that it would not issue definite rulings. Seemingly it would be well to revise this decision.

To strengthen the public faith in its ability to handle this tremendous problem of valuation, as well as to render substantial justice to all, the commission should open the doors and let all concerned see what it has done, and learn the reasons why.

HALF SPAN AND APPROACH ON ARIZONA END BEING CONSTRUCTED

Novel Method of Erection Adopted in Raising Longest Highway Arch Span

Old Trails Bridge Over Colorado River Has 592-Foot Steel Arch—Assembled in Horizontal Position and Raised by Tackle from Central Tower

EXCEPTIONALLY daring and successful for work of such magnitude was the method of erecting the trusses for the 592-ft. three-hinged arch highway bridge crossing the Colorado River at Topock, Ariz. Exceeding by 1 ft. the span length of the Detroit-Superior bridge in Cleveland, this span ranks third among arch bridges in this country and is the longest highway bridge of its kind.

After being assembled and riveted up in a horizontal position, the half-arch spans were raised into place by hoisting apparatus at a temporary central tower constructed by using floor steel from the main span. Both the local conditions at the site, which made the ordinary timber falsework expensive and dangerous and allowed the use of piles for the central tower, and the peculiar ball-and-socket type of center hinge suggested the unusual scheme of erection to the engineer of the fabricating company who devised the erecting methods and apparatus.

General Dimensions and Conditions

The bridge is located at Topock, Ariz., near the Red Rock cantilever bridge of the Santa Fé Railroad, crossing the Colorado River on the route of the national "Old Trails" highway. The river at this point is very swift. During construction of this bridge last winter it often ran from 15 to 18 miles per hour. The river bed is a fine silt, very changeable, the depth of this silt being from 80 to 100 ft. at the bridge site. The main stream is under the California half of the arch span, as can be seen in the photograph. A rise of 1 ft. would often result in scouring out 25 ft. of the silt, and after the completion of the bridge a rise of 4 ft. took out all the falsework except the piling under the center tower.

The total length of the steel superstructure is 832 ft., including the main 592-ft. arch of 32 panels at 18 ft. 6 in. each, with a rise of 100 ft., and approaches at each end consisting of two 56-ft. plate-girder spans carried on steel bents and towers. The main arch trusses are 25 ft. center to center, while the approach girders are 22 ft. on centers. The floor system consists of rolled I-beams, supporting a timber floor for a 17-ft. clear roadway.

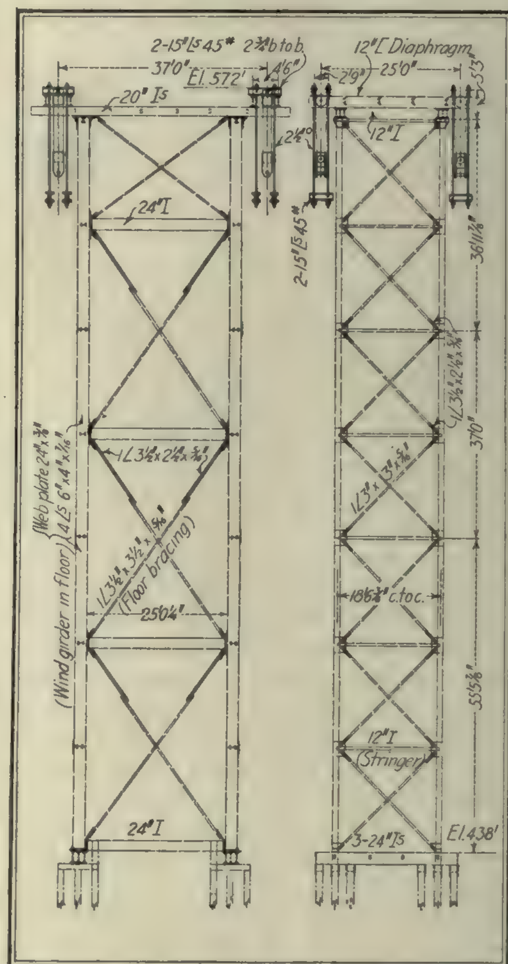
Why Special Erection Method Was Adopted

The extremely treacherous conditions of the river bed at the site, as described, made the usual method of erection by the use of high falsework not only very expensive, but also dangerous. As seen in the photographs, it was possible to erect the trusses in a nearly horizontal position with the use of very little temporary falsework. The trusses on the Arizona side were supported by several posts resting upon the sand. The California trusses on the other side of the river were supported upon pile bents, with the piles driven about 25 ft. into the silt of the river bottom.

These pile bents on the California side made a working floor for the erection derrick, and on this floor pony bents carried the steelwork. The piling was driven by a stiffleg derrick, similar to the one shown in the foreground of one of the pictures. The extreme length of boom used was 120 ft.

The scheme of erection thus adopted, which worked out with great economy and with complete satisfaction, included the construction of a temporary steel tower upon piling at the center of the span, using floor steel for the columns and bracing and hoisting apparatus with which the half spans could be revolved vertically into place around the end pins by raising them at the center. It was planned to avoid danger from a sudden washout of the falsework, under the California trusses, by supporting the trusses on the center tower and on the lower pin.

The main abutments were first constructed, the end hinges set in place and the trusses on the Arizona side built out on the



ERECTION TOWER REQUIRED LITTLE MATERIAL IN ADDITION TO FLOOR FRAMING

sand bar from that side and continued to the center hinge. Piling was then driven into the river from the center tower to within approximately 60 ft. of the California end hinges. The California end hinges were next set and erection of trusses then proceeded toward the center tower, cantilevering across the 60-ft. gap by shore supports. Thus, should the falsework go out, the erected portion of the California trusses could be held by the central tower and the lower end hinges. The center hinges were thus located on top of the Arizona trusses, as indicated in one of the photographs.

All joints in the main trusses were

COMPLETED 592-FOOT ARCH HIGHWAY BRIDGE—LONGEST OF ITS KIND

HALF SPAN ON CALIFORNIA END RESTING IN SLINGS WHILE THE OTHER HALF SPAN IS BEING RAISED

riveted up. Lateral struts and lateral diagonal rods were bolted loosely in position so as to allow some slight movement between the trusses during erection. Sufficient lateral bracing near the center hinge was left out to allow both half spans, when lying in the horizontal position, to pass the erection tower, which was made just wide enough for sufficient clearance.

DETAILS OF TEMPORARY TOWER

The columns of the temporary erection tower were made of the wind-chord girders from the main arch floor system, their finished length being just the proper length for use in the tower, so that no changes were necessary. The tower bracing was also taken from the main bridge floor, using I-beam stringers for horizontal struts and single-angle bottom laterals for the diagonal bracing. Thus all material except the connections and splicing angles and the special framing and hangers, as seen in the accompanying drawing, could afterward be used in the main structure. All connections were bolted, the bracing being connected to bent gusset plates on the columns.

The tower foundation consisted of thirty-six piles, nine at each corner, driven to an average penetration of 42 ft., cut at the top 2 ft. above low water and capped by 12 x 12-in. timbers. Across these, transverse 12-in. I-beam stringers distributed the load equally to the piles.

At the top of the tower, hoisting sheave blocks and special slings for supporting the California half span were carried upon I-beams as indicated in the drawing of the tower. Two 4-in. pins were provided for each load block. The same channels which supported these blocks were used to carry two sets of slings at the corners on the California side to support the half span after raising, and allow the same pair of sheave blocks to be used in raising the Arizona half. These slings each consisted of four 2½-in. round bolts 24 ft. long, threaded 6 ft. at each end.

RAISING THE ARCH TRUSSES

Two 30-hp. engines located on the Arizona shore were used to raise the half spans after they had been riveted up complete except for the lateral bracing, with end pins in position. Using a ⅝-in. cable and a 9-sheave upper block with an 8-sheave lower block, the California half span was raised first, the actual working time being about 15 minutes, and the total time 40 minutes. These trusses were raised about 3 ft. higher than their final position in order to allow the Arizona trusses to pass. This gave about 6-in. clearance. The sheaves were transferred to the other corners of the tower, and the Arizona trusses raised in a total time of about 30 minutes,

PREPARING TO RAISE HALF-ARCH SPAN AT THE CENTER TOWER

and in the same actual working time as the California trusses.

About 6 hours were then required to lower the two sides together until the crown hinge came to a bearing. The auxiliary half hinges were then riveted up. So accurate was the shopwork that the final position of this crown joint when connected up was within ½ in. vertically and ⅜ in. laterally of the true position, allowance being made for temperature variations.

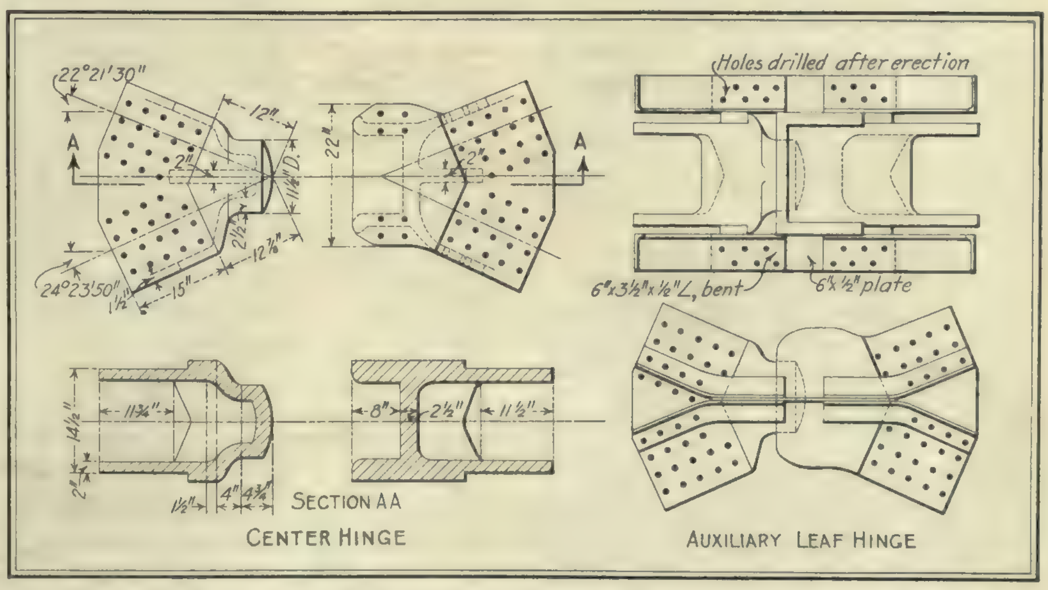
The center hinge of the ball-and-socket type is of cast steel, with a spherical compression bearing. As shown in an accompanying drawing, the milled head of convex bearing surface fits the concave spherical surface of a nickel-steel compression piece carried by the cast-steel hood attached to the other truss. For adjustment, steel shims of varying thickness could be inserted in the pan of the hood back of the nickel-steel compression piece.

For the purpose of tying the trusses together at the hinge and resisting any possible tensile stress which might be developed at the leeward hinge under excessive wind pressure, auxiliary leaf hinges as illustrated were provided, using 6-in. plates and bent angles to form a hinge flexible under rise and fall of the arch.

The method and details of erection were designed by A. M. Meyers, contracting engineer of the Kansas City Structural Steel Company, Kansas City, Mo., which fabricated the steelwork and erected the bridge. The design of the structure was made by J. A. Sourwine of San Bernardino, Cal., and J. P. Kemmerer acted as the latter's representative to inspect the work and superintend the construction. The total weight of the two arches is 360 tons, and the total cost of the bridge, including foundations, was nearly $80,000, paid jointly by the U. S. Commission of Indian Affairs and the states of California and Arizona. The bridge was completed and accepted on Feb. 20, 1916.

Pennsylvania Stream-Gaging Stations

Twelve new stream-gaging stations were established in Pennsylvania in 1915, making 110 stations from which the State Water Supply Commission receives reports.



DETAILS OF THE CAST-STEEL CENTER HINGE AND SPECIAL AUXILIARY LEAF HINGE

Sanitary Code for Waterways Formulated by Committee

Recommendations Regarding Stream Pollution Submitted to American Public Health Association

A CONCISE statement of the principles underlying the proper solution of waterway-pollution problems and a code of regulations for the sanitary control of waterways were the main features of the committee report submitted Oct. 26 to the sanitary engineering section of the American Public Health Association at its convention in Cincinnati. The committee which presented its findings consisted of Harrison P. Eddy, chairman; E. A. Fisher, Paul Hansen, Theodore Horton and W. H. Dittoe. The code of regulations proposed is as follows:

Objectionable Deposits

1. There shall be no objectionable deposits at any point in a waterway as a result of sewage or other wastes discharged therein.

To prevent such deposits public authorities should recognize the efficacy of such preventive and corrective measures as the dredging and removing of the deposits before they become objectionable, the proper location of sewer outlets and the removal of solids by screening, sedimentation, chemical precipitation and like methods.

2. There shall be no local nuisance created at or in the vicinity of any sewage or industrial wastes outfall, arising from excessive turbidity or the production of odors.

To prevent such conditions public authorities should recognize the efficacy of such preventive and corrective measures as the arrangement and proper protection of sewage outlets and all methods of sewage treatment in properly designed plants, including screening, sedimentation, chemical precipitation, oxidation in various types of coarse and fine-grained filters and treatment by the activated-sludge process.

3. There shall be no general nuisance created in a waterway due to excessive turbidity or to odors, as a result of sewage or other wastes discharged therein.

To prevent such conditions public authorities should recognize the efficacy of such methods of sewage treatment as are enumerated in Article 2, but it will be necessary to carry the treatment far enough to meet the following requirements:

(a) That dissolved oxygen shall be present in the waters of the waterway at all points and at all times in such quantities as to prevent the emanation of putrefactive odors.

(b) That every municipality or industrial establishment discharging sewage or wastes into a waterway may have its proper share of the dissolved oxygen, subject to the aforesaid limitation of Paragraph 1.

(c) That the share of dissolved oxygen of a waterway, which a municipality or industrial establishment may utilize at any time, should be subject only to the aforesaid limitation (stated in Paragraph 1), so long as other parties are not utilizing it nor thereby being deprived of its use.

(d) That as the size and number of municipalities or industrial establishments discharging sewage or wastes into the waterway increase, and the available share of dissolved oxygen for each decreases, treatment methods must be increased generally and correspondingly, in order that each party may continue to have the share of the available oxygen to which it is entitled.

Protection of Water Filters

4. There shall be no interference with or undue burden upon mechanical operation or bacterial efficiency of water-purification plants procuring their raw water from a waterway.

The public authorities should recognize in this case:

(a) The efficacy of relocating water-supply intakes and sewer outlets as a means of remedy.

(b) The efficacy of such methods of sewage treatment as will reduce the quantity or alter the character of either that suspended matter or that dissolved matter, or both, which may interfere directly or indirectly with the mechanical efficacy and operation of water-purification plants.

(c) The efficacy of such methods of treatment as will reduce the number of bacteria which may cause a bacterial burden upon water-purification plants.

(d) That since water or sewage purification processes can be carried to any desired limit, at least theoretically, the share of responsibility which is to be imposed upon the different sewage-disposal and water-purification plants, with respect to extent of purification, will obviously depend upon a number of legal and administrative considerations of an economic, engineering and public-health nature which properly come within the jurisdiction of central authorities and the courts.

5. There shall be no active (potentially dangerous) bacterial contamination or gross pollution of properly located and authorized shellfish beds.

Public authorities should recognize in this matter five important features:

(a) The proper supervision, by competent authority, of the location of shellfish beds and drinking places, and suitable control of shellfish operation.

(b) That the gross pollution of shellfish beds by deposits of suspended matter from sewage or industrial wastes can be prevented, and that bacterial contamination of the beds may be avoided, by relocation of sewer outlets.

(c) That the gross pollution of shellfish beds by deposits of suspended matter from sewage or industrial wastes can be prevented also by the installation of proper sewage-treatment processes which will remove these solids to the extent necessary.

(d) That where shellfish beds are so located as not to be subject to gross pollution and where bacterial protection only will be necessary, this protection can be accomplished satisfactorily by the employment of such methods of treatment as will destroy or remove the bacteria.

(e) That since active bacterial contamination and gross pollution of shellfish beds can be prevented by proper location of such beds and by proper location of sewer outfalls and proper treatment of sewage and other wastes, the enforcement of the abandonment or relocation of shellfish beds or of preventive or remedial measures to protect such beds will obviously depend upon a number of legal and administrative considerations of an economic, engineering and public-health nature which properly come within the jurisdiction of central authorities and the courts.

6. There shall be no active (potentially dangerous) bacterial contamination or gross pollution of properly located and authorized bathing beaches and other bathing places.

The public authorities should recognize in this matter:

(a) That notwithstanding the legal rights of riparian owners, in view of our knowledge of the dangers to health arising from bathing in waters contaminated by the bathers themselves as well as from sewage and wastes discharged into them, control is needed both in the selection and authorization of bathing places and of the discharge of sewage and wastes into the waters in which bathing is authorized.

(b) That the gross pollution of bathing beaches by suspended matter from sewage or industrial wastes can be prevented, and bacterial contamination may be avoided, by relocation of sewer outlets.

(c) That where protection of properly authorized bathing places, from bacterial contamination only, is required, such protection can be secured by such sewage-treatment processes as will destroy or remove the bacteria.

(d) That where properly authorized bathing places require protection against gross pollution arising from suspended or other objectionable sewage matters, this additional protection can be secured by the installation of such additional sewage-treatment processes as will sufficiently remove the objectionable matters.

(e) That since active bacterial contamination and gross pollution of bathing places can be prevented by proper location of such places and by proper location of sewer outfalls and proper treatment of sewage and other wastes, the enforcement of the abandonment or relocation of bathing beaches or of preventive or remedial measures to protect such beaches will obviously depend upon a number of legal and administrative considerations of an economic, engineering and public health nature which properly come within the jurisdiction of central authorities and the courts.

Conclusion

Considerable misunderstanding and confusion exist as to what constitutes a nuisance or a menace to public health. These are questions of effect and intensity of pollution. They involve not alone principles of biology, chemistry and engineering, but also of law and psychology, the determination of which must be left to judicial and administrative bodies such as courts and state departments of health. It also appears to be a fact that whereas much may be accomplished in an endeavor to establish general limitations as to dilution, presence of organic matter, dissolved oxygen and other factors within which a nuisance or menace to public health may or may not be created, present knowledge of these relations is of such indeterminate and variable a character as to preclude definite formulation, and even were formulation possible, it could not usurp the offices of the courts and other judicial and administrative bodies in determining the facts and imposing remedies based upon such facts. It appears therefore that the code of regulations herein provided goes as far as present knowledge of the subject warrants.

Urges Skilled Operation of Sewage Works

State Supervision Indorsed in Report Presented by W. L. Stevenson to American Public Health Association

SKILLED supervision of operation, approval of plans by state boards of health, and selection of analytical tests which will give useful, rather than merely academic, information are among the most pressing needs in the field of sewage disposal, according to the report of the committee on sewage works operation, presented at the recent convention in Cincinnati of the American Public Health Association. These conclusions were reached by a committee headed by W. L. Stevenson of Philadelphia, and including F. E. Daniels, C. A. Emerson, Jr., C. B. Hoover and Richard Messer.

Stability Test at Small Plants

It is recognized that in a great number of small works, the purpose of which is primarily to prevent the creation of nuisance, only the simplest tests are practicable under present conditions, and it is recommended that in such cases samples of the final effluent be incubated at room temperature with methylene blue and that a record be kept of the number of days the samples retain their blue color. The required degree of stability depends largely upon the conditions in the receiving body of water. Where stability is demanded, on account of the dilution afforded being small, the samples of the effluent should retain their blue color at least ten or twelve days at room temperature or five or six days if incubated at 37 deg. C.

In selecting analytical tests for sewage works attention is again called to the importance of the fact that changes in methods of operation and records for comparison are the primary purposes of this work, and the acquirement of mere academic information, while interesting, is energy wasted which could better be expended in other directions.

Considering the number of municipal sewage-treatment works in America, it is surprising to learn how few are subject to laboratory control; but the newer plants are being so equipped and show the growing appreciation of the economy of proper operation.

Flow Should Be Measured

Another very noticeable defect in the design of a large percentage of works is the complete absence of any method of determining the amount of sewage treated. This

is of prime importance to successful operation, for otherwise retention in tanks and rates on filters are indeterminate and it is difficult, if not impossible, to know whether unsatisfactory results are due to overloading of the parts of the works or to improper methods of operation. Where fall is available a weir, preferably with an automatic recording device, is a simple and inexpensive method to use. Where the sewage has to be pumped, the Venturi meter has proved successful.

THREE GROUPS OF STATES

The committee has divided the state boards of health in the United States into three groups as follows:

1. Those states whose boards of health either have no engineer upon their staff or have no specific legislation giving them control over the disposal of sewage, or have so few sewage treatment works under their jurisdiction that the subject is negligible. These twenty-three states in 1910 had a population of more than 24,250,000 or 26 per cent of the total population of the United States, and are: Alabama, Arizona, Arkansas, Colorado, Delaware, Georgia, Idaho, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, South Carolina, Tennessee, Utah, Washington, West Virginia, and Wyoming.

2. Those states whose boards of health have an engineer or other officer charged with supervision over disposal of sewage, but whose legal powers are limited and the number of sewage-treatment works are small. The officers of this group of states have all signified their willingness to cooperate with the committee and have furnished valuable data. These ten states in 1910 had a population of 12,753,000, or 14 per cent of the total population of the United States, and are: Connecticut, Florida, Indiana, Kentucky, Louisiana, Maine, New Hampshire, North Carolina, Rhode Island, and Vermont.

3. The remaining states have boards of health with engineering divisions, and either have legal authority or otherwise exercise control over the disposal of sewage and operation of sewage-treatment works. The 1910 population in those states was about 54,000,000, or 60 per cent of the total population of the United States. In these states, generally, sewerage plants must be approved before construction and supervision, inspection and analyses are made, and in some reports of operation are made to the state board of health.

APPROVAL OF PLANS

The approval of plans for sewerage projects by the commonwealth is of great advantage to the community, institution or individual about to expend funds for the construction of sewers or sewage-treatment works, for it assures the carrying out of the work along comprehensive lines, which ultimately is economy; it prevents the construction of improperly designed works and tends to uniformity of practice throughout the state.

The supervision over operation and inspection of sewage-treatment works by the state in cases where works are efficiently operated becomes an indorsement more than anything else. In the case of the smaller works, which are frequently placed in charge of untrained and technically deficient operators, state supervision not only protects the commonwealth but makes possible the performance of the functions of the works for which they were designed and the funds invested.

The examination of the plans submitted should also include the fitness of the design and types of treatment to produce the quality of effluent demanded by the conditions of the receiving body of water. For example, it is unjust and a waste of public funds to approve, without comment, a complete treatment works for sewage to be discharged into a receiving body of water where neither the public health nor æsthetic conditions require at the present time more than preliminary treatment.

The committee has carefully considered the preparation of a standard form of report and has come to the conclusion that it is impracticable to do so.

Filter Patent Claims Invalid, Court Declares

Minneapolis Wins Suit Against Ira H. Jewell Involving Equipment of Mechanical Filter Plant

DECLARING invalid Ira H. Jewell's patent claims for the central control of operating valves and the use of a screen between the gravel and sand layers of mechanical filters for water purification, Judge William C. Hook, of the United States Circuit Court of Appeals, Eighth District, recently rendered a decision reversing the decision of the lower court and dismissing the bill of complaint against the city of Minneapolis. This action brings to a close litigation begun about four years ago and involving the equipment of the city's large filtration plant, which has been described in detail in the Engineering Record of Nov. 18, 1911, page 586, and June 21, 1913, page 680. The U. S. District Court decision upholding the claims which have just been declared invalid was noted in the Engineering Record of Aug. 7, 1915, page 181. The case which Minneapolis has just won was handled by City Attorney Charles D. Gould, who has furnished this journal with a copy of Judge Hook's decision, which is given below in full:

JUDGE HOOK'S DECISION

This case was appealed by the city of Minneapolis from the decree for an injunction and accounting for infringement of claim 1 of patent 649,410, and claim 14 of patent 649,411, both issued to the plaintiff, Ira H. Jewell, and dated May 8, 1900. The first of these patents relates to systems for controlling the operation of filters. Claim 1, held to be infringed, is as follows:

> 1. A filter provided with a system of controlling valves which are provided with actuating devices located so as to be accessible for control from a single position of an operator.

This claim is not for any particular, novel method of accomplishing the result indicated, but embraces broadly the idea of control of the valves of a filter from a central station or position. It is quite immaterial whether it was intended to apply it to a single filter unit or a series of units, or by actuating means, or by hand, hydraulic, pneumatic, or electric power. The claim is for an all-embracing central control.

CENTRAL-CONTROL PRINCIPLE COMMON

This is too common, familiar practice in other branches of industry to admit of the validity of a claim so broadly made. We refer to the patent to Cowles, No. 564,474, dated July 21, 1896, relating to improvements for hydraulic system for closing water-tight bulkheads on board ships, for opening and closing doors, hatches, ports, valves, cocks, gates, etc.

One of Cowles' specified objects was a combination of apparatus "whereby two or more independent, mechanical devices, which may be widely separated and of varying types, may be independently and systematically operated, controlled, continuously registered, and locked, all from the same point, central station or operating-board, and by one operator."

Cowles' idea of operating from a central position with mechanical devices is pointed out very clearly, and it is not important that he intended it principally, if not exclusively, as he says, to be applied to a hydraulic system on shipboard.

SCREEN NOT PATENTABLE

Claim 14 of the second patent reads as follows:

> 14. A filter comprising a tank having a tapered lower end, and an opening at the bottom of the same, a screen at the lower end of the tank in line with said opening, a granular filter bed within said tank, the part of said bed contained within the tapered portion of the tank being made of relatively large granules whereby water passing upwardly therethrough in washing the filter is laterally deflected so as to be distributed throughout all parts of the bed and a screen interposed between said larger granules and the part of the bed above the same.

It was old in the filtering art to employ a filter medium inclosing in a bed of fine material like sand overlying one of coarser material like gravel.

It was desirable for efficient cleansing that the water in reverse movement be deflected and distributed so that it would reach every part of the filter bed, but particularly the overlying sand and leave no unwashed portions. We think it is too clear for much discussion that all of the elements of claim 14 are found in the prior patents to Hyatt, No. 322,103, 409,970 and No. 619,755, and the patent to Peterson, No. 222,731. These pertaining to the object above indicated and which it is contended the defendant is using in its municipal filter plant are shown in the last patent to Hyatt, No. 619,755, Feb. 21, 1899, excepting the screen interposed between the sand and gravel.

The plaintiff says that the screen is important as an aid in distributing the reverse flow of water to the superimposed bed of sand. This idea is an after-thought, born of litigation. The function of the screen is described in the specifications of the patents in suit as being "to prevent the pebbles from rising upward out of place when the filter is being washed by reversing the water therethrough"; and it is added, "In case the reverse current be under low pressure, said screen may be omitted."

NO NEW FUNCTION OF SCREEN

No such function for the screen as is now asserted was mentioned in the specification or stated in the claim, though it should be said that if the screen were novel and the function were actually performed, the omission would not deprive the plaintiff of the benefit. But it was old to have a screen between the coarse and fine layers of the filter bed. See patents to Peterson, No. 222,731; Hyatt, No. 322,103; Weiderman, No. 437,403, and Hefel, No. 603,483. If the screen performed the function mentioned by the plaintiff it would perform it in the older

structures, though perhaps not in the Hyatt case as effectively, because the screen did not rest in contact with the gravel or larger particles of the filter bed. It is also said in high velocity washing the screen was to prevent disturbing the relative position of the sand and gravel. This was doubtless the principal reason for its use in the older structures and also in the plaintiff's, but in practice the gravel showed a tendency to be forced up and out of place. We do not think the insertion of a screen to prevent its doing so rises to the dignity of invention. It would naturally occur to a person ordinarily familiar with such work.

Let the decree be reversed and the cause remanded with directions to dismiss the bill.

Arizona Experiments with Oiling of Roads

Phoenix-Tempe Highway in That State Has Been Found to Take Oil Better When Surface Is Wet

MOST road surfaces are oiled best when dry, but the Phoenix-Tempe caliche road in Arizona takes oil better when the surface is wet, according to the latest report of Lamarr Cobb, state highway engineer, from which the following notes are taken. The physical condition of this road, the various substances used in its construction, caliche conglomerate and disintegrated granite and caliche, and the heavy traffic (1500 vehicles per day) made the proper selection of oil and its application difficult.

For the first application to 3.1 miles 75 per cent Union oil was applied at 250 deg. Fahr. by a Cannon distributor at the rate of 0.44 gal. per square yard. The screenings consisted of wash gravel ranging from ½ in. to dust, composed of fragments of granite, quartzite and rhyolite. The graveling at $1.70 per cubic yard, spread ½ in. thick, cost 2.37 cents per square yard. The oil at 4.39 cents per gallon cost 1.932 cents per square yard. Labor of preparing, oiling, screening and rolling cost 2.191 cents per square yard. Other costs were: Teams and wagon hire, 0.294 cent; heating oil, 0.258 cent; repairs and fuel for truck, 0.965 cent; superintendence, 0.375 cent; equipment, repairs and rentals, 0.375 cent; total, 8.76 cents. The shoulders were oiled for a total width of 14 ft. with crude oil, at the rate of 0.36 gal. per square yard, at a cost of 1.605 cents.

After letting the road wear a few months a second application of 90 per cent Roadamite was decided upon. First, the fat places were shaved off with a Russell grader pulled by a 5-ton Sauer truck. Then it was swept with a horse sweeper and finally cleaned with water and a squeegee.

The oil was applied at the rate of ¼ gal. at 325 deg. Fahr. and followed with washed gravel screenings and a steam roller. For 1700 ft. the treatment was varied somewhat. After the first application of oil and gravel to a depth of ¼ in., a horse sweeper with the broom locked was dragged over the road, touching it very lightly. A second application followed of equal amounts, after which a steam roller went over it. This section of double-oiled road gave an almost perfect wearing surface. The other, says the report, while not so perfect, is standing remarkably well. The second treatment cost 6.75 cents per square yard.

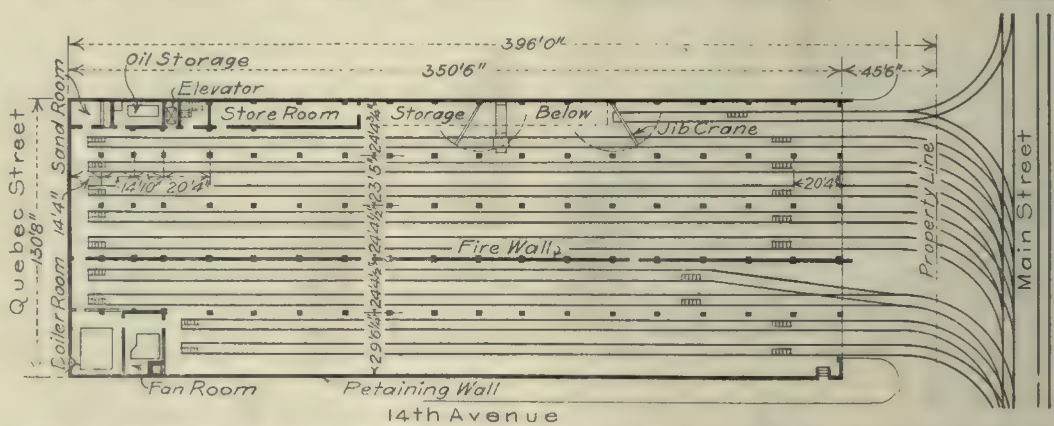
Two-Story Concrete Car Barn in Vancouver Designed with Steel Columns

Advantage Is Taken of Sloping Ground to Provide Double-Deck Storage Space for Cars — Entrances at Opposite Ends

ALTHOUGH the final completion of the structure as designed has been postponed on account of war conditions, the two-story reinforced-concrete car barn for the British Columbia Electric Railway Company, Ltd., Vancouver, B. C., will be unusual in the fact that car storage is provided on two levels to which access is obtained by entrances at opposite ends of the building. The elevations of the street tracks differ by about 20 ft. in the total distance of nearly 400 ft. between streets, and a counterfort retaining wall is used to provide the necessary resistance to earth pressure on one side and one end of the structure.

To save space and reduce the column spacing to a minimum, relatively slender built-up steel columns of the box type were used up to the second-floor beams of reinforced concrete, using concrete fireproofing cast with the latter. Track pits under all cars on the first floor were provided by supporting the rails and concrete slab platforms on reinforced-concrete piers. The new barn is located just south of a one-story timber-frame barn which was in operation, and it was required that the construction should proceed without encroachment on the existing yard on the south more than was absolutely necessary. This was accomplished by constructing the new concrete structure in two parts, the southern portion, including the fire wall which divides the building, being completed first.

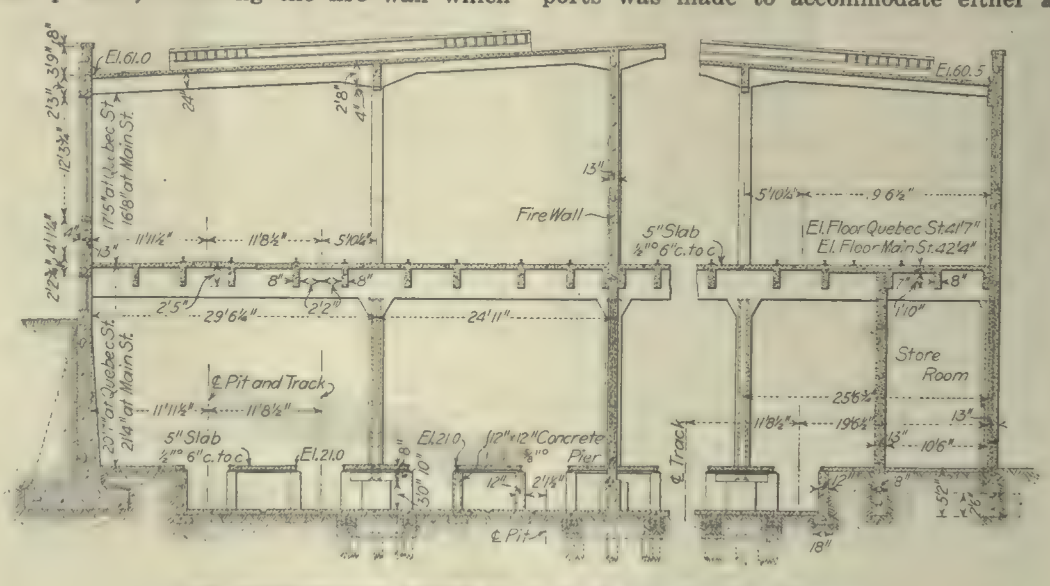
It is seen from the plan view and part section here shown that the new concrete building will be 350 ft. long, 130 ft. wide and about 40 ft. high on Main Street and 20 ft. high on Quebec Street. The difference in level of these streets at the ends of the building suggested the idea of doubling the storage space by making the barn of two-story construction, running the cars to be stored on the upper level half way around the block through Thirteenth Avenue on the north. This required a special design to support the heavy car loading on the second floor. Reinforced-concrete beams and slab were used, as indicated on the cross-sections herewith, with the beams placed under the rails in all cases except at the north side, where a turnout beyond the lunchroom, elevator and foreman's room in the northwest corner is necessary to locate the north, or tenth, track.



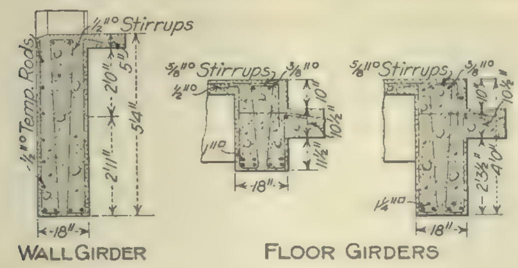
FIRST-FLOOR PLAN—MAIN STREET CARS ENTER ON FIRST FLOOR, QUEBEC STREET CARS ENTER ON SECOND FLOOR

By spacing the tracks 11 ft. 8½ in. on centers and using steel-core columns for the first floor, it is seen that the property width just accommodates ten tracks, placed in five aisles of two tracks each. In the northwest corner the sand room, oil-storage room and elevators are located, with a storeroom and general storage space below on the north side of the building, with jib cranes located as shown.

The design of the first-floor track supports was made to accommodate either a



PART CROSS-SECTION SHOWS BEAM, SLAB AND COLUMN DETAILS



SECTIONS OF SECOND-FLOOR GIRDERS

55-ft. interurban car weighing 82,000 lb. on four axles spaced 6.5, 25.5 and 6.5 ft. apart or a 43-ft. line car weighing 73,000 lb. on four axles spaced 6, 23 and 6 ft. apart. The second-floor design will accommodate the double-end city car over 42 ft. long weighing 47,500 lb. on four axles spaced 4.5, 13.6 and 4.5 ft. apart. On the spaces between cars the regular specified live load of 75 lb. per square foot was provided for. The working unit stresses in steel and concrete complied with the building law. The concrete-protected steel columns were designed without considering the concrete to carry any of the load.

The first-floor tracks and slabs are carried on 12 x 12-in. piers spaced about 7 ft. apart, and 4½ ft. high in order to give free access to the running gear of any car at any time. The steel rails, 7¼ in. deep, supported laterally by the concrete slab, act as beams between the piers. The main piers supporting the interior columns are of concrete about 8 ft. square, reinforced by ¾ in. rods, and capping the ten timber piles used to increase the bearing power of the foundation soil.

Steel Columns Used

The second floor is supported by box columns of steel composed of two 9-in. or 10-in. channels with two 12-in. plates, protected on the outside by 4 in. of concrete and filled with concrete to prevent corrosion on the inside. This concrete, a 1:2:4 gravel mix, was poured with the beams and slab of the second floor, with brackets as indicated in the photograph. The south part of the building was constructed first, up to the 13-in. fire wall, allowing the use of the storage yard on the south of the old barn until the first part of the new building could be used.

The retaining walls, of the reinforced-concrete counterfort type, with counterforts spaced about 8 ft. apart, were constructed on the south and west, the height of the west wall decreasing with the grade of Fourteenth Avenue and surmounted by a wall containing windows as soon as the grade permitted sufficient clearance. The building is sprinkled by the dry-pipe system. When completed, a 35,000-gal. water tank will be placed on the roof, supported on a steel tower over a bay near the center of the building. The construction and design were carried out by Westinghouse Church Kerr & Company of Montreal and New York, with H. H. Forsyth acting as engineer in charge and J. F. Single as superintendent at Vancouver. The steel columns were fabricated by the Canadian Northwest Steel Company of Vancouver, B. C.

VIEW OF TWO-TRACK AISLE—PIERS SUPPORT RAILS AND PLATFORMS BETWEEN TRACKS

Reviews Refuse-Collection and Disposal Methods

More Investigations Made—Collection End Getting Attention — Michigan to Test Plants During Operation

A RESUME of developments in refuse collection and disposal for the last year given by S. A. Greeley, chairman of a committee on the subject, to the American Public Health Association, Oct. 27, indicates that there is a growing interest in the Cobwell system of reduction, and that supervision over maintenance by state boards of health has already started.

Plants of the Cobwell type have been built at Los Angeles, Cal., the Panama-Pacific Exposition, and New Bedford, Mass. A plant located on Staten Island is proposed for New York City. The feature of the process is that the cooking, de-watering, de-greasing and drying of the garbage are carried out in one receptacle without exposure to the air. After the garbage is placed in the receptacle nothing is exposed to the air until the tankage is taken out ready for shipment. The chance for odors, it is claimed, is thus largely reduced.

Many small incinerating plants have been built. There has been a uniform advance in the disposition of city officials to give more attention to the investigation and the preparation of plans and specifications in advance of construction.

During the year investigations and reports have been made at Kansas City, Washington, Danville, Ill., and Galesburg, Ill. A particularly important feature in these reports is the special attention that has been given to the collection part of the problem, both as regards the cost and location of disposal works and the efficiency of the service as a whole.

One of the interesting court cases at San Francisco on the question of fulfillment of guarantees for a refuse incinerator is to come to trial. This case is similar to that which was on trial a year ago at Atlanta. At Worcester, Mass., hearings producing valuable information have been held on the operation of the city pig farm for garbage disposal. At Philadelphia the question of whether odors resulted from the sewage pollution in the Schuylkill River or rendering plants formed a large part of the controversy.

At New York, at present, there is much interest over the location of a large garbage-reduction plant on Staten Island. The officials of the city of New York favor the undertaking, whereas the residents of Staten Island have combined in an attempt to prevent the location of the plant at this point. No settlement has been reached.

The Michigan State Board of Health has undertaken to make tests of all newly installed garbage plants, and, where practical, is having recording pyrometers installed at incinerators. At Milwaukee and Savannah a considerable amount of steam has been generated at mixed-refuse incinerators and made useful for other purposes in the municipality. At Savannah steam is used at the waterworks pumping station. At Milwaukee the steam is used for generating electricity, which has been sent several miles to pumps which discharge lake water into the Milwaukee River for flushing purposes.

Old Sandstone Blocks Serve as New Pavement Foundation

Topeka Railway Company Intends to Utilize Them in Repaving Ten Miles of Track—Cost Less Than Solid Concrete

OLD Colorado sandstone blocks that have given thirty years of service—they were laid in 1886—are being utilized in place of concrete for the base of the new brick pavement being laid by the Topeka (Kan.) Railway Company. After shifting the track, a 2 x 9 ft. trench is dug and a 1-in. layer of cinders put down, which is followed by a

LABORERS MIX GROUT BY HAND AND BRUSH IT INTO CREVICES

course of the sandstone blocks, which are 6 x 6 x 8 in. Grout, mixed by hand, is then brushed into the crevices between the blocks. The 85-lb. railway track is then moved back upon this foundation and the spaces between the ties are filled with Joplin chats. This is followed by a 3-in. course, which joins on either side a similar pavement foundation put in by the city. On top of this base a regular sand cushion and 4-in. brick block paving are laid across the street.

The Topeka Railway Company has a stretch of 10 miles of track with a surface paving of sandstone block which it intends to repave in the manner described. The pavement is claimed to be less expensive than solid concrete work and, in the opinion of the company, will support the street railway adequately.

Asphalt Covering for Trestles

The Southern Pacific Railroad uses untreated timber for decking over trestles which are to be ballasted. By omitting the treatment the maximum strength in the timbers is available and they are protected from moisture and sun by an asphalt covering.

New Tables to Aid Design of Concrete Form Supports

Construction Practice Recommended After Illinois Factory Bureau Finds Collapse of Poor Forms Serious Accident Factor

AFTER an investigation of the collapse of numerous concrete buildings, the Illinois Department of Factory Investigation concludes that the danger of these occurrences would be greatly reduced if more attention were paid to form design. With that point in mind, the bureau presents in its report an article by Ernest McCullough, chief engineer of the Fireproof Construction Bureau, Portland Cement Association, outlining practice in the design of floor form supports which is recommended as standard for such construction.

When it is considered that the cost of the forms amounts to about one-third of the entire cost of the work, it seems strange, continues the report, that many contractors should leave this work to foremen. Its proportionate value suggests that it should be intrusted only to a designing engineer or architect. One example is cited where, due to weather conditions, the concrete set very slowly. When the second story was added, the first floor collapsed. Evidently the fact that the supports had to carry the load of both floors until the first floor concrete had attained its strength was neglected in designing the centering. It is concluded, however, that foremen and contractors without technical training must not receive all the blame, as there has been no guide for them to follow. Though numerous books on concrete design and construction exist, there have been no comparable works published on the design and construction of forms.

Condemn Posts Made of Pieces Nailed with Flat Sides Together

All centering posts, it is stated, should either be one solid piece, as 4 x 4 in., or should be T-shaped. The strength of such a post properly made is given as two-thirds that of a solid piece of the same overall dimensions. The practice of using two 2 x 4-in. pieces spiked together should not be allowed, as the pieces cannot be loaded equally. Also, the use of short posts with several blocks underneath should be abandoned, as the blocks may be accidentally knocked out. Moreover, if they are not properly placed under the posts the latter may slip off these built-up blocks. However, the posts should not rest directly on the concrete floors, as this would concentrate too great a load on a small area. For spacing of 4 x 4 ft. a 2 x 12-in. plank is recommended; for 4 x 6-ft. spacing, 3 x 12-in. plank and for 6 x 6-ft. spacing, 4 x 12-in. plank.

Care should be taken to have the posts vertical. They should be tied together in four directions at such intervals that their greatest unsupported length will not be more than 30 times the least thickness. Posts should be spaced at intervals not exceeding 6 ft. The girders should be centered over the posts and should be braced at 4-ft. intervals. The use of blocks under the girders should be avoided. If wedges are employed, they should be in pairs and should be as thin as possible. The accompanying tables, 1 to 6 inclusive, give the minimum sizes and maximum spacing of joists, girders and posts, as determined for the load conditions outlined in the first table.

Good Practice in Concreting

In building construction Mr. McCullough recommends that forms be provided for not less than three floors when the temperature is above 50 deg. Fahr. In the case of work done in cooler weather, the amount of centering should be increased accordingly. After the slab, girder, beam and column forms have been removed, one-half of the centers should be put back, to remain in place for at least a week or until the concrete has dried out and hardened. The length of time recommended under varying conditions as necessary before the forms can be removed is given in Table 7.

How to Tell Frozen Concrete

The method of constructing a dam inclosing several square feet of floor and filling it with several inches of hot water is stated to be the most reliable for determining whether concrete is frozen. The water should have a temperature of not less than 150 deg. Fahr., but should not be boiling. If the concrete is frozen, it will soften in a few minutes.

Mr. McCullough further advises that if the temperature during the working day falls below 50 deg. Fahr., the building should be inclosed. If it falls as low as 40 deg. Fahr., salamanders should be installed, and if it falls below 40 deg. Fahr., the concrete ingredients should be heated and care should be taken to eliminate frozen lumps of material.

TABLE 1—SLAB NUMBERS

Slab number	Slab thickness in inches of solid slab	Combination tile and concrete	Slab number	Slab thickness in inches of solid slab	Combination tile and concrete
1	3	..	10	7	13
2	4	6	11	..	14
3	..	7	12	8	..
4	..	8	13	..	15
5	5	..	14	9	..
6	..	9	15	10	..
7	..	10	16	11	..
8	6	11	17	12	..
9	..	12			

TABLE 2—POSTS FOR CENTERING

3 x 4-in. solid, to be spaced 4 x 6 ft. or less, under slabs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, braced in four directions every 7 ft.
To be spaced 4 x 4 ft. or less under slabs 11, 12, 13, 14, 15, 16, 17, and 4 ft. apart under girders or beams.

4 x 4 in. solid, or T post of two 2 x 4 in. properly spiked.
To be spaced 6 x 6 ft. or less under slabs 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, braced in four directions every 8 ft.
To be spaced 4 x 6 ft. or less under slabs 11, 12, 13, 14, 15, 16, 17, or 5 ft. apart under girders or beams.

6 x 6 in. solid, or T post of 2 x 4 in. and 2 x 6 in., properly spiked, braced in four directions every 8 ft.
To be spaced 6 x 6 ft. or less under slabs 12, 13, 14, 15, 16, 17, or 6 ft. apart under girders or beams.

TABLE 3—SIZE AND SPACING OF JOISTS ON 4-FOOT SPANS

Slab number	Size, inches	Spacing, inches
1	2 x 4 2 x 4	16 24
2 to 15 inclusive	2 x 6	24
16	2 x 6	21
17	2 x 6	21

TABLE 4—SIZE AND SPACING OF JOISTS ON 6-FOOT SPANS

Slab number	Size, inches	Spacing, inches
1, 2	2 x 6 2 x 8	16 24
3	2 x 6 2 x 8	15 24
4, 5, 6	2 x 6 2 x 8	14 24
7, 8	2 x 6 2 x 8	12 24
9, 10, 11, 12, 13	2 x 6 2 x 8	12 21
14, 15, 16, 17	2 x 8 2 x 8	21 18

TABLE 5—MINIMUM SIZES OF GIRDERS ACROSS POSTS ON 4-FOOT SPAN, SPAN OF JOISTS 4 FEET OR 6 FEET

Slab number	Size, inches
1, 2	2 x 10, 3 x 8 or 4 x 6
3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	2 x 10 or 3 x 8
14	2 x 10, 4 x 8 or 6 x 6
15	3 x 10, 4 x 8 or 6 x 6
16	3 x 10 or 4 x 8
17	2 x 12, 3 x 10 or 4 x 8

TABLE 6—MINIMUM SIZES OF GIRDERS ACROSS POSTS ON 6-FOOT SPAN, SPAN OF JOISTS 4 FEET OR 6 FEET

Slab number	Size, inches
1	2 x 12 or 3 x 10
2, 3	3 x 12, 4 x 10 or 6 x 8
4, 5, 6, 7, 8, 9	2 x 14, 3 x 12, 4 x 10 or 6 x 8
10	2 x 14, 3 x 12, 5 x 10 or 6 x 9
11	3 x 12, 6 x 9 or 7 x 8
12, 13	3 x 12, 5 x 10, 6 x 9 or 7 x 8
14	4 x 12, 5 x 10 or 6 x 9
15	3 x 14, 4 x 12, 5 x 10, 6 x 9 or 8 x 8
16	2 x 16, 3 x 14, 4 x 12, 5 x 10, 7 x 9 or 8 x 8
17	2 x 16, 3 x 14, 4 x 12, 6 x 10 or 7 x 9

Photographs from Aeroplanes for Reconnaissance Aids

For use in preliminary studies in working out an elaborate scheme for beautifying the city of Santa Barbara, and as an aid in examining possible locations for a proposed sewer outfall, photographs were recently taken from a hydroplane showing the general appearance of the city from above. The views bring out clearly the general contour and the relative position of the city with regard to the sea and the mountains. The actual use of such photographs as adjuncts to maps provoked some local comment on the possibilities of this kind of photography as a more generally useful aid in engineering studies. For example, one engineer pointed out that "after every flood season the overflow channels of the Colorado River in the neighborhood of Volcano Lake are radically different from those of the preceding season. It is a very difficult country to survey at any time, but particularly so after a flood, as there are always bottomless lakes of liquid mud that cannot be traversed on foot or by boat. The use of an aeroplane would make it possible to take photographs that would give the desired information quickly and accurately." The Los Angeles Weather Bureau has used an aeroplane for about six months in making meteorological reconnaissance, it was stated, and engineers who have interests in Mexico suggest that when political conditions there have quieted down a demand will be felt for aeroplane reconnaissance of country which is rugged, and at the same time thickly overgrown, to a degree that makes it extremely difficult to make topographic studies off the beaten track.

TABLE 7—TIME REQUIRED BEFORE REMOVING FORMS

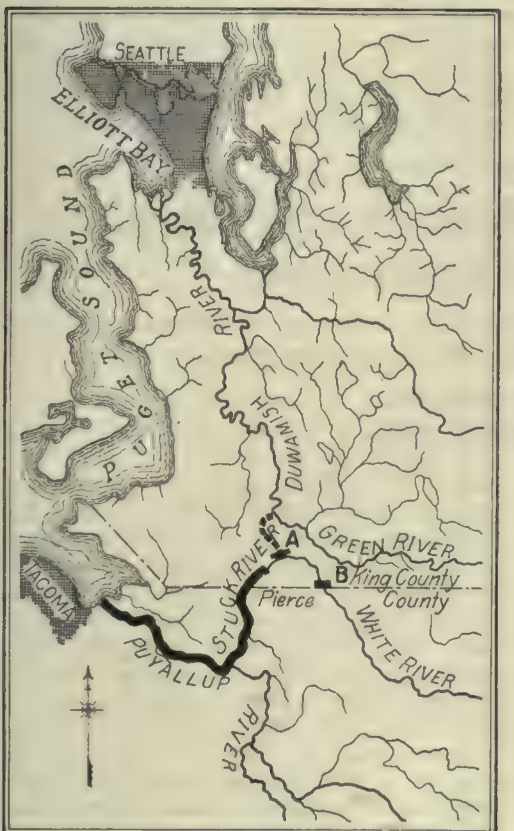
	Above 60 deg. Fahr.	50 to 60 deg. Fahr.	40 to 50 deg. Fahr.	Less Than 40 deg. Fahr.
Columns	Within 3 days..	5 days...	Not less than 10 days	Not until tests have been made indicating that the concrete is set.
Side forms for girders and beams	Within 4 days..	6 days...	Not less than 10 days	
Bottom forms of slabs (6 ft. or less span)	*Within 4 days..	8 days...	Not less than 14 days	
Bottom forms of beams and girders (less than 14 ft. span)	*Within 14 days..	18 days...	Not less than 14 days	

*Add 1 day for each additional foot of span.

Divert Flow of White River, Washington, to Tacoma

King and Pierce Counties Carry Out Work—Diversion Dam, Drift Barrier and Channel Rectification Involved

PRIOR to 1906 the main discharge of the White River emptied into Elliott Bay at Seattle. A small portion of the flow, averaging about 500 sec.-ft., left the main stream on an inland delta 40 miles from the mouth, flowed southward into the Puyallup River and thence into Puget Sound at Tacoma, a distance of 20 miles. This connecting link between the White and Puyallup Rivers was known as the Stuck River. Topographical conditions on the inland delta were such that the shifting of a bar or accumulation of drift would divert the river north or south overnight. This did occur, in fact, in November, 1906, when high-water conditions turned all of the White River through the Stuck valley and thence to Tacoma by the Puyallup River.



MAP OF INTERCOUNTY RIVER IMPROVEMENT

King County desired to make this channel permanent by artificial means, but the situation was complicated by the fact that the King-Pierce County line passed near the point of diversion and only a short bend of the original channel was in the former county. Pierce County authorities attempted to make King County take the river back and allow it to empty into Elliott Bay as before; but King County disclaimed all responsibility in the matter. Finally in 1913 the state legislature passed the Intercounty River Improvement Act, providing for the establishment of funds to carry out the necessary work. A tax levy of one mill in Pierce County and 0.6 mill in King County provided $250,000 per year for six years—a total of $1,500,000—for construction, with a maintenance fund of $50,000 a year for 99 years.

It was decided that the entire flow would be conducted through the Stuck-Puyallup route to an outlet at Tacoma, as shown. A diversion dam was built at the point marked A on the map. The work to be done was accordingly classified under three heads—removal of drift, rectification of channels, and bank protection. The point B marks the location of the drift barrier. The contract for channel rectification, which involved the excavation of 3,000,000 cu. yd. of earth, was let to the Puyallup Dredging Company. That part of the river on which improvements were made is indicated by the heavy line on the map. Under the terms of the contract the county supplied an electrically operated dredge, the details of which are given in another article in this issue.

Electric Power to Dredge a Relocated River Channel

Washington Counties Build Dredge Operated by 800-Horsepower Motor—Contractor Buys Outfit When Work Is Done

By J. H. WALTER

TO CARRY OUT the contract for channel rectification on the Puyallup River on the intercounty river-improvement project in Washington an electrically operated dredge was constructed at a cost of $70,000. Under the terms of the contract the counties supplied the dredge, which the contractor agreed to purchase at the termination of the work at 75 per cent of its original cost. The job of handling 3,000,000 cu. yd. of earth was let to the Puyallup Dredging Company. During the work the municipal plant of Tacoma supplies current at the rate of 0.45 cent per kilowatt-hour.

DREDGING MACHINERY

The hull of the dredge, which was built specially for this river work, is 155 ft. long, 40 ft. wide, and has a depth over all of 9½ ft. It is built with 10 x 12-in. bottom and 10 x 18-in. bulkhead timbers. The design is such that all machinery is located on deck and not inside the hull, thus making recourse to trussing or framing unnecessary. The longitudinal timbers are all long lengths. Three interior cross-bulkheads are secured with 1-in. staybolts. The stanchions are 10 x 10-in. timbers and 10 x 10-in. deck beams. The rigidity was increased by using 4 x 12-in. cross-bracing. The hull is divided into ten watertight compartments, with a separate compartment, as water tank, for the boiler. In building the hull 170,000 ft. b.m. of lumber and 27,000 lb. of iron and steel were used.

The dredging equipment proper consists of a rotary cutter suction head and a 20-in. centrifugal pump with a direct-connected motor. The digging ladder is built up of 24-in. 100-lb. I-beams 52 ft. long. The cutter shaft bearings, which are set on top of the ladder, are of standard pattern with the exception of the one forward and an outboard bearing in the suction head. These have cast-iron glands in place of babbitt, to allow for the excessive wear on account of grit and to permit of quick and economical renewals. In these two bearings the cutter shaft is provided with cast-steel sleeves.

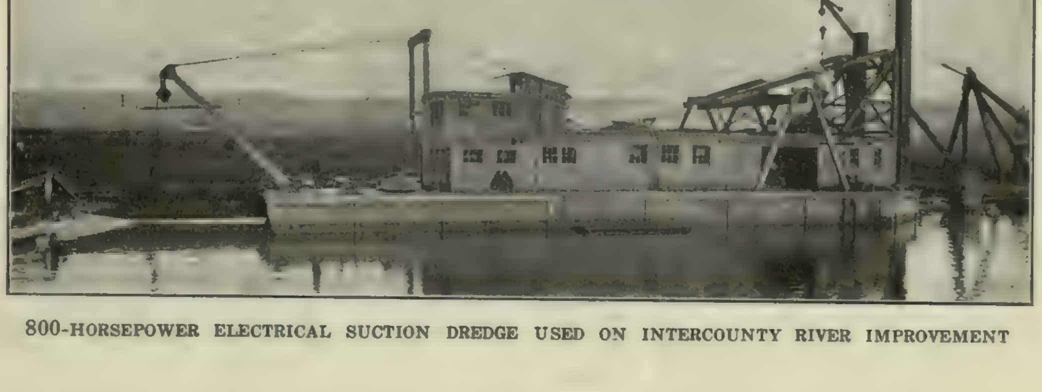
STRAIGHT-BLADE CUTTER

The cutter was originally of the helmet type, but has been replaced with a straight-blade cutter on account of encountering very hard clay strata. The cutter motor is mounted on a framed base in the port tongue of the ladder well and transmits its power through the port trunnion on a 60 to 1 reduction. The 20-in. cast-iron suction pipe passes from the cutter head up the digging ladder and through the starboard trunnion. The clearance provided in the trunnions is such that the weaving of the ladder when snags are encountered does not affect either the suction pipe or the cutter transmission.

The bullwheel on the cutter shaft is 86 in. in diameter and has an 8-in. face. Special collars are provided for the end thrust of the cutter shaft. The suction head carries a back ring for the cutter, 6 ft. in diameter. The swinging plates are located far enough back from the cutter to keep the swinging blocks free from sand and grit. The 8-in. cutter shaft is in three parts connected by standard couplings.

The pump itself is a 20-in. Bucyrus convolute, with front and back lining and a renewable nose ring and stuffing box. The pump shell and runner are high-carbon annealed-steel castings; the front and back heads are medium steel castings, and the nose ring is of cast iron. The liners, which are of plate steel, are in one piece. The runner shaft is hammered steel, 9 in. in diameter, with one oil-ring bearing. The pump casing, together with these three bearings, is assembled on a cast-steel base, with a structural sub-base between this and the structural bed. This bed is built up of six 12-in. I-beams running the full length of the unit and plated top and bottom with ½-in. steel. The bed sets directly upon and centers the five center bulkheads of the hull to which it is bolted. This construction has been so carefully installed and fitted that there is not the least vibration when the unit is running full capacity.

The 20-in. suction and discharge pipes are of cast-iron ⅞ in. thick and have flange connections. Immediately behind the pump in the discharge line is a 20-in. cast-steel flap valve to control the back flow when the pump is shut down. This is designed with a renewable valve seat and an unobstructed



800-HORSEPOWER ELECTRICAL SUCTION DREDGE USED ON INTERCOUNTY RIVER IMPROVEMENT

passage for material, and is fitted with an outside hand lever and counterweight.

The dredge is held in position by two steel-shod stern spuds, 50 ft. long, in cast-steel wells 14 ft. apart. The leads to the spuds run direct from the headblock on the spud tower to the spud drums of the winding machinery.

ELECTRICAL EQUIPMENT

The dredging pump is driven by a direct-connected 800-hp. 3-phase 2200-volt motor, operated at 360 r.p.m. (synchronous speed). The motor is designed for continuous operation at any speed from 33 1/3 per cent reduction to full speed, and for two hours when developing 25 per cent overload, or for 50 per cent momentary overload, without undue strains or overheating. The cutter motor, operated at 2200 volts, is rated at 75 hp. for 600 r.p.m. (synchronous speed), and is similar to that which drives the winding machinery. Both are reversible induction motors and allow continuous operation for two hours at 25 per cent overload.

While the cutter and winding-machine motors have standard drum-type controls, that for the pump is equipped with contactor and master control. The resistance grids for the latter are mounted in a well-ventilated house abaft the pilot house and atop the main deck structure. All controls, including the levers operating the various drums of the winding machinery, together with the three motors, are in the pilot house forward. The switchboards are made up as follows: Panel 1, incoming line; panel 2, 800-hp. induction motor; panel 3, 75-hp. induction motor; panel 4, 75-hp. induction motor; panel 5, lighting and small power.

The pilot house also contains pressure and steam gages, the digging gages and graduated dummy gage connected to the ladder to indicate the depth of cutter and vacuum. The winding machinery has an auxiliary double 10 x 12 steam engine, with movable coupling to line shaft. This arrangement permits using the winding machinery, irrespective of electrical power.

STEAM PLANT

The boiler is kept constantly under a full head of steam and the engine is limbered up every day. Steam is supplied at 120 lb. by a Clyde type boiler located on the main deck at the stern and jacketed with 2-in. asbestos blocks. Steam is also supplied to a 4-in. ejector for priming the main dredging pump and to a 12 x 7 x 12-in. Fairbanks-Morse pump which handles the bilge and can be used for fire service. This pump is so connected that water can be drawn through a 6-in. line from any of the ten watertight compartments or from outboard. There are four 2-in. fire hydrants on the dredge which are fed through a throttling valve, so that any desired pressure can be secured. A 2-in. relief valve on this line affords safety against overpressure.

With the dredge there were furnished 12 pontoons, 500 ft. of 7-gage riveted pipe with dredging sleeves, 3000 ft. of 10-gage riveted levee pipe and the necessary couplings. The pontoons are 12 x 24 ft. in plan, 2½ ft. deep, and four of them are equipped with turntables so that the obstruction to cross-currents can be reduced to a minimum. It was found advisable to build a 26 x 48-ft. derrick scow as a dredge tender, equipped with a 9 x 10-in. 3-drum hoisting engine and a 40-ft. boom stiffleged derrick. This scow is used in removing drift and snags from the channel and for general repair work around the dredge.

In a test run to determine the efficiency of the pump unit a 3000-ft. length of discharge line was laid to obtain 25 ft. difference in elevation between the end of the discharge and the surface of the water at the dredge. Owing to the fact that a uniform formation was seldom encountered while digging, only a clear-water test was made. The velocities were measured by placing 6-in. wooden balls in the suction pipe and noting the time of transit to the end of the discharge. Also, 1-gal. jugs of potassium permanganate were used, the jug breaking in the pump and coloring the water. Fairly uniform results were secured in eighteen trials.

The vacuum pressure and power-consumption ratings were taken at intervals of one hour or less over a period of 19 hours' steady running. The only difficulty—holding the land pipe together—arose from the fact that the line was assembled hurriedly; and as only clear water was pumped, there was no silt to close up the joints. The results of the test run showed that the average pressure was 43 lb., equal to a 98.9-ft. head, and the average vacuum was 19 in., equal to a 21.5-ft. head. The total equivalent head was therefore 120.4 ft. With a velocity of 15.3 ft. per second the horsepower output equals 456.3. The power consumed equals 505.8 kw.-hr., or 678 hp. input, which gives 67.3 per cent efficiency of unit. Assuming 90 per cent motor efficiency, that of the pump would be 75 per cent.

W. J. Roberts is chief engineer of the Intercounty River Improvement. The writer, as principal engineer, designed the dredge and equipment, supervised its construction, and operated the outfit for sixty days, at the end of which time it was turned over to the Puyallup Dredging Company.

Public-Utility Commissions Should Regulate, Not Operate, Corporations

Paper Presented Oct. 11 at the Joint Convention of the Illinois and Iowa Sections of the American Waterworks Association

By LEONARD METCALF
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PUBLIC UTILITY activity did not begin until after the middle of the last century—in the waterworks field early in the eighties; in the electrical, gas and telephone fields in the early nineties; and in the railroad field at an earlier time, though the greatest expansion has occurred therein since 1890.

This rapid expansion necessitated a change in the earlier policy of building betterments in considerable measure out of the earnings of the corporation, to the present method of building from the proceeds of large bond issues, which throw the burden of payment in greater degree upon the future users of the service than did the earlier practice. This change brought about serious abuses in the obtaining of franchises and overcapitalization of corporate property during the first decade of this century.

COMMISSIONS CREATED

The natural result followed, in an attempt to control the activities of the corporation, evidenced by the establishment of the Wisconsin Railroad Commission in 1905, the New York Public Service Commission in 1907, the California Commission in 1911, the Pennsylvania Commission in 1913, the Indiana Public Utilities Commission in 1913, although the Massachusetts commission had been in operation for many years before the establishment of any of these.

There followed a period of corporation baiting and the passage of many laws making the operation of the corporations, and more particularly the maintenance of good efficiency and esprit de corps, very difficult to them.

The railroads particularly have continued to suffer acutely, as evidenced by the statement last year of Howard Elliott, formerly president of the Northern Pacific Railroad, now chairman of the board of directors of the New York, New Haven & Hartford Railroad, before the annual meeting of the Chamber of Commerce of the United States. Mr. Elliott said: "Whatever the reasons for the malady of the railroads, two facts stand out prominently in the history of the railroads of the United States for the year 1915. One is that less mileage was built in that year than in any year since 1864. There have been only three years since 1848 that there was a smaller mileage of new railway constructed than in 1915. The other fact has to do with the amount of railway mileage in the hands of receivers in 1915. With only one exception, 1893, was the mileage, that entered into the hands of receivers, larger than last year, and 1893 was a panic year." And this was in spite of good crops of recent years and great activity in certain sections of the country due to war orders.

Further evidence of these influences is to be found in the recent advocacy by President Wilson, and enactment by Congress, of the Adamson railway bill, granting ten hours' pay for eight hours' work to railway engineers, conductors and others, subject to review hereafter by a commission to be appointed by the President, and to the possible increase in rates, if economies to be effected by the railroads shall not otherwise offset this arbitrary increase in operating expenses.

CORPORATIONS IN FINANCIAL STRAITS

Similar experience has developed in the Far West in the State of California, where from one cause or another, acts of the corporation on the one hand, or on the other hand of the commission, or other public representatives, a large number of public service corporations are at present in financial straits. Among these might be mentioned the Peoples Water Company, the Spring Valley Water Company, the Western Pacific Railroad, the San Francisco-Oakland Terminal Railways (Key Route System), the Oakland-Antioch & Eastern Railway, the West Sacramento Land Company, the Oro Electric Corporation (Electric Light, Power

& Water Supply Co.), the Cuyamaca Water Company, the Pacific Gas & Electric Company, the San Francisco Telephone Company, and a number of others. In the East and Middle West there are many similar examples.

But to-day there are already evidences of better conditions and that the pendulum is swinging again toward its middle position. The management of our great public utilities is cleaner and better for the agitation. The rights of the public are to-day recognized quite as clearly as are those of the corporation. Indeed, a spirit of toleration and effort to court the favor of the public has been developed on the part of the corporations probably to a greater degree than on the part of the public service commissioners and the public, for it is an unfortunate fact that some of the public representatives still appear to regard themselves as advocates of the public interest, rather than as impartial judges—between the interests of the public and the corporation—and it is unfortunately still true, and is likely to continue to be true under American political conditions, that political pressure is felt by the commissions as well as by the corporations. Here, too, however, conditions are improved over those of a decade ago.

THE PRESENT OUTLOOK

In the view that regulation by commission is probably the best solution of current issues between the corporations and the public, it may be of interest to review the present outlook, in its broader aspect, after a decade or more of commission control.

What do we mean by control of the public utilities by public service commission? The effort to so regulate the conditions of service and the financial return as to assure the public good service at fair price, and to the corporation a reasonable return upon the fair value of its property devoted to public use.

This involves the determination by the controlling or regulating body, first, of the fair value of the property; and, second, the equitable rate of return upon it, commensurate with the hazard involved by the business.

BASIS OF COMMISSION CONTROL

The prescribed or existing conditions must be such as to attract capital to the rendering of these services, which the public, for one reason or another, has not cared to undertake for itself. In this connection a clear distinction must be made between natural monopolies, such as waterworks, electric or gas plants, and the competitive enterprises, such as the railroads.

Two methods of operation are possible—first, the guaranteeing to the corporation of fair return upon its actual investment, with the lower rate of return commensurate with this guarantee; second, forcing the company to bear the hazard incident to the investment and giving to it a higher rate of return, commensurate with this hazard and with the fair value of the property devoted to the service of the public.

The higher courts have constantly adhered to the second principle, ruling that original cost was of significance, but not necessarily of controlling importance; that reproduction cost as of date of valuation was of importance, particularly in the case of old properties; and that consideration should be given to the value of the securities, to the worth of the service to the consumer, and to any other matters which might seem to have probative force in fixing value.

The controlling commissions have, unfortunately, not always followed the precedent of the court, but have sometimes tended strongly toward the measurement of values practically by original cost, even excluding from the latter those elements of cost carried by the operating account, regardless of the question as to whether a fair return was earned contemporaneously with the payment of these costs. They have sometimes excluded certain elements or so-called increments of value, recognized by the courts; and have attempted to make the corporation carry the burden of the hazard of the business on an allowed rate of return commensurate with an implied guarantee, instead of with the actual hazards of the business.

REGULATION VERSUS OPERATION

There has been ground for anxiety lest the commissions should go so far as to attempt to dictate policies rather than simply to control or limit the activities of the corporations. In the main, however, the commissions have wisely limited themselves to the functions of a regulating body, upon the theory that it is safer to leave to the executive officers of the corporations—who are accountable not only to the owners of the property but also to the regulating commission—the determination of policies of operation, leaving the commission to sit in review upon the results obtained under them, rather than for the commission to determine those policies. If the commission is to dictate operating policies it must, in all fairness, assume full responsibility for them and relieve the corporation management of the hazard element involved, thus in effect guaranteeing revenue and operating conditions to the corporations, as would ultimately be necessary under such a theory of public administration.

The public has clearly manifested its preference for *regulation* by commission, of corporately-operated public utility property, rather than public or commission *operation* of such public utility properties, under the past and present conditions prevailing, and the future conditions likely to develop in the United States. Thoughtful observers see grave danger in the extension of the functions of the public service commission to the determination of the details of operating policies and practices, as well as to the broad problems of character of service, fair return, and equitable distribution of the burden of rates, unless the commission can be divorced from politics and be given far greater financial support and unless the hazard of operation be assumed by the public—all of which will certainly involve a serious change in policy and a final cost of service to the public likely to be substantially greater than that under private operation and public utility commission control of such properties.

REQUIREMENTS OF VALUATION

The fair valuation of large properties, having diversity of interests, is not a simple, but a highly complex matter. It is dependent upon:

1. Experience in the design, estimate of cost, construction, and operation of such properties.
2. Imagination, tempered by judgment.
3. Intellectual honesty and logical mental habits, the ability to determine causes and their effects, and the relative importance of different facts.
4. Knowledge of men, ability to work with them, and to be able to draw out information.
5. Technical knowledge and skill.
6. Character and judicial temperament.

THE STEPS IN VALUATION

Think for a moment of the steps in valuation of the property of public utilities. The trained mind does not think in formulas, but goes unconsciously straight to the heart of the matter, determines and faces the facts. If the facts be stubborn and do not fit preconceived theories, it reconstructs its theories but never blinks at the facts. Intellectual honesty and good morals demand this.

First, the imagination is called into play, picturing the historic conditions and the probable present day conditions under which the works have been or might be built and developed, in accord with available records of the past and the probable present conditions incident to the reproduction of the property.

Then the inventory of the property is prepared, requiring extreme care and technical knowledge of design and methods of construction.

Next the unit prices and overhead costs are applied to the inventoried quantities, involving thorough knowledge of cost, methods of construction, and careful study of local conditions and limitations—if the valuation is to be fair and not purely academic. It is here that the evaluator is at the greatest disadvantage, if he has not had breadth of actual experience in construction, for he is liable otherwise to seriously underestimate the difficulties and hazards to be encountered, and the collateral or incidental costs involved, as every man who has had breadth of construction experience in large corporate works, or who, perchance, has built himself a house, appreciates full well.

INTANGIBLE VALUES

Then comes the much more difficult determination of the so-called "intangible," though real, elements of value—the franchise, water rights, cost of developing the business, and other similar elements; a study of the financial elements involved; and so the final determination of fair value of the property and fair rate of return to be allowed upon it, in the light of all the pertinent facts.

As the construction and building up of such properties involves the work and cooperation of the promoter, the financier, the engineer, and the operator, for the development of the highest efficiency and accomplishment of the best results, so the valuation of the property at a later day involves, on the part of the evaluator, the qualities heretofore mentioned, coupled with much hard work, discrimination, open mindedness and judicial viewpoint. If the evaluator plays the roll of advocate instead of judge, and limits himself always to developing the viewpoint of one of the parties at issue—whether the public or the corporate—he is likely soon to acquire mental bias. At the upper end of the line we have the true expert, or man of experience in the particular subject under discussion, who strives to develop the facts honestly and with open mind, and then to interpret them judicially. At the other end of the line, we have the equivocator, the smart Alec and the political trimmer. The

former is a man of character, most valuable to the public; the latter a mere breeder of discontent and further trouble.

Members of regulating commissions and their engineering staffs are open to the same dangers in the field of valuation as are financiers, engineers, and operators, who testify for the public or for the corporation, in valuation or rate proceedings. The external pressure brought to bear upon them politically, through the newspapers or by individuals, is quite as dangerous as that of the officers or employees of the corporation; and the need of sturdy independence of character is equally essential.

THE PUBLIC'S ATTITUDE

The results of commission control reflect in general the attitude of the public and the body politic—the breadth or narrowness of view, the experience or lack of experience, the force and independence of character or yielding to expediency and political pressure of the commissioners themselves; the frankness, candor and honesty of the corporation officials, or the reverse.

The commissions have in certain respects rendered very important service. They have brought about a more wholesome publicity, have prevented the abuse of serious inflation of values, in some cases have tended to stabilize values and give greater security to property, and they have compelled a just recognition by the corporation of its obligations to the public. In some other respects they have not infrequently failed—to wit, in underestimating the value of public-utility properties, in arrogating to the public enhancements in value or elements of value granted to the corporation as well as to the individual by the highest court, and in prescribing or limiting rates to a return which shows no substantial margin of profit. When they have failed, it has generally been due to lack of breadth of experience and familiarity with such problems, but unfortunately, also, sometimes due perhaps to political pressure or ambition and the playing of the rôle of public advocate rather than that of judge. While the extenuating circumstances have often been great, the public responsibility large, the results have been none the less injurious to or subversive of the highest and most efficient standard of service by the corporation.

GOOD SERVICE THE MAIN ISSUE

There can be no doubt that the intelligent and fair-minded public is far more interested in having good, prompt and up-to-date service at a price yielding a fair or even liberal profit to the corporation rendering it than it is in the slight reduction in cost of service to the public, which may mark the turning point between a fair and an inadequate profit, or between profit and loss to the company.

Thus in the waterworks field who can doubt what would be the answer of the average man were he asked, "Would you rather have your present inadequate service or pay 20 cents more per month for your family service, which is equivalent to 40 cents more per capita per year for a thoroughly good service?" And yet this 20 cents per month increase would mean 1 per cent more or less increase in annual revenue or return to the corporation and might well mark the difference between good credit and bad. Moreover it is to be noted that the corporation is twice penalized if the commission fails to permit adequate earnings, first, in the reduction of revenue, and hence return upon the fair value of the property; and, second, by its resulting inability to borrow money so closely to the market as when it is earning a return which shows profit—for the market exacts interest rates commensurate with hazard and with the available protective margin of earnings.

For instance, the corporation may borrow money upon its bonds at a 5 per cent rate, if the bonds cover but one-half to two-thirds of its property value; at 6 per cent or more if they cover three-fourths to seven-eighths of its value; and at yet higher rates if the bonds equal the property value. In fact the corporation may not be able to market its bonds at all under the latter conditions. The allowing of a fair margin of profit is not only necessary but advantageous to the public.

INITIATIVE STIFLED

It is the consensus of opinion that the commissions have rarely given tangible reward to superior management, that they have found no substitute for the incentive of extra profit and that they have too often limited or reduced the revenue upon the property to a return which shows no profit and no inducement to superior management, with the result of a declining service, a declining market value of the corporation's securities, or even of loss of market, and final inability to borrow at previous rates. Such conditions cannot be justified by any temporary saving in rates to the public or to the individual, for the ultimate cost of the service is actually increased by such drastic treatment and the day of reckoning always comes. No individual, no commission, no court can long dominate money rates. Economic conditions ultimately control, and the lowest rates follow the fairest and most stable conditions of service.

The unfair claims by corporations of enormous franchise and intangible property value have brought their own reward—great shrinkage in these claimed values. The investing public, as well as the court, has discounted these claims.

VALUE OF ESTABLISHED BUSINESS

On the other hand, the failure of some of the commissions to give adequate recognition to the difference in value of the property with established business, as compared with one without it, and to permit rates of return showing profit as well as interest allowance, is also being discredited. The business man, the operator and the financier have always recognized this substantial enhancement in value of the property growing out of the developed business. The investor has always willingly paid for it. The highest court has long admitted it. Broadly speaking, it is only the commissions that have failed to make adequate financial allowance for it. Moreover, they have often failed to permit the earning of revenues which would show a return, including interest and profit.

Examples of the evil results of unreasonable regulation are not lacking. Note the present selling price of and return upon the stock of the Boston Elevated Railway, long under state commission control, the stock of which has been issued and sold for many years past at rates prescribed by the commission, much of it above 125, now selling at below 80, and the corporation obliged to plead for higher return to enable it to borrow funds necessary for extension and betterment of the property.

The Denver Union Water Company, victorious in its recent rates suit before the federal court, which declared confiscatory the city ordinance reducing rates 20 per cent, which ordinance was based presumably upon the Public Utility Commission's determination of the value of the property, which value was substantially doubled by the federal court.

The Spring Valley Water Company fair suits of 1903 and 1905 were won by the company, as were those of 1908-1915 recently concluded after ten months of nearly continuous trial, now awaiting the decision of the Federal Court for the District of Northern California. While this company was not until recently under the jurisdiction of the California Railroad Commission its rates have been subject to annual review and determination by the city's representative, the Board of Supervisors.

RICHMOND DECISION IN INDIANA

The Richmond decision of the Indiana Commission, subsequently revised by the commission itself, and the Terre Haute decision, both reduce the returns to a point adverse to public policy. This result is evidenced by the commission's own subsequent action in raising the revenue first allowed by it to Richmond. The Terre Haute company finds itself in financial straits, for it is unable to raise money for necessary construction and is compelled to suspend the payment of dividends to raise the needed capital. Dow R. Gwinn, president of the Terre Haute Waterworks, is known and respected by waterworks men and engineers the country over. The commission itself admits his good management and fair-minded point of view. Yet the commission has taken action which has seriously endangered the high character of the service which this corporation can render to the public. It is but fair to admit that the effect of the reduction in rates by the commission was rendered more burdensome by the contemporaneous change by the company from a flat-rate to a meter basis of selling water. But this only gives further evidence of the hazard which the commission took in fixing too low a minimum monthly meter-rate—an unnecessary hazard, as the commission could have fixed a tentative monthly minimum rate to make absolutely safe this transition from flat to metered service basis, reducing this minimum by progressive steps as the actual developments might have made possible.

CONTROL IN HANDS OF COMMISSION

The control of the situation was and still is in the hands of the commission, and therefore it may fairly be held responsible for the present deplorable situation. It is believed that the commission itself deeply regrets the situations which have developed both at Richmond and at Terre Haute, and these cases are specifically cited merely to bring home the lesson that it is not to the advantage, indeed it is to the distinct disadvantage, of the public to have the commission rule so closely in its decisions as to incur such hazards. The good faith of the commission is not challenged—merely the wisdom of its action from a public point of view.

Has not the reported "saving to the public" been derived at the expense of the character of service, possible in the long

run, and of fairness to the company? At least, the present financial standing of the company has been impaired and the attractiveness of investment in such properties in Indiana reduced. Time will show whether the action is not more far-reaching and of greater import as a problem in policy in control. It seems highly probable that a more liberal policy would have better served the public and the state.

COST OF LITIGATION

The cost of litigation resulting from the commission's extreme action is also to be borne in mind. The commission cannot play the public advocate and then say that the corporations are safe in its hands. The action of the public at Denver, adjudged unfair by the federal court, has involved an unnecessary aggregate cost of upward of $500,000 to the parties at issue. The San Francisco action entails probably $750,000. The expenses of inventory, valuation and litigation are rarely less than $25,000 even in the smaller cities. Such large expenditures yield better returns in structures than in legal battles. Moreover, it is very important to note that it is the public which ultimately has to pay these costs. As the federal court has said, in a recent California waterworks rate decision, though the expenses of such suits be excluded in determining the question of confiscation, they have unfortunately been incurred so frequently of late that they must be given consideration in fixing the fair return. The fair return must be raised to accord with the increased hazard of having to contest such suits and to meet the costs involved. The judge was a man of broad experience as well as a fine jurist, and he knew that this was the view of the business world and of common sense. Therefore the commissions should be prudent and conservative in action in the public interest.

THE REMEDY

These are the remedies:

On the part of the public better compensation, longer tenure of office and freedom from political control of the commissions and their staffs.

On the part of the commissions, greater liberality in their determination of value, and the fair rate of return—a return which will *in fact* recognize the necessity of giving *profit*, as well as mere interest upon investment, and which shall encourage and offer substantial inducement to and adequate compensation for superior management; conservatism in applying new rate schedules, making the changes step by step, and fixing safe tentative minimum monthly meter rates for the transition from flat to metered rate basis of selling water, lest the prescribed rates fail to yield the reduced return fixed by the commission; and finally a sound and fearless stand on the use of meters to their economic limit.

On the part of the corporations candor and frankness in their relations with the commissions, more careful accounting and record of property and costs. Take the commissions into your confidence, rather than hold them at arm's length. Be reasonable and recognize the difficulties of their position and that of their staffs. Play fair and let the facts prove your case, and then fight for fair treatment, if injustice be done. Under such conditions only—possible though difficult of attainment—can a permanent solution of vexatious present problems be reached.

Surges for 16 Miles from Pedro Miguel Lockages

Maximum Oscillation Observed at Panama Lock Is 3 Feet, with Time Interval of 45 Minutes Between Extremes

By R. Z. KIRKPATRICK
Assistant Chief Hydrographer, Department of Operation and Maintenance, Panama Canal, Ancon, Canal Zone

SURGES due to lockages through the Pedro Miguel lock in the Panama Canal are registered at San Pablo, 16 miles from Pedro Miguel, and at Juan Mina, 14 miles away on the Chagres River. They pass through the Gaillard cut 9 miles to Gamboa in 20 minutes, but require 25 minutes more to reach Juan Mina. The maximum oscillation recorded at Pedro Miguel is 3 ft., and except when slides have encroached on the canal prism there has been little difficulty in the handling of boats.

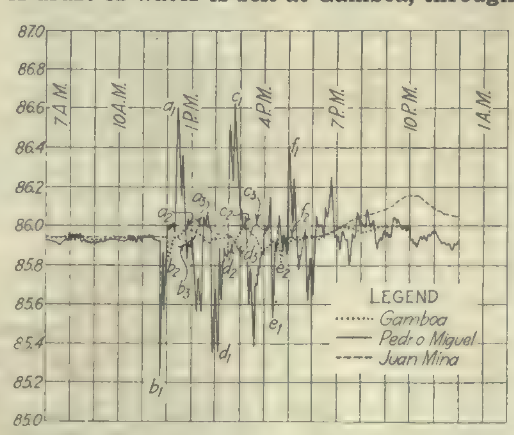
The Pedro Miguel lock is at the south end of Gaillard cut, the narrowest part of the Panama Canal. The cut, with the theoretical bottom width of 300 ft. and the theoretical side slopes, has a cross-section at El. 85 of 13,600 sq. ft. Due to removal of slides, a larger area occurs at some sections. The banks of the cut are rock and earth.

HOW THE LOCKS ARE FILLED

The twin chambers are filled through culverts in the walls, one to a wall. Each culvert has a minimum area of 255 sq. ft., and is controlled by two Stoney gate valves, with a clear area of 288 sq. ft. A chamber is 1000 x 110 ft., and requires more than 3,000,000 cu. ft. of water in locking a boat up from the Miraflores Lake to the Gatun Lake level. It takes from 7½ to 8 minutes to draw this water, using side and center wall culverts. When the side-wall culvert alone is used, the time is 13½ minutes. It is found that the lock chambers fill at nearly a uniform rate, after the valves are opened. In filling both chambers about 13,000 sec.-ft. is drawn, which would give 0.95 ft. per second velocity in the cut, if water were supplied as fast as drawn. To cut down this velocity the canal above the lock was made 600 ft. wide, narrowing down to 300 ft. at a point 3400 ft. north. The resulting basin acts as a reservoir for the first part of a draft of water.

SURGES LAST HOURS

The surges resulting are interesting. The sketch plan illustrates the positions of the surged areas. The vertical oscillations occur for hours, being felt as far as the Juan Mina and San Pablo hydrographic stations. A draft of water is felt at Gamboa, through



HYDROGRAPHS AT THREE POINTS SUPERIMPOSED FOR A DAY OF THREE LOCKAGES

9 miles of still water, in 20 minutes. It takes 25 minutes longer to be felt through the 5 miles of current up the Chagres River of the lake to Juan Mina. The succeeding crest of the surge, at all stations, is 45 minutes after the trough of the surge at that station.

The superimposed Pedro Miguel, Gamboa and Juan Mina hydrographs show conditions resulting from the up lockages of the steamships American Transport, Crickett and Lewis Luckenbach on Nov. 7, 1914. Points b_1, d_1, and e_1 on the Pedro Miguel hydrograph, b_2, d_2 and e_2, Gamboa, and b_3 and d_3 at Juan Mina show effects of drafts for the ships in the order named. Likewise a_1, c_1, f_1, etc., show the resulting surges or overtravels. It is noted that a Chagres River freshet, starting about 6.15 p. m., obliterated any effect at Juan Mina due to the lockage of the Lewis Luckenbach.

The observations made since canal operations began appear to show facts as in the following discussion: When the valves are opened to fill a lock chamber the basin above the gates becomes depressed, the extent of the lowering depending on the number of valves opened and the size of the resulting openings. This depressed water surface causes a surface current in the canal toward the lock that continues until

PART OF PANAMA CANAL SURGED BY PEDRO MIGUEL LOCKAGES

an elevation is reached that is as much above the initial level as the depressed elevation was below. The surface current and wave amplitudes continue for some time with decreasing intensities.

HARMONIC ACTION PROBABLE

It is probable that harmonic action increases or decreases the currents and amplitudes; that is, if a new draft of water should make a depression in phase with a secondary trough of a wave from a previous lockage, the resulting oscillations would be unusually large. It is fortunate for shipping that the doctrine of chance nearly always decrees that the oscillations from repeated lockages are partly antagonistic, thereby cutting down these wave amplitudes, with their resulting surface currents.

Except in times of partial closure of the prism, these surges have given little trouble in handling boats. When a cross-section was cut down by a slide, it was necessary to draw water at Pedro Miguel very slowly or not at all while boats passed the restricted portion.

Thus far the Pedro Miguel water-stage instruments have shown no surge amplitude of more than 18 in., or a total oscillation of 3 ft., and there is ordinarily 45 minutes of time between the extremes of the fluctuations.

Tests Apparently Substantiate the Theoretical Formula for Strength of Outstanding Flanges

Results of Experimental Investigation Presented and Discussed to Show Effects of Distribution of Metal in Column Sections

By RAYMOND J. ROARK
College of Engineering, University of Wisconsin, Madison

IN AN article entitled "Strength of Outstanding Flanges in Beams and Columns," published in the Engineering Record of Dec. 27, 1913, page 722, the writer proposed a theoretical formula for the elastic buckling strength of flanges in compression. It was appreciated that, lacking experimental verification, the formula could only be regarded as tentative, and the necessity for substantiating tests was recognized. A number of such tests have recently been made by the writer, and it is the purpose of this paper to present the results obtained and to discuss these results in conjunction with the theory previously developed.

Original Assumption Revised

It was assumed in the original analysis that the elastic curves of the hypothetical vertical and horizontal strips were parabolic. Perhaps a more nearly correct assumption is that each vertical strip bends in the sine curve indicated by Euler's theory, and that each horizontal strip assumes the curvature of a cantilever beam under triangular disposition of load. If the analysis is made on the basis of such assumption, it is found that

$$p = Et^3L^2/9.35b^4 + \pi^2Et^2/12L^2$$

This gives a minimum value of p when $L = 1.66b$, and substitution of this value gives the equation

$$p = 0.6Et^2/b^2$$

in which p is the unit load in pounds per square inch, causing the elastic buckling of the flange; E, modulus of elasticity of the material in pounds per square inch; L, length in inches of that portion of the flange over which bending in one direction extends; t, thickness in inches, and b, width in inches, of the flange.

INSTRUMENTS ATTACHED TO SPECIMEN

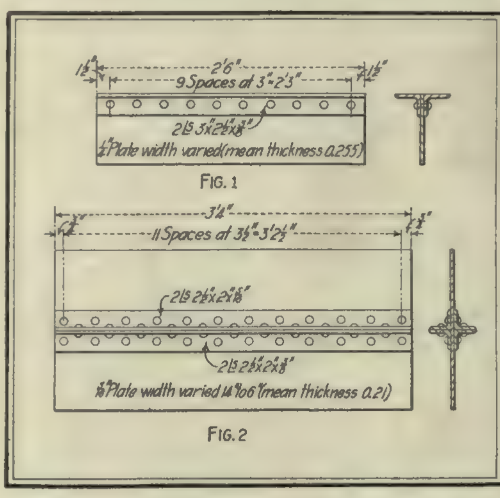
In the original analysis the formula for minimum strength was

$$p = 0.65Et^2/b^2$$

for $L = 1.60b$.

Test Pieces and Methods of Testing

Two series of tests were made, those of the first series on columns of T-section, each consisting of a wide plate with angles riveted along one edge. The dimensions and details are shown in Fig. 1. These specimens had their ends ground to an even bearing and were tested in the 600,000-lb. hydraulic machine in the laboratory of the University of Wisconsin. Loads were applied in increments of about 5000 lb. per square inch, and the corresponding strains at the free edge of the flange measured over two 2-in. gage lines with a Berry strain gage.

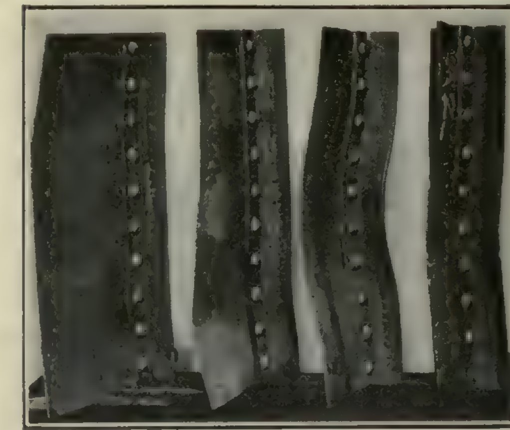


FIGS. 1 AND 2—DIMENSIONS OF SPECIMENS

It was found that up to a certain unit load the strains increased proportionately to the load. Beyond that point the flange began to bend visibly, and the strains either remained constant or decreased slightly. The stress corresponding to the maximum observed strain was in each case taken as the buckling strength of the flange. When the test had been carried far enough to determine this buckling strength, the load was applied continuously until the specimen failed, and the ultimate load and manner of failure were noted. The results of this series of tests are given in Table 1.

The second series of tests was made on a short column of star section, consisting of a wide plate with four angles riveted along the center line. This test piece was designed to give a greater range of values of the ratio b/t than had been obtained with the T-sections. Its dimensions are shown in Fig. 2.

Loads were applied in increments of approximately 1000 lb. per square inch, and strains measured over 10-in. gage lines on each flange edge by means of wire-wound dials extensometers reading to 1/10,000 in. Two dials, placed equidistant from the plate, were used on each edge to eliminate errors due to bending. Upon reaching the point at which the strains no longer increased with increased loading, the load was removed, a new zero reading taken, and the test repeated as a check. The specimen was then taken from the machine, the width of the flanges reduced by cutting a 2-in. strip from each edge of the plate, and the specimen retested. The results of this series of tests are given in Table 2.



TYPICAL FAILURES OF T-SECTION

Comparison of Results with Theory

The graph of the equation $p = 0.6Et^2/b^2$ is shown in Fig. 3. On the same figure are indicated the points corresponding to the observed strains in the specimens tested. For the first series of tests the stresses plotted were found by averaging the maximum unit strains measured on any one specimen over the two gage lines, and multiplying this average by 30,000,000. In all cases but one the measurements over the two gage lines agreed closely; in that one instance only the more consistent set of readings was used, the other evidently having been vitiated by flaws in the drill holes.

For the second series of tests the stresses on the north and south edges of the plate were computed separately. Here again the maximum unit strain multiplied by 30,000,000 was taken as the buckling stress. In two instances (when $b/t = 67$ and when $b/t = 29$) results were obtained for only one flange edge. In the first case only one set of dials was attached; in the other case the load was slightly eccentric, and one edge began to buckle before the stress in the other had reached more than 6000 lb. per square inch. It is believed that the results of this second series of tests are more reliable than those of the first, and that more weight should be attached to them.

Fair Agreement Noted

It will be noted that only a fair agreement obtains between the curve and the plotted points. It was to be expected that the results would, in the main, lie below the curve. The theory was developed on the assumption that the flange was truly fixed at the attached edge. In these tests the body, or central portion, of any specimen was light and of a form poorly adapted to resist the twisting induced by loading of the flanges. For this reason the horizontal cantilever strips were only partly fixed at the attached edge of the flange, and the support afforded the vertical strips by them was consequently less than the theoretical amount. This is brought out by the fact that, when the load on a specimen was carried beyond the point of the maximum flange stress so as to cause perceptible bending of the flange and twisting of the

specimen, the unit stress along the flange edge diminished somewhat.

It is not apparent, at first glance, why certain points should lie above the curve. In the general equation for p, the substitution of cb for L, c being any constant, yields an equation of the form

$$p = KEt^2/b^2$$

where K is a constant depending on c. As has already been shown, p is a minimum when $c = 1.66b$, K then being 0.6. For values of c either greater or less than 1.66, K increases, showing that p becomes greater when flexure in one direction extends over a length of the flange either less or greater than 1.66 times the width. The nature of this variation is shown clearly by the curve, Fig. 4, obtained by plotting values of K against corresponding values of the ratio of length to breadth of bent flange.

In the first series of tests the length over which bending of the flange took place was not measured. In the second series of tests, however, this length was measured. In the test where $b/t = 57$ the north edge of the plate bent in a reversed curve, and bending in one direction occurred over a length of about 20 in. The south edge, however, bent in the same direction over its entire length, or 40 in. The width of the flange was 12 in., so that the ratio of L to b was 3.3, and from the curve of Fig. 4 the corresponding coefficient K is seen to be 1.3. Hence the theoretical stress becomes 1.3/0.6 times the value indicated by the graph of Fig. 3, or about 12,000 lb. per square inch. The observed stress was less than this, probably because of the twisting of the column. In the test where $b/t = 48$, both edges bent over lengths of about 18 in., but in the next test, where $b/t = 38$, the south edge again bent in the same direction over its entire length, and showed a high buckling strength. This tendency was probably due to a very slight initial curvature, or to a small unevenness of the bearing surfaces. The high values obtained in the first series of tests are probably similarly explainable, and it seems therefore that all the experimental results are really lower than the theoretical values.

It will be seen from the data in Tables 1 and 2 that the observed stress in the flange edge is, in most cases, less than the average unit load on the specimen. As the loads were applied in increments of from 1000 to 5000 lb. per square inch, it is evident that an equal discrepancy might exist between the buckling stress and the average unit load. It was impossible, of course, with such wide sections, to secure either an exactly even bearing or a perfectly central loading. In general, the agreement between the flange stress and average stress seems to be as close as could be expected under the circumstances.

TABLE 1—TESTS ON T-SECTIONS (SERIES 1)

Number of Specimen	Area of Cross-Section, Sq. In.	Breadth of Flange, In.	Ratio of Breadth of Flange to Thickness, b/t	Unit Stress at Edge of Flange When Buckling Occurred, Lb. per Sq. In.	Average Unit Load on Specimen When Buckling Occurred, Lb. per Sq. In.	Total Load at Failure, Lb.	Unit Load at Failure, Lb. per Sq. In.
A1..........	5.13	3.56	14	35,700	38,500	222,500	43,500
A2..........	5.13	3.56	14	26,800	39,200	214,000	41,700
B1..........	5.90	5.37	21	30,700	36,700	225,500	38,200
B2..........	5.90	5.37	21	25,500	30,100	207,500	35,200
C1..........	6.40	7.50	29	28,300	29,100	201,500	31,500
C2..........	6.40	7.50	29	24,000	30,000	225,500	35,200
D1..........	7.01	10.00	39	14,800	19,400	204,000	29,100
D2..........	7.01	10.00	39	13,000	19,500	221,500	31,600

TABLE 2—TESTS ON STAR SECTIONS (SERIES 2)

Number of Specimen	Area of Cross-Section, Sq. In.	Breadth of Flange, In.	Ratio of Breadth of Flange to Thickness, b/t	Unit Stress at Edge of Flange When Buckling Occurred: North Edge, Lb. per Sq. In.	South Edge, Lb. per Sq. In.	Average Unit Load on Specimen When Buckling Occurred, Lb. per Sq. In.
1.......	12.44	14	67	2,400	....	4,820
2.......	11.60	12	57	3,300	7,800	6,900
3.......	10.76	10	48	4,800	5,550	7,430
4.......	9.92	8	38	10,650	16,650	10,000
5.......	9.08	6	29	20,700	....	13,200

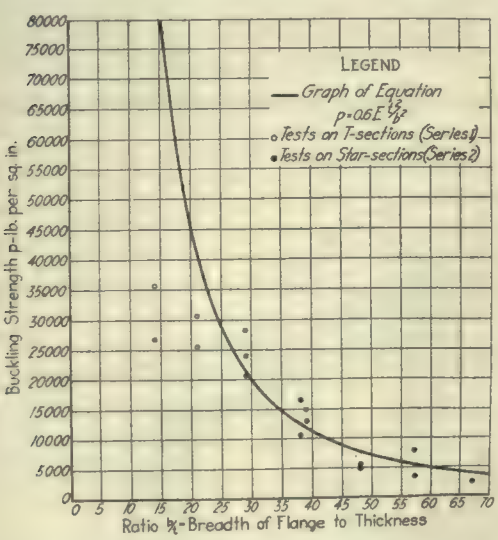


FIG. 3—RESULTS OF TESTS PLOTTED FOR COMPARISON WITH GRAPH OF EQUATION

MANNER OF FAILURE

The manner of failure of all the specimens of the first series of tests was the same, and was characterized by a gradual bending of the flange, followed by twisting of the body of the member and failure through such twisting. This twisting is shown by the photograph of the specimens after failure. The wide flanges, starting to bend at a comparatively low stress, induced torsion at a lower load than the narrow flanges. As a result, the ultimate unit load is much less for the specimens with wide flanges than for those with narrow flanges; indeed, even the total load appears to decrease as the flange width increases. This shows clearly that the presence of wide unsupported flanges constitutes a source of weakness in columns, and that the factor of safety may be lowered thereby, even though such flanges may carry their share of the load under working conditions. It should be noted, in this connection, that the bodies of the specimens tested were very light, and of a form poorly adapted to resist torsion. The effect of torsion induced by the flexure of wide flanges on columns of heavy section and ordinary design would probably be much less marked.

FIG. 4—HOW STRENGTH VARIES WITH RATIO OF BENT LENGTH TO BREADTH

The specimen used in the second series of tests was not loaded to failure, but its behavior under load indicated that it would fail in the same manner as the others. The accompanying photograph of the specimen under load shows flexure just beginning, and this flexure, when carried a little further by increased loading, caused a perceptible twisting.

CONCLUSIONS

The results of the tests appear to warrant the following conclusions:

1. The buckling strength of an outstanding flange, of width b and thickness t, truly fixed at the attached edge, is given approximately by the formula

$$p = 0.6Et^2/b^2$$

2. Flexure in one direction may be induced by initial curvature or eccentric loading over a length greater than that for which the buckling strength is a minimum. In this case the strength of the flange may be considerably greater than that indicated by the formula.

3. If the flange is not truly fixed at the attached edge the buckling strength may be considerably less than indicated by the formula.

4. Under a unit load exceeding the buckling strength an outstanding flange bends, and this bending induces torsion in the member of which it forms a part. Such flanges may thus constitute a source of weakness, and while carrying their share of the load at low stresses render the ultimate strength of the member less than it would be were the flange, or part of it, removed.

All the specimens used in the tests were donated by the Worden-Allen Company of Milwaukee, Wis., whose courtesy the writer takes pleasure in acknowledging. Thanks are also due Dean F. E. Turneaure and Prof. M. O. Withey of the College of Engineering, University of Wisconsin, for suggestions as to the design of test pieces and methods of testing.

Date Set for Completion of Hetch Hetchy Project

Construction work on the Hetch Hetchy water supply project, which is to provide a new supply for the city of San Francisco from Lake Eleanor in the Yosemite National Park, is being rapidly advanced. In a recent discussion on the progress of the work City Engineer M. M. O'Shaughnessy stated that the project will be carried out at such a rate that the water can be delivered to the city in 1923.

Says Oregon Road Laws Need Overhauling

John H. Lewis, State Engineer, Believes Well-Organized Department Is Needed to Complete General Highway System

THAT there is need for a general overhauling of road laws in the state of Oregon, so that responsibility may be fixed upon the proper officers, is the opinion of John H. Lewis, state engineer. In outlining the present organization he says: "We have 105 county judges and commissioners, 35 county surveyors, four roadmasters and 862 road supervisors in charge of the expenditure of from $4,000,000 to $6,000,000 per annum on county roads. Three members of the state highway commission and a state engineer are in charge of the expenditure of $235,000 of state money. In general these men are honest. With a definite plan or policy to work under they would doubtless prove efficient. But they are disorganized. Frequent changes in office and occasional recalls and reorganizations make it very difficult for the public to profit by past experience. Many unnecessary disputes occur between state and county officials because of indefiniteness of existing laws. Valuable time is wasted. Having only limited power and without any substantial policy to adhere to, these state and county officials are dragged around by interested property owners, enthusiastic citizens having pet projects, or by designing contractors and material men. They are forced to spend public money on small, disconnected, hastily considered, inadequately financed, unrelated projects without regard to the larger plans of interest to the whole people.

"There is thus need for a general overhauling of road laws in Oregon to the end that responsibility for road work may be definitely fixed upon officers having adequate powers. Some provision should be made for continuity of effort through a well-organized department for the completion of a general highway system for the state."

One-Fourth of Water Fund Expended

According to reports, $104,000 of the $400,000 voted for the Wishkah water project in Washington has been expended. Most of it was spent for materials, the remainder for clearing, grubbing and actual construction work. Clearing and grubbing of the pipe line right-of-way have cost $262.47 per acre. So far 68.16 acres have been cleared and 25.54 acres grubbed.

ARCHITECTS' SKETCH OF TERMINAL AS IT IS TO APPEAR WHEN COMPLETED

Pennsylvania Freight Terminal at Chicago Striking in Both Size and Appearance

Five-Story Structure Occupying Entire Block and Surmounted by Ornamental Tower Will Be Supplemented by Ample Team and Storage Yards

BOTH in size and appearance the new freight terminal of the Pennsylvania Lines West of Pittsburgh, now well on toward completion, is striking. Occupying an entire city block of about 420 x 740 ft., with the ground level given over entirely to tracks and narrow trucking platforms, and four freight and warehouse floors rising above, it will take front rank in size; while the architectural treatment, including the massive tower, will give it an individuality not heretofore attempted in this country in such utilitarian structures. To make room for the Union Station development (see last week's issue, page 558) it will be necessary for the Pittsburgh, Fort Wayne & Chicago to give up the site of its freight houses in the vicinity of Madison and Adams streets, and it was therefore decided to concentrate all of the Pennsylvania's less-than-carload downtown business in one two-level freight house. The site chosen was south of Polk Street, between the present tracks and the Chicago River. The freight house will extend to Taylor Street, and south of that street will be team tracks and storage yards.

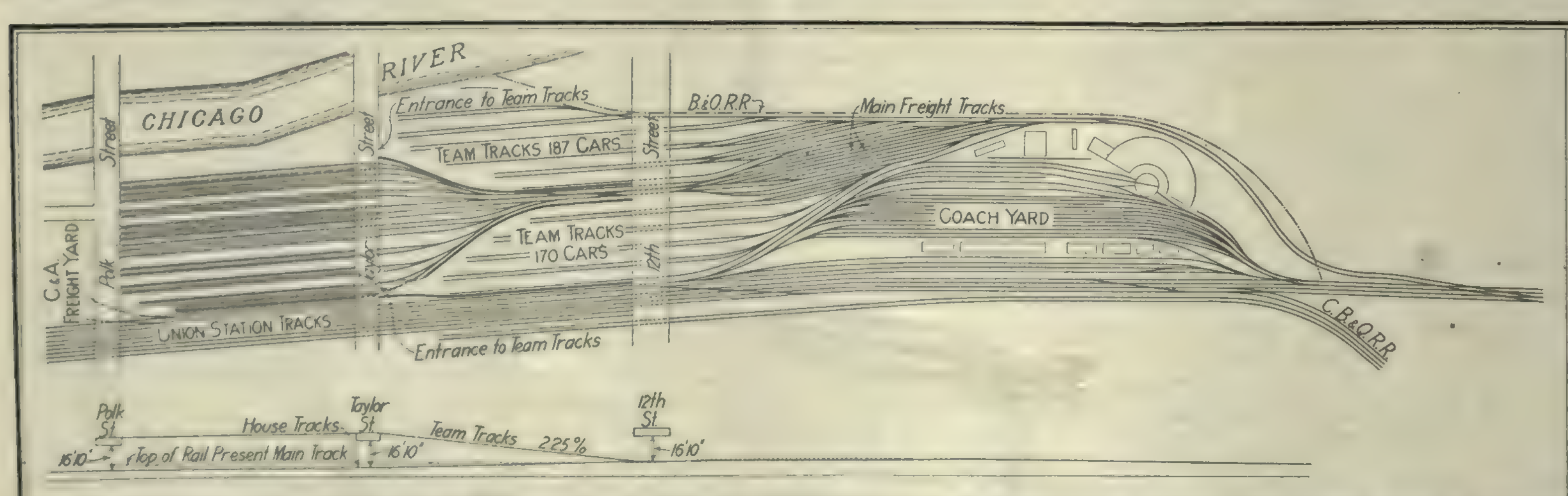
Site Had to Be Acquired

Practically all the land occupied by the freight house and the yards had to be acquired. Where the frame of the freight house now stands was a miscellaneous collection of buildings, including a ten-story warehouse owned by the Chicago Dock Company. Just north of Twelfth Street were the engine house and coach and coal yards of the Baltimore & Ohio. These have been relocated at Robey Street.

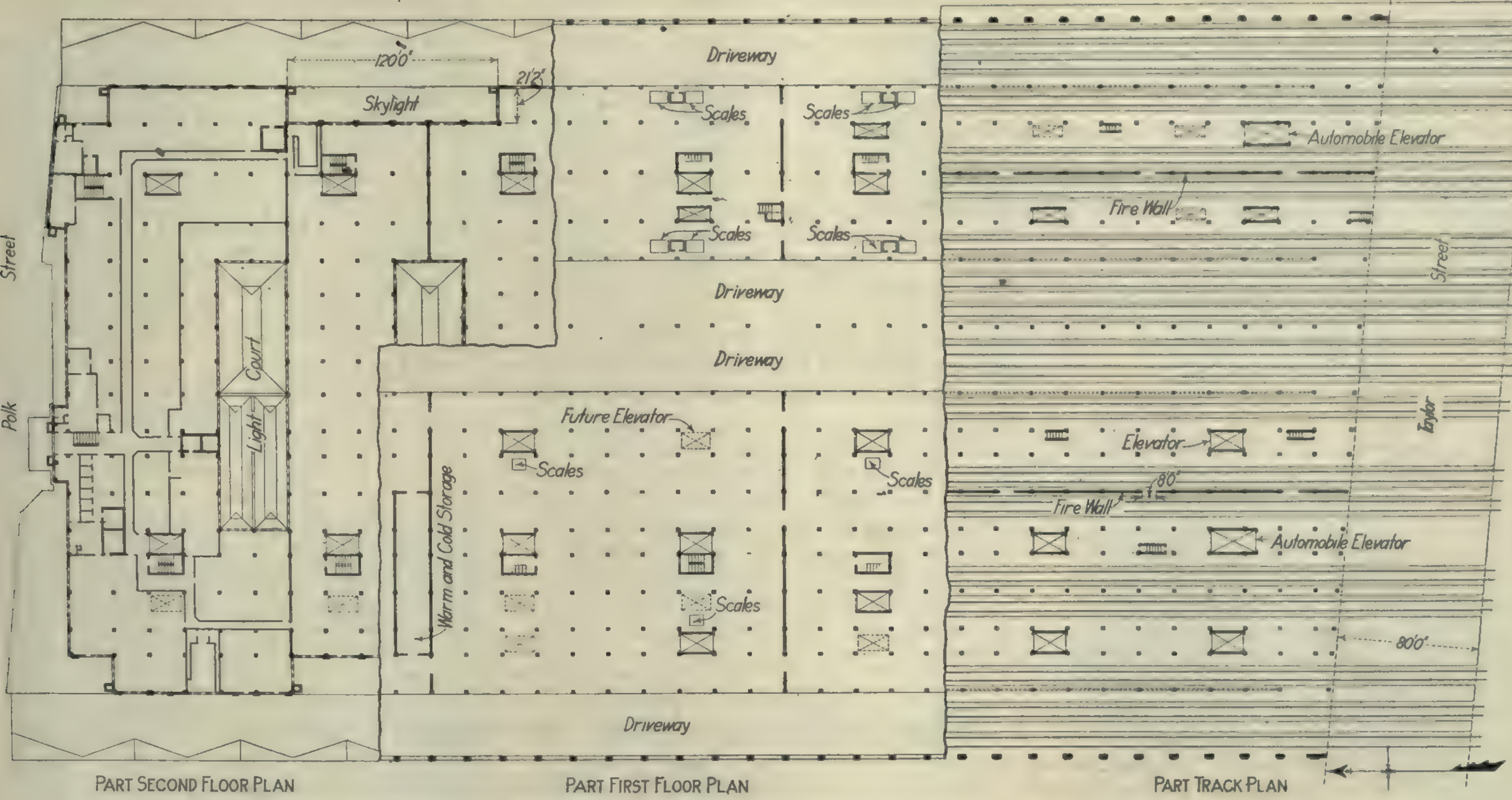
Freight House

The freight house itself is 745 ft. long and 420 ft. wide, and rises four stories above the streets, which pass over the tracks. It has a structural steel frame and brick walls. In the center of the Polk Street end will rise a tower 180 ft. high and about 50 ft. square, with a clock with dials 16 ft. in diameter at the eleventh floor on each of its four sides.

All of the ground level under the building is given over to tracks and trucking platforms. There are fourteen tracks under the building proper, four under the covered driveways on each side of the building, and one additional track on the outside east of the structure—making nineteen in all. The platforms vary in width from 5 ft. 4 in. where they merely separate tracks to 28 ft. where large freight elevators are provided to connect with the upper floors, but in every case there is a platform between tracks so that there will be no necessity for spotting cars to bring doors opposite each other. The platforms extend under Taylor Street, giving a total length of 800 ft. each, except that at the northwest corner, which is encroached upon somewhat by tracks leading to the Chicago & Alton freight yard north



TERMINAL BUILDING OCCUPIES ENTIRE BLOCK—APPROACH TRACKS FLANKED WITH TEAM YARDS RISING TO LEVEL OF TAYLOR STREET



PARTS OF THREE FLOORS—GROUND LEVEL GIVEN TO TRACKS, INBOUND AND OUTBOUND HOUSES ON STREET LEVEL, WAREHOUSE ABOVE

of Polk Street, three of the house tracks are slightly shortened.

The second floor, or street level, is divided longitudinally by a 72-ft. double driveway, leaving an outbound house 100 ft. wide on the east and an inbound house 171 ft. wide on the west. In addition along the outside of each house is the 36-ft. covered driveway previously mentioned. Transverse fire walls divide each house into lengths of about 200 ft.

The three upper floors will be used for warehouse purposes except at the north end, in which the offices will be located. In the warehouse section the longitudinal wall which divides the street level into the two houses is omitted. Light for the street floor is provided by the system of skylights shown in the building plan. Six interior light courts are carried down to the second floor, the street floor being considered the first, and in addition notches 120 ft. long and 21 ft. wide—two in each side of the building—make four more large skylights possible. Transverse fire walls at each transverse light court divide the warehouse floors into 100-ft. sections.

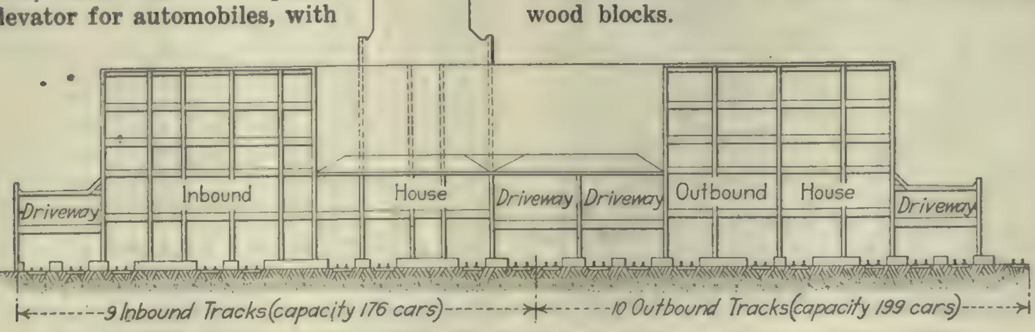
In addition to a passenger elevator on Polk Street to serve the offices, there will be thirty-one freight elevators, with provision for eighteen others as required. In general these will have 9 x 17-ft. platforms and 8-ft. doorways. Near the Taylor Street end of each house, however, there will be a special elevator for automobiles, with 10 x 24-ft. platforms and doorways 10 ft. high. The locations of present and future elevators are shown on the plan.

TEAM TRACKS

The general track plan shows the problem encountered in providing the team tracks. There was not room available for ramps from Taylor Street, the natural outlet of the team yard, to the ground level without a prohibitive sacrifice of costly land. On the other hand, the Twelfth Street viaduct made it necessary to keep all tracks down to the ground level at that point. The only solution therefore seemed to be to raise the entire team yard, both sides of the approach tracks to the freight house, from ground level at Twelfth Street to street level at Taylor Street, and by means of retaining walls hold the fill away from the low-level freight-house tracks and also from the Union Station tracks on the west. This gives a team-track capacity of 403 cars, with 30-ft. driveways between pairs of tracks and between ends of tracks and retaining walls, and two 50-ft. entrances to Taylor Street. North of Twelfth Street the tracks are necessarily on a 2.25-per cent grade.

South of Twelfth Street will be a storage yard for 117 cars, warped to the east to make room for the coach yard shown at Fourteenth Street.

The tracks will be laid with 100-lb. rail on wooden ties. No. 8 turnouts will be used throughout. The driveways in the freight house will be paved with creosoted wood blocks.



TRANSVERSE SECTION SHOWS ARRANGEMENT OF TRACKS, DRIVEWAYS AND FLOOR SPACES

Motor-Truck Legislation Advocated in Michigan

Bill Restricting Weight, Size and Speed of Trucks Prepared by Wayne County Commissioners

LEGISLATION regulating the use of motor vehicles on public highways is advocated in the 1915-16 report of the Board of County Road Commissioners, Wayne County, Michigan. The following bill has been drafted and its adoption is recommended:

PROVISIONS OF BILL

Section 1—No traction engine, road engine, trailer, steam roller, automobile truck or other power vehicle, the face of whose wheels are fitted with spikes, shall be driven upon public highways in this state which have been improved in whole or in part with the aid of funds of the state of Michigan, paid in the shape of highway rewards by the state to any road district of the state. No such vehicle whose wheels are fitted with flanges, ribs, clamps, cleats, rings or lugs, or any other projection, shall be permitted to use such highways unless such projections are fastened upon all the wheel thereof and are not less than 2½ in. wide and not more than 1½ in. high, and are so placed that not less than two of said projections upon each wheel bear upon the ground at all times and so that the weight shall be distributed equally on all parts thereof. But where such vehicles are used solely in transporting agricultural machinery or products, the following requirements shall apply: There may be a guide band not less than 2 in. wide on the front wheels, in which case no flanges, ribs, clamps, cleats, rings or lugs shall be required. The full set of flanges, ribs, clamps, cleats, rings or lugs furnished upon the rear wheels of such vehicles according to the original design must be used. No rivet heads or bolts shall be allowed to project upon either front or rear wheels.

Section 2—Such vehicles whose equip-

ment does not comply with this act may be licensed by the state highway commissioner to travel upon such highways in cases where coverings of wood or other substance are attached to the wheels in such manner as to present a smooth surface, and in accordance with regulations fixed by the commissioner. No vehicle subject to the provisions of this act shall be equipped with ice picks or mud lugs. No such vehicle which, with its load, weighs over 14 tons shall be operated upon any highway of this state subject to the provisions of this act, unless a license therefor is previously secured from the state highway commissioner. Such license shall prescribe such regulations as are necessary in the opinion of the commissioner for the preservation of the highways. No object which weighs more than 14 tons shall be moved over such highways by means of wheels, rollers or otherwise, without a similar license from the state highway commissioner. No load exceeding 9 tons shall be carried upon any one axle or upon any single roller. Except as herein otherwise provided, the tires of such vehicles shall be smooth and the weight of such vehicles when loaded shall not exceed 800 lb. per inch in width of such tires, except in cases where the carriage of a greater weight is permitted by the state highway commissioner.

Width and Speed

Section 3—No such vehicle of greater width than 90 in. shall be operated upon any such highway, except that traction engines having a width of 110 in. may be so operated.

Section 4—No such vehicle weighing when loaded over 4 tons shall be run upon any such highway at a speed greater than 15 miles an hour. No such vehicle weighing when loaded more than 6 tons shall be run on any such highway faster than 6 miles an hour, if it is equipped with iron or steel tires, nor faster than 12 miles an hour if it is equipped with tires of hard rubber or similar substance.

Section 5—In cases where the state highway commissioner is authorized by this act to grant special licenses or permits, he shall do so only upon written application made in such form as he shall prescribe. Such licenses and permits shall be written and shall plainly state the acts which are thereby permitted to be done, shall be issued under such restrictions as the commissioner shall prescribe.

Section 6—The owner, driver, or operator of any vehicle subject to the provisions of this act, and the owner of any object, other than a vehicle operated on or transported over such highway, shall be responsible for all damages to said highways resulting from the violation of any provisions of this act or from the violation of the terms and provisions of any license or permit granted by the state highway commissioner. The amount of such damage may be recovered in an action of trespass on the case by the state highway commissioner, or by the board of county road commissioners of the county in which such damage occurs. The amount of such damage shall also be a lien upon the vehicle or object transported which is the cause thereof.

Section 7—Any person who violates the provisions of this act or who exceeds the provisions of any license or permit issued by the state highway commissioner under this act shall be guilty of a misdemeanor; and upon conviction thereof shall be fined not to exceed $250 or shall be imprisoned in the county jail not to exceed six months, or may be both fined and imprisoned in the discretion of the court.

We also recommend that Section 34, Act 302, Public Acts 1915, be amended so as to include special fees credited to the state highway department, consisting of licenses for chauffeurs, manufacturers and dealers' licenses; duplicate plates lost, or destroyed, and motorcycle licenses be included in the distribution to be returned to the treasurer of each county on the basis of 50 per cent of the amount collected to be used to maintain the highways by the local authorities. During the past year over $30,000 was collected from this source, the major portion coming from Wayne County, and all of it was credited to the state highway department. We feel that it should be treated in the same manner as the amounts collected from registered motor vehicles in each county; and we urge that the proper steps be taken by the board of supervisors to bring this recommendation to the attention of the Wayne County delegation in the state legislature.

Finds Electrolytic Sewage Treatment Little Better Than Lime Alone

Company Orders Tests at Decatur Plant Discontinued and Outfit Dismantled After City Insists on Comparison with Lime Only

By EDWARD BARTOW
Director, Illinois State Water Survey

THE Illinois State Water Survey was invited on July 12 to "co-operate with and assist the city to whatever extent it may feel able to or disposed" in the official tests of the "electrolytic lime" sewage-disposal plant built at Decatur by the Electrolytic Sanitation Company of Illinois. Analyses developed the fact that the purification by treatment with lime alone was greater than that obtained in several of the individual samples treated with lime and electricity.

An outline indicating some of the items to be considered in determining the efficiency of the plant was prepared and submitted to the chemists who were to conduct the tests on the ground. The following items were suggested:

I. Cost of Installation.
   (a) Comparison with cost of installing plants of other types.
II. Cost of Maintenance.
   (a) Power for the mechanical operation.
   (b) Power for the electrolysis.
   (c) Lime and other chemicals.
   (d) Labor.
   (e) Interest and depreciation.
   (f) Disposal of sludge.
      1. Sludge pressing.
      2. Moisture in sludge.
      3. Hauling of sludge.
      4. Land required for disposal.
III. Efficiency of Plant.
   (a) Effect of electrolysis.
   (b) Effect of lime.
   (c) Effect of sedimentation (sedimentation capacity necessary).
   (d) Quality of effluent measured by total residue, organic nitrogen, putrescibility, oxygen consumed, alkalinity (to phenolphthalein and methyl orange).
   (e) Comparison of quality of effluent with reported effluents obtained by other processes.

It was impossible for the Water Survey to obtain data concerning all of the items enumerated. Some have been discussed in the report furnished by the chemists and engineer, but others have not yet been given sufficient consideration. The report shows the estimated costs of installing the electrolytic-lime purification plant, but does not give data showing a comparison of the cost of treatment with the cost by other types of sewage-purification plants, especially plants which might obtain an effluent

Analyses of Samples from Decatur Sewage Experimental Plant
(Chemical Results in Parts Per Million)

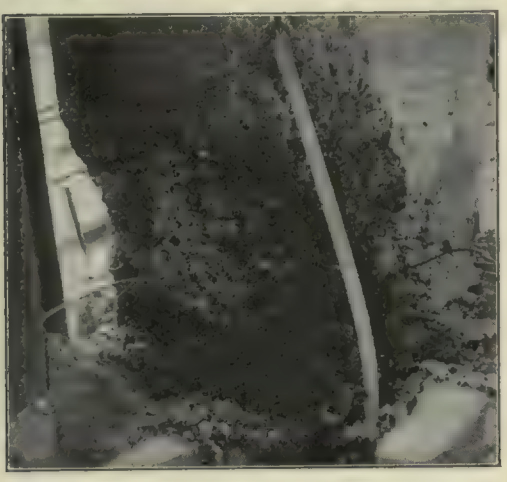
Date	Nitrogen: Ammonia Raw.	Nitrogen: Ammonia Effl.	Nitrogen: Total Organic Raw	Nitrogen: Total Organic Effl.	Nitrogen: Nitrite and Nitrate Raw	Nitrogen: Nitrite and Nitrate Effl.	Solids: Total Raw	Solids: Total Effl.	Solids: Suspended Raw	Solids: Suspended Effl.	Solids: Dissolved Raw	Solids: Dissolved Effl.	Alkalinity Raw	Alkalinity Effl.	Ox. Cons. Raw	Ox. Cons. Effl.	Methylene Blue Effl.	Lb. lime per mil. gal.
Sewage Treated with Electricity and Lime																		
July 24	26.4	12.0	....	...	...	1.0	1,840	1,487	245	62	1,595	1,425	364	146/360	302	185	15 hr. at 20 deg. C	*
Aug. 4	46.0	11.2	....	...	0.5	0.3	1,515	1,550	460	20	1,055	1,530	460	200/380	164	174	10 min. at 20 deg. C	3,149
Aug. 11	28.0	12.0	....	...	0.7	0.2	1,505	1,405	190	60	1,315	1,345	440	120/140	160	165	5 min. at 20 deg. C	3,757
Aug. 19	36.0	14.0	188	82	1.2	1.2	1,970	1,549	291	67	1,679	1,482	320	116/160	350	291	....	3,433
Aug. 20	24.0	12.0	136	76	1.0	1.0	2,830	1,653	517	66	2,213	1,587	320	132/200	390	235	....	2,600
Aug. 20	72.0	15.0	24	75	0.8	1.8	1,537	1,508	165	64	1,372	1,424	520	108/192	212	215	....	....
Aug. 20	42.0	13.0	70	75	1.6	1.6	2,159	1,524	381	40	1,778	1,484	440	96/208	260	270	....	....
Aug. 25	28.0	24.0	....	...	0.32	1.6	1,548	1,417	216	24	1,332	1,393	340	64/324	200	182	Decolorized in few minutes	....
Aug. 25	28.0	20.0	....	...	0.64	2.0	1,576	1,385	224	20	1,352	1,365	360	80/284	202	186		
Average	36.8	14.8	104	77	0.75	1.2	1,809	1,498	299	47	1,520	1,448	369	118/227	249	211		
Average per cent removed	...	59.8	....	26	...	..	17.2	....	84.4	..	....	4.78	...	42.7	...	15.3		
Sewage Treated with Lime Alone																		
Oct. 6	48.0	27.2	54.4	46.4	1.4	1.1	1,581	1,354	313	26	1,268	1,328	512	.24/488	264	178	Decolorized in few minutes	2,400
Oct. 6	36.8	24.8	41.6	55.2	1.0	0.9	1,436	1,336	198	45	1,238	1,291	468	112/440	260	168		
Average	42.4	26.0	48.0	50.8	1.2	1.0	1,508	1,345	255	35	1,253	1,309	490	118/464	262	173		
Average per cent removed	...	39.0	Increase,	3.8	...	..	....	10.8	...	86.4	Increase,	4.3	...	5.3	...	34		

*Amount of lime from Mariner & Hoskins' report of official test.

of the same quality, as, for example, chemical precipitation with lime.

The Water Survey has also been unable to obtain estimates of the cost of maintenance and can only form conclusions from the results furnished by the chemists and engineer of the company. In these estimates we note especially the high value given to the sludge. We have been unable to confirm the statement through correspondence with manufacturers of fertilizer. It is our belief that the dried sludge containing about 1.6 per cent nitrogen (N) would have little if any value and would probably be disposed of only at considerable expense to the city.

During the official test the plant was visited on five different occasions by Dr. F. W. Mohlman, J. F. Schnellbach and the



LOOSE BOARD CONCRETED INTO WEST COLUMN

writer. Samples of raw sewage and of the final effluent were obtained and brought to the State Water Survey laboratory for analysis. At the conclusion of the official test the plant was run for a short time without electricity. One visit was made during this period and samples collected for examination. Additional samples would have been taken when the plant was running without electricity, if the company officials had not ordered the plant shut down.

LIME ALONE BETTER AT TIMES

The results of the analyses have been compared, as shown in the accompanying table. When lime alone was used, less lime was added than on any of the days when lime and electricity were being used. The raw sewage was approximately of the same concentration. That treated with lime alone was weaker than the average if measured in terms of total residue, suspended solids, dissolved residue, and total organic nitrogen, but stronger if measured by ammonia nitrogen and oxygen consumed. The purification by treatment with lime alone was greater than that obtained in several of the individual samples treated with lime and electricity. The alkalinity to methyl orange did not show as great a decrease when lime alone was used, indicating the use of a smaller proportion of lime and confirming the figures obtained by weighing the lime. Measured in terms of oxygen consumed the reduction was greater with lime alone, though in some individual cases greater reduction was obtained with lime and electricity.

COMPANY OBJECTS—QUITS

We regret that because of the objections of the company we were unable to obtain further samples when the plant was running with lime alone. While it is unsatisfactory to draw conclusions from a single test with lime alone, yet the results obtained are better than some of the individual results obtained with lime and electricity. This would indicate that a series of tests would show lime to be as efficient as a combination of lime and electricity. After the test with lime alone the city insisted that there should be a comparative test of one week's duration with lime and electricity and of one week's duration with lime alone.

This test was started on Oct. 23, using lime and electricity. Composite samples were taken to be analyzed in triplicate by the chemist of the company, the city chemist and the State Water Survey. After five days of operation the test was discontinued by the company and the plant ordered to be dismantled. The city will, however, install sufficient apparatus to test the effect of lime on the Decatur sewage.

Poor Concrete in Columns Caused Failure of Bridge

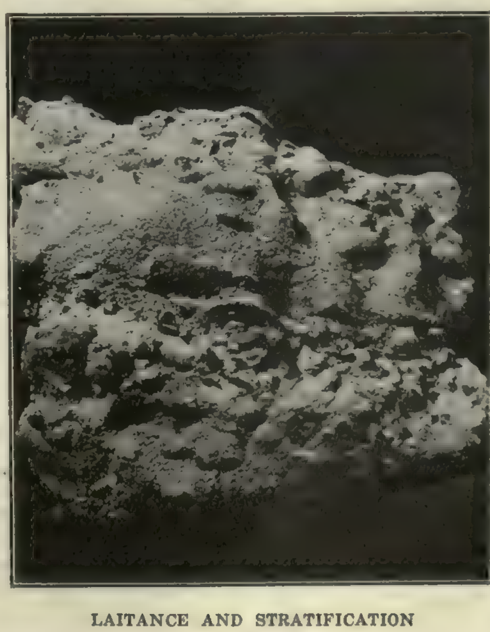
C. B. McCullough Reports Improper Construction as Cause—Laitance, Segregation of Aggregates and Loose Board Found

AN INVESTIGATION of the cause of the failure of a reinforced-concrete highway bridge at Independence, Ore., has recently been reported by C. B. McCullough, of the civil engineering department of Oregon Agricultural College, Corvallis, Ore. Careless and incorrect methods of construction are cited as being chiefly responsible. The more important weaknesses found are the presence of laitance, of segregated aggregates and lack of bond due to excess water and of an embedded board near the base of one column which caused the formation of a pocket of very friable concrete. It is stated that the contractor is in large measure responsible for the faulty construction resulting in failure, and that the county is in a minor degree responsible in not insisting upon careful inspection.

WORKMANSHIP FAULTY

One lesson to be learned from the manner of failure of the 50-ft. girders is the efficacy of shear stirrups in preventing diagonal tension cracks. The following abstracts are taken from the report.

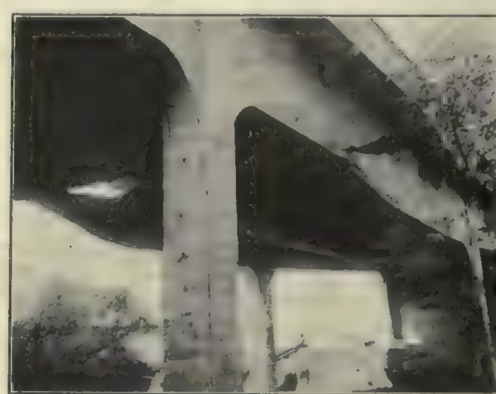
Careful analysis of the design revealed no inherent weakness therein, and no reason



LAITANCE AND STRATIFICATION

is found to blame the cement. While portions of the concrete are lean and friable, other portions immediately adjacent are of much better quality. A sample taken just above the point of failure near the base of the west column developed a compressive strength of 1146 lb. per square inch, about three times the actual unit loading at time of failure. Fine sand was found in some parts of the columns, and the concrete was very lean and porous.

Examination of the columns and footings indicates that the latter did not settle, but that the columns failed above the footing, the longitudinal reinforcement being buckled. The concrete at the point of failure in the west column was loose and friable, probably due to the presence of a loose board concreted into it near the base so as to cause the formation of a pocket of



DIAGONAL CRACKS IN WEBS OF 50-FOOT GIRDERS —CRACKS BEGIN WHERE STIRRUPS END

considerable size. The load was thus concentrated upon a relatively small sound section of the column. Marked segregation of material, showing sandy streaks interbanded with streaks of rich mortar, was also found. In one spot an analysis showed proportions of 1:17:34. Such a sand pocket could be explained only by improper or careless proportioning or by lack of thorough mixing.

The east column near the point of failure showed complete stratification—a layer of coarse aggregate devoid of finer material, above this a layer of fine aggregate, also very lean, and above this a white chalky material, which is undoubtedly laitance washed to the surface during the operation of depositing the concrete. The bond between aggregate and mortar was everywhere found to be poor, and connected lines of air voids surrounding the stone were very apparent. The concrete was evidently deposited too wet and a film of excess water not forced to the surface by thorough working of the mass had been drawn slowly to the surface and left the aggregate separated from the mortar by lines of connected air voids.

In the conclusions, strong emphasis is given to the fact that the failure was the result of careless and incorrect methods of placing the concrete, and the responsibility is placed upon the contractor and the county, the latter in not insisting upon expert supervision and inspection.

Operates Autos for Less Than 5 Cents a Mile

The thirteen automobiles used by the San Diego (Cal.) operating department covered during the month of September 14,663 miles at an average cost per mile of $0.047. This includes all repairs, tires and tubes, gas, distillate and oil.

Interstate Commerce Commission Makes Its First Two Tentative Valuation Reports

Original Cost Not Found for Atlanta, Birmingham & Atlantic or Texas Midland—No Allowance for Appreciation, Contingencies or "Other Values"

ORIGINAL cost complete is not attempted in either of the first two tentative valuations reported by the Interstate Commerce Commission under the federal Valuation Act. The reports, as announced in the news section of this journal last week, cover the Atlanta, Birmingham & Atlantic Railroad and the Texas Midland Railroad, and are dated respectively Oct. 19 and Oct. 21, 1916. In the case of the former, original cost is dismissed with the statement that it could not be found. Original cost of equipment and of land is given for the Texas Midland. In both reports accrued depreciation is deducted to determine reproduction cost less depreciation, though there is lack of uniformity in the deductions for engineering and some of the general-expenditures accounts. No "other values or elements of value" were found in either property, and there is no mention or apparent allowance of appreciation, contingencies or working capital—or of development expenses or going value, which the carriers have sought to have included in the "other values or elements of value." No allowance is made for land other than the market value of contiguous land.

Parts of both reports, as well as parts of reports on several other carriers, have been in the hands of the carriers for several months, and were in fact discussed at informal conferences between the Division of Valuation and the carriers concerned in June. These partial reports, as well as some of the carriers' comments thereon, were printed by the general secretary of the Presidents' Conference Committee, Thomas W. Hulme, Philadelphia, and distributed among the carriers. The committee has distributed the reports of Oct. 19 and 21 in the same way.

Atlanta, Birmingham & Atlantic

The report proper on the Atlanta, Birmingham & Atlantic, as printed by the Presidents' Conference Committee, has fifty-three pages. The property comprises 641 miles of operated line, including 15 miles leased from the Georgia Terminal and the Alabama Terminal Railroad. The report gives tabulated statements of the reproduction cost new, reproduction cost less depreciation and present value of land of the whole property allocated as to corporate ownership and of the individual properties allocated as to primary accounts and as to states. It also gives a general description of the property, and discusses briefly the physical conditions relating to construction; economic conditions relating to traffic; corporate history; development of fixed physical property; history of capital financing, increases and decreases in securities in any reorganization; aids, gifts, grants and donations; results of corporate operations; investment in road and equipment, and numerous other subjects, both for the main company and for the terminal properties.

The engineering report presented to the carriers earlier in the year sets forth the program for reproduction and explains the bases for unit prices and other figures adopted. The accounting report of 68 pages deals mainly with the corporate history of the property, including that of the related companies. The land report contains only 11 pages; it classifies the lands in various ways, and then explains briefly how the land was appraised.

Reproduction Totals

The property was valued as of June 30, 1914. As stated in the note in last week's issue, the estimated reproduction cost new on that date, exclusive of land, is $24,154,998 and the present value of the land is given as $2,291,413. Depreciation to the extent of $4,746,188, or approximately 20 per cent, is deducted from the road, equipment and general-expenditures accounts to obtain reproduction cost less depreciation, giving a total of $19,408,810 exclusive of land.

Reproduction cost new plus present value of land, as given by the commission, is $26,446,441, which may be regarded as the commission's total for reproduction cost new. This compares with an outstanding capitalization of $54,571,176.14 for the Atlanta, Birmingham & Atlantic Railroad alone, the two terminal companies being capitalized for about $9,500,000 and there being in addition outstanding receivers' certificates amounting to $4,994,000, for which the three companies were jointly liable. This gives a capitalization per mile of the main company of $86,296, and a total reproduction cost new per mile of line operated of $41,258, or, excluding the terminals, $37,860.

Jan. 1, 1909, the main property, and the following month the terminal companies, were placed in the hands of a receiver, and have so continued to the date of valuation. For the eight years and two months from May 1, 1906, to June 30, 1914, the report shows a net loss from operation of $4,446,695.25. No dividends have been paid.

TABLE 1—REPRODUCTION FIGURES FOR CERTAIN PRIMARY ACCOUNTS, ATLANTA, BIRMINGHAM & ATLANTIC RAILROAD

Class	Reproduction cost New	Reproduction cost Less depreciation	Depreciation deduction, per cent
Road:			
Engineering	$569,503	$569,503	0
Grading	5,263,885	5,254,891	0.17
Bridges, trestles and culverts	2,370,720	1,980,705	16
Ties	999,281	508,347	49
Rails	2,717,804	2,400,600	12
Ballast	381,770	278,343	27
Tracklaying and surfacing	716,705	549,166	23
Equipment:			
Steam locomotives	1,263,647	942,793	25
Freight-train cars	2,895,376	1,570,641	46
Passenger-train cars	399,780	264,357	34
Total road and equipment	*20,912,153*	*16,653,400*	*20*
General expenditures:			
Organization expenses	20,912	16,729	20
General officers and clerks	125,478	100,378	20
Law	62,736	50,190	20
Stationery and printing	20,912	16,730	20
Taxes	104,561	83,649	20
Interest during construction	1,215,737	972,590	20
Other expenditures—general	83,648	66,918	20

TABLE 2—PERCENTAGES OF ROAD AND EQUIPMENT TOTALS ALLOWED FOR GENERAL-EXPENDITURES ACCOUNTS

Organization expenses	0.1
General officers and clerks	0.6
Law	0.3
Stationery and printing	0.1
Taxes	0.5
Other expenditures—general	0.4
Total	2.0

Depreciation of Primary Accounts

Coming now to the primary accounts, space does not permit their presentation in full, but some of them are given in Table 1. The depreciation percentages have been computed by this journal. Of the large road items it will be noted that the highest percentage deducted is from ties. Tracklaying and surfacing is diminished 23 per cent. Grading is reduced 0.17 per cent. No deduction is made from engineering, which, the engineering report states, was figured at various percentages from 2½ to 5. This allowance of 100 per cent for the service condition of engineering is in conformity with the views of the Engineering Board of the Division of Valuation, as set forth in the Engineering Record of June 17, page 794. Of the equipment accounts, freight-train cars sustain the heaviest deduction—46 per cent.

TABLE 3—REPRODUCTION FIGURES FOR CERTAIN PRIMARY ACCOUNTS, TEXAS MIDLAND RAILROAD

Class	Reproduction cost New	Reproduction cost Less depreciation	Depreciation deduction, per cent
Road:			
Engineering	$54,926	48,807	9
Grading	411,866	411,471	0.11
Bridges, trestles and culverts	387,792	289,461	25
Ties	272,688	136,345	50
Rails	525,134	434,205	21
Ballast	210,637	168,509	20
Tracklaying and surfacing	207,502	140,642	32
Equipment:			
Steam locomotives	187,928	107,643	43
Freight-train cars	190,432	120,423	37
Passenger-train cars	73,455	39,236	47
Total road and equipment	*3,183,360*	*2,370,648*	*26*
General expenditures:			
Organization expenses	831	831	0
General officers and clerks	15,000	15,000	0
Law	9,100	9,100	0
Stationery and printing	1,100	1,100	0
Taxes	5,971	4,478	25
Interest during construction	144,691	108,052	25

Considering the combined total of the road (exclusive of land) and equipment accounts, the depreciation deduction averages approximately 20 per cent, and this is the deduction made uniformly from the general-expenditures accounts. The reproduction-cost-new figures, with the exception of interest during construction, are, as the engineering report states, percentages of the total of the road and equipment accounts, exclusive of land. These percentages are as shown in Table 2, making a total of 2 per cent. The estimated depreciation of the terminal properties is less than for the main company, and the depreciation of general expenditures is correspondingly reduced.

Interest During Construction

Interest during construction was reckoned at 5 per cent per annum on all road and equipment accounts except land. Interest on the road accounts was figured for one-half the construction period, plus three months, of a particular section, it being considered essential to have the money on hand three months in advance of actual expenditure. The construction periods assigned vary from 1½ to 3 years, the maximum period being allowed for two sections only in mountain country where the work is heavy. Interest on the equipment accounts was reckoned at 5 per cent for a period of three months.

Land is figured on the basis of market

value of contiguous land, with no allowance for cost of acquisition, severance or continuity. The figures are kept separate from the reproduction cost totals, and are designated "present value of land."

As previously stated, nothing is allowed for "other values or elements of value." Neither is there separate mention of development expenses, appreciation of roadbed and track, contingencies or working capital, and apparently nothing is allowed for them.

The road accounts, general expenditures and land items are allocated to the two states, Georgia and Alabama, containing the properties. There is no allocation of equipment.

Texas Midland Railroad

Covering a road of only 111 miles, the Texas Midland report is much smaller. As already announced, the reproduction cost new and reproduction cost less depreciation are given as $3,382,004 and $2,527,417 respectively. Both figures exclude land, which is given a present value of $236,690. These figures compare with a capitalization of $2,112,000. Per mile the capitalization is $19,027, the estimated reproduction cost new, taking into account the report's figure for present value of land, is $32,601 and reproduction cost less depreciation $24,902.

TABLE 4—PERCENTAGE OF ROAD AND EQUIPMENT TOTALS ALLOWED FOR GENERAL-EXPENDITURES ACCOUNTS

Organization expenses	0.03
General officers and clerks	0.47
Law	0.29
Stationery and printing	0.03
Taxes	0.19
Other expenditures—general	0.00
Total	1.01

As to the primary accounts, the figures corresponding to those in Table 1 for the Atlanta, Birmingham & Atlantic are given. (They are exclusive of subsidiary properties valued at about $22,000.) It will be noted that depreciation is deducted from engineering, the engineering report explaining that the service condition for preliminary and location surveys and for construction of roadbed is assumed to be 100 per cent, the remaining expense being given a service condition per cent equal to the weighted service condition per cent of the remaining road accounts (exclusive of land). On the other hand no depreciation deduction is made from the figures for organization expenses, general officers and clerks, law or stationery and printing.

These figures, and that for taxes, were not determined by percentages of the road-and-equipment total, as was done on the Atlanta, Birmingham & Atlantic, but were estimated in each case. Nothing is accredited to other expenditures—general. The resulting percentages of this total, corresponding to Table 2, figure approximately as shown in Table 4, and total 1.01 per cent.

Interest during construction is figured on one-half the total expenditures for the total period of construction.

ORIGINAL COST

On the subject of original cost the report says:

"An attempt was made by the accountants of the commission to show as required by the statute the original cost to date of each piece of property in detail. For this purpose every voucher of the Texas Midland Railroad was examined and an attempt made to rewrite the investment account of that company according to present accounting rules of the commission. The result has not been satisfactory. It was possible to correct many errors, but there were also many instances in which the voucher could not be allocated with reasonable certainty. Great difficulty was experienced in determining what should be written out of the account by reason of retirements of worn-out and abandoned property. . . . It was possible to identify the equipment now in existence and show the cost of that, and also to show original cost of lands with reasonable certainty, but to attempt a statement of the original cost of particular structures, or by primary accounts or even of the property as a whole would be entirely misleading."

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

"Uniformity Coefficient" a Misnomer

SIR: As clearness and conciseness of definition are most desirable in engineering education, I want to call attention to a lack of both which exists in defining the "uniformity coefficient" of sand. The difficulty can be obviated to a large extent, it seems to me, by introducing a name for the larger size which is taken to determine this coefficient; that is to say, the size than which 60 per cent of the given sample is smaller and 40 per cent is larger. For some time, in referring to that size, I have used the term "uniformity size," which seems to me appropriate, as this size is only used for the purpose of determining the uniformity of a given sample. Having defined the uniformity size as above, and following the usual definition for effective size as being that size than which 10 per cent of the given sample is smaller and 90 per cent is larger, it is a simple matter to define the "uniformity coefficient" as the ratio between the uniformity size and the effective size.

I hope the above suggestion will attract the attention of those interested and produce some discussion of the subject.

HUGH MILLER,
Lecturer in Civil Engineering, Rice Institute.
Houston, Texas.

Belts for Floating Concrete Should Be Waterproof

SIR: Referring further to the use of belts for floating concrete pavements (see the Engineering Record of Oct. 14, page 481), I am convinced from the experience of several contractors during the past month that the best results are to be obtained from the use of rubber-coated belts, or with a belt that is at least well vulcanized so as to render it absolutely waterproof. An ordinary canvas belt not properly waterproofed is of no service, as it soon becomes saturated.

I am still inclined to believe that the 8-in. belt should be used for the first floating, and on a number of jobs have secured excellent results by the use of this same belt for the second floating, although it is necessary for convenience and economy of operation to have two belts on the job.

It takes some little time and considerable patience to break in a new belt, due to the fact that new belting is very stiff and has a tendency to scallop at the edges. This is particularly true of the wider and heavier belts.

I have found a number of contractors who were not securing the best results, due to the fact that they did not limber up the belt before using it and did not float at the proper time. With these matters straightened out I find no case where the belt had not been entirely satisfactory to all parties concerned.

H. B. BUSHNELL,
Division Engineer, Illinois State Highway Department.
Aurora, Ill.

A Sewer System Without Manholes or Records

SIR: Previous to 1915, at which time the commission-manager form of government went into power, the city of St. Augustine, Fla., had made only spasmodic efforts at retaining the services of a city engineer. It was customary to retain the services of an outside firm to do the engineering work, and the yearly average paid on such work would have nearly paid the salary of a good engineer. The results obtained by the city by this hit-and-miss method cannot be compared with the results if a permanent engineer is employed. The permanent engineer has time and opportunity to gather information, study conditions and work toward a general plan. Better permanent records will also be left.

When the writer accepted the position of city engineer of St. Augustine in October, 1915, he found that the storm sewers were not doing the work that should be expected of them. The water would stand over some of the catchbasins for nearly a day after a rain. There were only three manholes to be found on 6 miles of storm sewers, and the only plan to be found was one owned by the Florida East Coast Hotel Company, showing the approximate location of a number of services which that company had constructed, some as early as 1887.

The sewer grades must necessarily be very slight, for the ground is very flat and there is scarcely a place 10 ft. above mean sea level. Notwithstanding this very flat grade no attempt had ever been made to clean the sewers except occasionally to flush with a firehose, although a large percentage had been in the ground over 25 years.

Manhole and catchbasin castings and a sewer-cleaning machine were purchased and the work of constructing manholes for the purpose of cleaning the sewers was for the first time begun in December, 1915.

Much difficulty was experienced in most of the sections in running the rods through the sewers, and in nearly every case it was necessary to flush the sewer to aid the rods. All the sewers were found to have large quantities of dirt and occasionally large chunks of roots. One 12-in. sewer in a prominent street, close to the business and

hotel district, was 95 per cent full of dirt.

In one instance two 12-in. and one 8-in. line emptied into a 10-in. trunk. This trunk, as well as some other sewers, had an up grade toward the outlet. In two other cases one 12-in. pipe formed the outlet for two 12-in. pipes, all on about the same grade.

The Valencia St. sewer was shown by the Florida East Coast Hotel Company plan to run through the railroad yards and empty into the San Sebastian River near the railroad bridge. A thorough search for the outlet revealed nothing until a foreman was found who had been around the yards for a number of years. He went to a point about 50 ft. back from the present shore line and said that the end of the pipe was under the place where he stood. The end of the pipe was found buried under rubbish 5 ft. deep.

The process of cleaning the sewers revealed obstructions in the pipe. In several cases pipes of various sizes crossed through the sewer. One 4-in. gas main crossed through the center of a 12-in. sewer.

One 6-in. lateral from a catchbasin extended 4 in. into the 8-in. main with which it connected. One obstruction was a sharp reverse curve made by two one-eighth bends. There was no apparent cause for this freak.

When the work of constructing manholes was begun there was adverse criticism, for it was considered useless expense. About 150 manholes have been constructed and most of the sewers have been cleaned. Now that the former critics have seen the results of the work they have changed opinions. As one expressed it, "Where it formerly required hours for the water to get away, it now requires only minutes. The sewers are as good as new at a fraction of the cost of constructing new sewers."

C. E. HENDERSON,
St. Augustine, Fla. City Engineer.

Speed Suppressors in Roads Needed to Curb Automobiles

SIR: The subject of fatalities resulting from automobile accidents is one that commands much attention in the mind of the public, and is being widely discussed throughout the country. The evil is fully appreciated, but no one has proposed a remedy.

The subject, in so far as it demands public concern, presents itself mainly in two aspects, (1) dangerous speeding in the streets of cities and towns, and (2) fatal collisions between automobiles and railroad trains or suburban trolley cars, where highways cross the tracks. The last named probably takes a much higher toll of human lives than speeding in city streets.

Experience has abundantly shown that laws enacted for the purpose of suppressing the evil cannot be made effective, as it is not practicable to enforce such laws. Since no efficient remedy is to be sought in the enactment of speed laws, the only remaining recourse is to apply physical control to moderate the speed of autos.

To abate or prevent the enormous death toll at railroad crossings due to lack of caution by auto drivers there is a simple, direct and efficient device that may readily be invoked for the purpose; to wit, on each side of the railroad track at highway crossings erect a "bumper," a ridge of earth or other road material, across the highway, generally outside the railroad right-of-way. This bumper should be steep enough to compel auto drivers to put on "slow speed" to climb over it, and its proportions adjusted after experimentation. Probably an elevation of 3 or 4 ft., with a grade of one on six, would serve the purpose.

This physical impediment would not only slow down the auto at this critical point, but would forcefully remind the occupants that they were in the presence of danger. The obstruction offered to ordinary horse-drawn traffic would not be serious, as sufficient extra effort could be put on for a short pull of say 20 ft.

Referring to speeding on city streets, there is no logical justification for building speedways capable of developing high speeds —30 or 40 or 50 miles an hour—in situations where considerations of public safety forbid such speeding. City governments take a pardonable pride in building long and smoothly surfaced streets, suitable for much higher speeds than is permissible, but to what practical end? Only to hold out invitations to high speeders, with a strong temptation to yield to the speeding impulse.

Here is presented an engineering problem for the consideration of those engineers who have control of street building and paving.

Throughout the domain of structural engineering the aim always is to build structures to serve certain purposes, and not to serve other and foreign or antagonistic purposes. Pursuing this principle in the building of streets in cities and towns, correct engineering practice would dictate that the streets should be so designed as to serve the purposes of street traffic, and not of speedways. In the variety of situations to be encountered streets should be so paved and surfaced as to permit without undue impediment fair degrees of speed up to the maximum as fixed by ordinance, and no higher.

The particular form and spacing of "speed suppressors" presents a problem that ought to be worked out by careful experimentation, the aim being to avoid undue disfiguration of streets, as well as undue hindrance to maintaining a uniform rate of speed within or up to the maximum allowed. This might take the form of graceful undulations along the axis of the street or of individual bumpers of proper design and spacing. T. G. DABNEY.

Clarksdale, Miss.

Durability of Concrete Roads

SIR: Concrete has established itself too firmly as a high-quality material for permanent road construction to be overthrown by biased testimony, but nevertheless the letter by D. T. Pierce in your issue of Oct. 21, page 509, strikes one as being about the extreme of partisanship deserving of accommodation in a technical journal.

Mr. Pierce is a dialectician of ability. On the correction of an editorial error as a peg he hangs a criticism on concrete as a road material and a praise on asphalt as another road material. He performs the trick so nicely that the editor could hardly fail being intrigued into publication. Ostensibly the illustrations of road defects are intended to reach no further than correction of a writer's error, if, considered broadly, error it was, but in reality they carry as far as a general condemnation of concrete roads. Because of this fact answer is demanded in defense of a road material so good that its opponents must resort to counting an occasional dropped stitch in order to find fault with the weave.

No type or form of permanent road construction has been developed of which examples of failure cannot be found. This is true of all engineering structures. Steel bridges have failed, masonry dams have been swept away, brick and concrete buildings have collapsed, steel railway rails have snapped and wrecked trains, locomotive boilers have exploded. Are these facts justification for condemning the materials and structures named? If not, then examples of concrete road defects merit the same judgment.

Any engineer and road builder knows that no type of road construction devised has recorded complete freedom from failures. Brick roads, bituminous roads, concrete roads, roads of any material can be found and photographed so as to present an appearance of dilapidation beside which the ruins of the Appian Way would appear smooth. This had been done with the concrete roads of Wayne county even before it was so carefully done by Mr. Pierce. Yet the fact remains that all but a minor fraction of the 150 miles of these roads remain excellent examples of the road builder's art. Even the destroyed fraction seems good enough, according to Mr. Pierce, to serve as a base for the bituminous surface which he indicates is preferable to a new concrete surface.

These things being as related, protest is justified against publication of a letter of the character of Mr. Pierce's in a professional paper without clear explanation of its limited value as evidence. We submit, sir, that you have a fault to remedy in the publication, without qualification, of the biased and misleading evidence presented by Mr. Pierce. A. CAMERON.

President, National Association of Mixer Manufacturers.

Chicago.

[Comment on this letter will be found in the editorial columns of this issue.—EDITOR.]

Manning vs. Kutter for Measuring Flow of Water

SIR: The writer would like to see discussed in your columns the relative merits of Manning's and Kutter's formulas for the velocity of flow through pipes and conduits. Manning's formula was published in the *Engineering News* of June 17, 1915, page 1171. This formula is:

$$V = \frac{1.486 \times r^{\frac{2}{3}} \times 5^{\frac{1}{2}}}{n}$$

where r is hydraulic radius; s, slope, and n, coefficient of roughness.

Malden, Mass. R. W. HORNE.

Industrial Accidents in Pennsylvania

According to the recent report of the commissioner of the Pennsylvania Department of Labor and Industry, John Price Jackson, 203 workmen have been killed on an average every month in Pennsylvania industrial plants during the current year. At the same time more than 20,000 others have been injured monthly. During the month of September injuries averaged 888 per day, and during the first nine months of the year a total of 188,278 industrial employees in Pennsylvania were injured while at work. This economic waste the report holds to be largely preventable.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Powerful Pipe Wrench Dismantles Large-Diameter Pipe Line

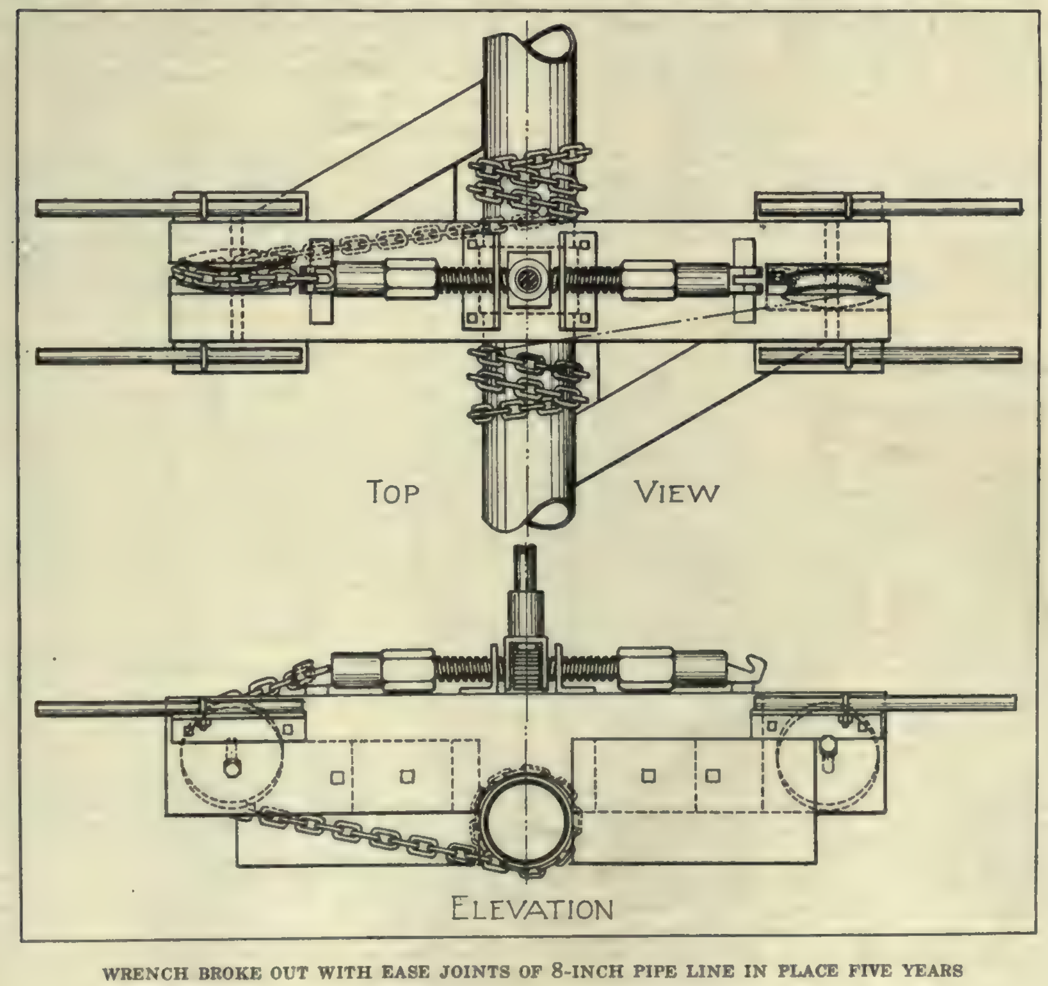
By JAMES RYAN and E. C. ENTLER
Keokuk, Iowa

IN REMOVING a line of about 4000 lin. ft. of 6 and 8-in. pipe with screwed joints which had been in place for about five years the pipe wrench shown in the illustration was used with great success to break the joints. It was rigged from a steamboat ratchet and a 12 x 12-in. timber 6 ft. long. With this rig it was possible for one man to start the joints on 8-in. pipe.

In operation the wrench was placed astride the pipe and centered over the coupling. Then the chains were given several turns around the pipe, carried over the sheaves at the ends of the wrench and hooked into the special hooks on ends of the ratchet, the screw at the start having a hold of a few turns in each sleeve. Then by means of the handle and ratchet the chain was quickly tightened up and the joint broken, in most cases with a jump. The sleeves on the outer ends of the ratchets were kept from turning over by the short pieces of steel shown on the bottom of the hooks. The short diagonal struts on each side of the 12-in. timber rested against the pipe and took the pull of the chains. The handle used in the ratchet was about 3 ft. long.

Two short pipe handles at each end provided means for carrying the wrench from place to place. For clearness the chain is shown on one-half of the sketch only, the other half being the same.

This rig could also be used for tightening joints in pipe laying by reversing the chains and the diagonal braces.

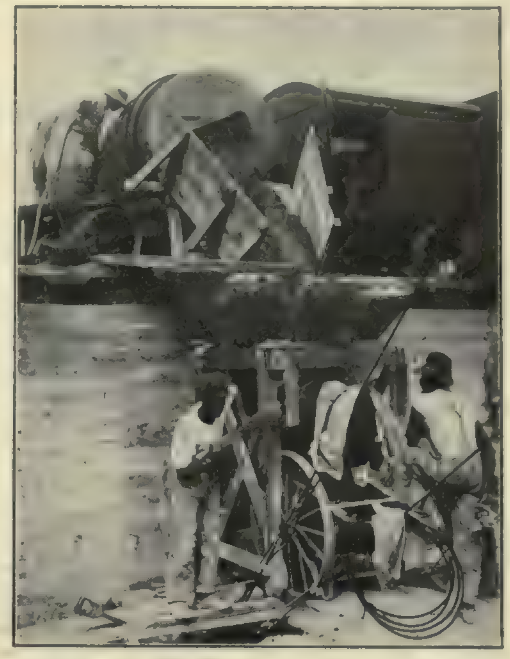


WRENCH BROKE OUT WITH EASE JOINTS OF 8-INCH PIPE LINE IN PLACE FIVE YEARS

Mixers Mounted on Street Wall Speed Up Foundation Work

MOUNTED portable mixers on the street foundations of a 200 x 287-ft. industrial warehouse in Chicago are used to expedite the foundation work and to supplement the output of three distributing towers. The Chicago Junction Railway Company is building a large general warehouse at Thirty-ninth and Canal streets, in the central manufacturing district, a rapidly developing manufacturing and mail-order merchandising center served by this railroad. This five-story building is of flat-slab, reinforced-concrete design, with red-face brick curtain walls and terra-cotta trim. The floors are designed for heavy loads, and railroad switches enter the center of the building on the first-floor level to afford shipping facilities.

As time was an important factor in the construction, C. A. Sawyer, Jr., manager for the contractor, the George A. Fuller Company, is using the same method he had employed on a Harvard University dormitory building, where the concrete had to be deposited over large floor areas. He found much economy by mounting portable mixers on the walls and moving them along as the work progressed. In the Chicago job two Standard mixers, one of 10-ft. capacity and the other of 16-ft., were mounted directly on the street foundation walls when the latter had been completed. All charging operations are carried on from the street level and in the street. The discharge is to a small steel storage hopper for filling the carts.

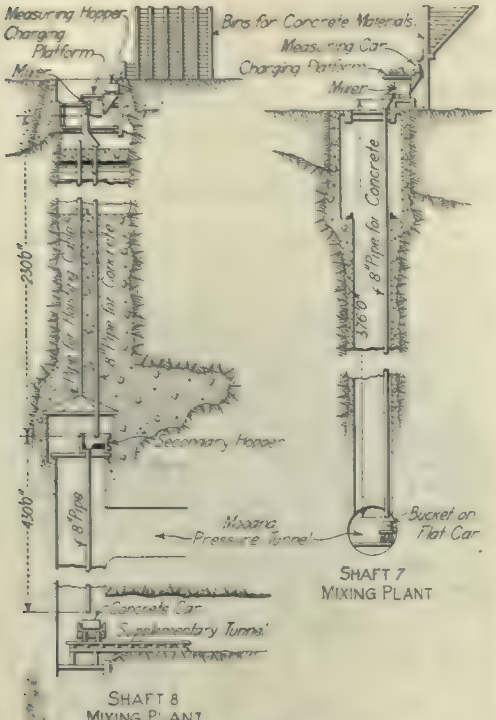


SMALL PORTABLE MIXER MOUNTED ON WALL SUPPLEMENTS TOWER PLANTS

Wet Concrete Successfully Dropped 660 Feet Into Tunnel Cars

IN LINING the supplementary tunnel at the west end of the siphon which carries New York City's new Catskill aqueduct under the Hudson River all of the concrete was dropped vertically through 8-in. open pipes down shafts 7 and 8, which furnished the only access to the work. The method, which was noted in the description of the work published in the Engineering Record of April 24, 1916, page 541, was developed by allowing the pipe to discharge directly into the tunnel cars, and used with success for the entire work. According to data made public in a paper presented by George J. F. Carey to the Municipal Engineers of the City of New York, strength tests of concrete samples taken at the mixer and in the tunnel below showed the concrete to be actually stronger after the drop than before.

As will be remembered from the article referred to, this supplementary tunnel was constructed by sinking a blind shaft, 7A, from the floor of the old tunnel about 380 ft. west of the old construction shaft 7, and driving, from the bottom of shaft 7A and from the side of old shaft 8, near the river bank, a supplementary tunnel some 400 ft. below the original tunnel. The work was



CONCRETE DROPPED 660 FEET TO CARS

undertaken after a preliminary test had developed weakness in the overlying rock near the river bank. Concrete for lining shaft 7A and for part of the invert in the new tunnel was shot down shaft 7 into round buckets on cars, in which it was transported west in the old tunnel to the new shaft. Concrete for lining most of the supplementary tunnel was shot down shaft 8 to the tunnel level, where it was discharged into concrete cars which carried it west in the new tunnel to the forms. After some experiments with a short chute at the bottom of shaft 7, it was found best to discharge the concrete directly into the cars or buckets. The concrete moved at such speed that a shower of sparks could be seen at the lower end of the pipe, and the buckets and cars rocked under the impact. The falling concrete, however, churned into the mass already in the bucket or car without the least objectionable splashing, although a moderately wet mixture was used. No free water was present after discharging and there was no separation of the aggregate. In fact, the drop appeared to improve the mixture.

At shaft 8 the concrete had to pass through a plug in the shaft above the level of the old tunnel and from there down to the level of the new tunnel. Just beneath this plug the upper 8-in. pipe discharged into a hopper from which a second pipe extended to the lower level. The bottom of the hopper was reinforced with several feet of scrap metal. Beside this protection, the falling concrete soon wore a hole which, as it was always filled with concrete, acted as a buffer.

Tests were made to determine the strength of the concrete before and after dropping at periods of 29, 31, 52 and 54 days for shaft 7 and of 21, 22, 30 and 32 days for shaft 8. In both cases the long tests showed the samples taken from the bottom of the pipe to be considerably stronger than those taken at the surface, while the short tests showed some of the surface samples to exceed in strength the samples taken in the tunnel. The average of the 52 and 54-day tests showed the tunnel sample to be 25 per cent stronger than samples taken from the same batches at the surface. While concrete has been placed before on the Catskill aqueduct work through pipes by discharging it directly into the mass of plugs and similar structures, it is believed that this is the first instance in which the method described was ever used successfully at such depth for discharging concrete into cars.

The work was carried out for the Board of Water Supply by the Oscar Daniels Company under the direction of its engineers, D. E. Baxter and C. L. Ostenfeldt, with S. A. Knowles as superintendent. The author of the paper mentioned, as field engineer, and W. B. Hoke as section engineer had charge of the work for the Board of Water Supply under Ralph N. Wheeler, department engineer; Alfred D. Flinn, deputy chief engineer, and J. Waldo Smith, chief engineer of the board.

Exact Distribution Kept in Form for Comparing Final Costs

By HOMER V. KNOUSE
Construction Engineer, Metropolitan Water District of Omaha

THE FORM shown herewith was devised by the writer to record labor distributions accurately in the field, and at the same time to make a record in convenient shape for direct use in compiling final costs. Folded along the dotted line and inserted in an aluminum sheet holder, this form is readily carried around in the pocket. It makes use of both sides of the sheet, and the way in which time is kept on it and the distribution totals arrived at is evident without further explanation. The sheets as they are filled up day by day are filed in a ring binder after being punched as shown along the long side when open.

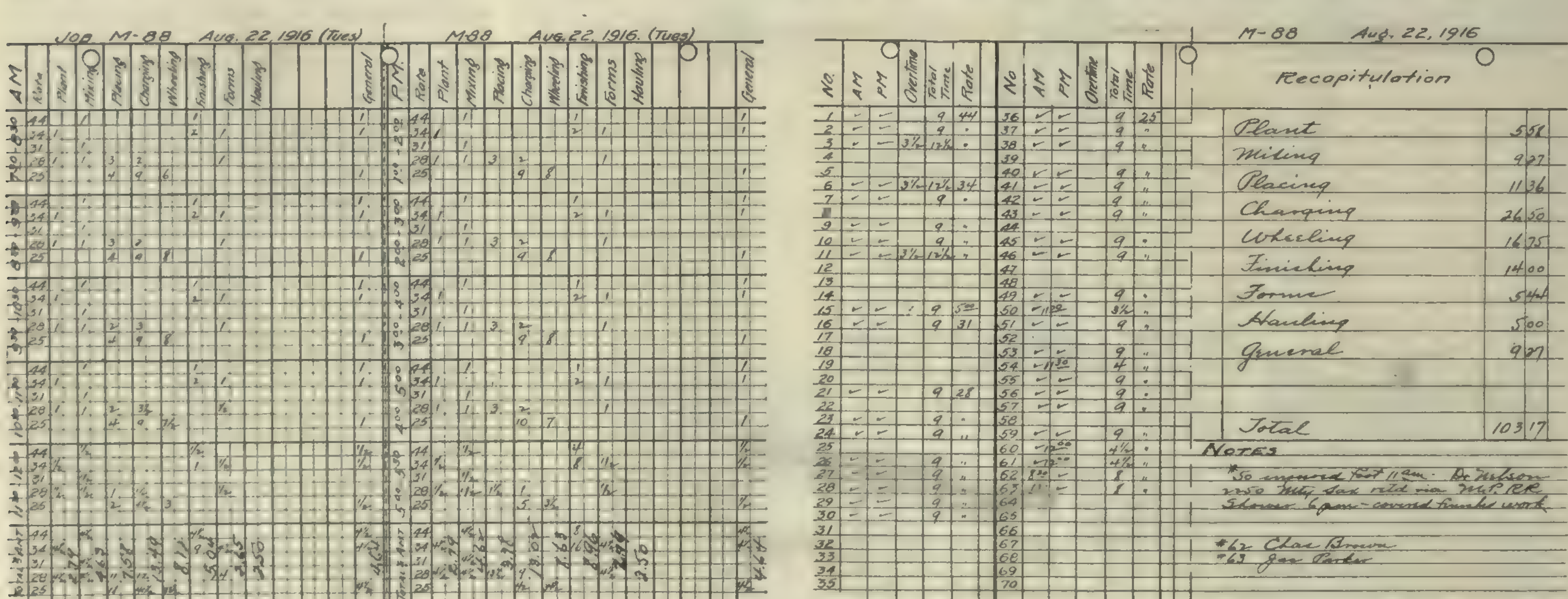
Asbestos Lining in Truck Body Holds Heat in Asphalt

IN two 7-ton trucks recently furnished the White Paving Company, Chicago, for hauling hot asphalt an insulated lining was built inside the regular steel body. These trucks, which are equipped with 6-cylinder 60-hp. electric starter engines, have the extra lining bolted to the regular body. The lining consists of a light sheet-steel, metal-lined plank frame, with asbestos sheets between the steel plates and the planks. For hauling stone, gravel, coal or other material in which it is not desired to retain the heat the lining can easily be detached as a whole.

The dump bodies of these trucks, which are made by the Stegeman Motor Truck Company, Milwaukee, are equipped with chutes to deliver on either side and a hydraulic hoist to operate the body to dump the material to the rear.

Shipyards Active and Export Records High in Northwest

In Seattle and vicinity three shipbuilding firms are at work on twenty-three steel vessels and two Portland firms are building eight more, making a total of thirty-one, the gross registered tonnage of which will be about 200,000 tons and total value, completely equipped, about $25,000,000. Wooden vessels are under construction as follows: Seattle, six; Portland, two; Aberdeen, four, and Astoria, three—the total value of the fifteen being about $1,600,000, exclusive of engines. Some of these will be driven by steam and some probably by Diesel engines. Announcement of final decision has not yet been made. According to a recently published summary by the Department of Commerce at Washington, D. C., Puget Sound ports surpassed all previous records in June, when their total foreign trade amounted to $43,812,200.


Job M-88 Aug. 22, 1916 (Tues) M-88 Aug. 22, 1916 (Tues)

M-88 Aug. 22, 1916

Recapitulation

Plant	5 58
Mixing	9 27
Placing	11 36
Charging	26 50
Wheeling	16 75
Finishing	14 00
Forms	5 44
Hauling	5 00
General	9 27
Total	103 17

NOTES

#62 Chas Brown
#63 Jas Parker

DOUBLE-SIDED SHEETS, TAKEN OUT EACH DAY, ARE FILLED IN AND TRANSFERRED TO A FILE FROM WHICH ACCURATE COSTS ARE MADE UP

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Let the Contractor Solve Disposal Problems

San Francisco Simply Asks for Bids, Leaving It to Bidders to Draft Plans and Name Guarantees

The question of garbage disposal in San Francisco has been before the board of supervisors of that city for more than a year. It has been discussed several times, the health committee has made recommendations, and proposals have been received from a large number of would-be garbage disposal companies, but nothing had been done up to Oct. 30 when the matter was on the supervisor's calendar as a special order.

When the subject came up at this session, instead of entering into a lengthy discussion of the best course to pursue, Supervisor McLaran moved that the city call for bids for the disposal of garbage, proposals to be received Nov. 20 accompanied by a certified check for $10,000. Each bidder is to furnish detailed plans which he proposes to use, and state fully the terms, conditions and guarantees attached thereto. After a short discussion this motion was adopted and official action was taken accordingly.

Eighteen Proposals Received

In a recent report issued by M. M. O'Shaughnessy, city engineer of San Francisco, eighteen propositions which had been tendered to the city were discussed in detail. This large number of offers would naturally be taken to indicate that there is a considerable interest in the profits that may accrue from the disposal of the city's garbage. The present situation which has developed from the refusal to accept the incinerator which was built under contract for the city has been covered in Engineering Record articles as follows: general description of the plant, Aug. 16, 1913; report of tests, July 4, 1914; discussion of design and operation, June 19, 1915; brief review of the situation, Feb. 20, 1915.

New Subway Link Opened November 5

The Ely Avenue extension of the Queensboro subway, from the Hunter's Point Avenue station in Queens north to the new Queensboro Bridge plaza station, New York City, was opened to the public Nov. 5 at noon, completing the first through rapid-transit link between the new half-million dollar station on the Queensboro Bridge plaza and Park Avenue and Forty-second Street, Manhattan.

The Queensboro subway is an important link in the new dual rapid-transit system. Ultimately it will be extended west from Park Avenue to Times Square. At the bridge plaza station in Queens it connects with the Astoria and Corona elevated extensions, which are now being pushed to completion and should be in operation within the next few months.

Concrete Institute Convenes February 8, 9 and 10 at Chicago

The thirteenth annual convention of the American Concrete Institute will be held Feb. 8, 9 and 10 at Chicago. The fourteen technical committees of the institute are actively at work in their respective fields and will report at the February gathering. Funds are now available for publishing all back issues of the proceedings, and the material is in the final stage of editing. Volumes 9 and 10 will be issued this year, and Volume 12, which is a record of last February's convention, is now being bound.

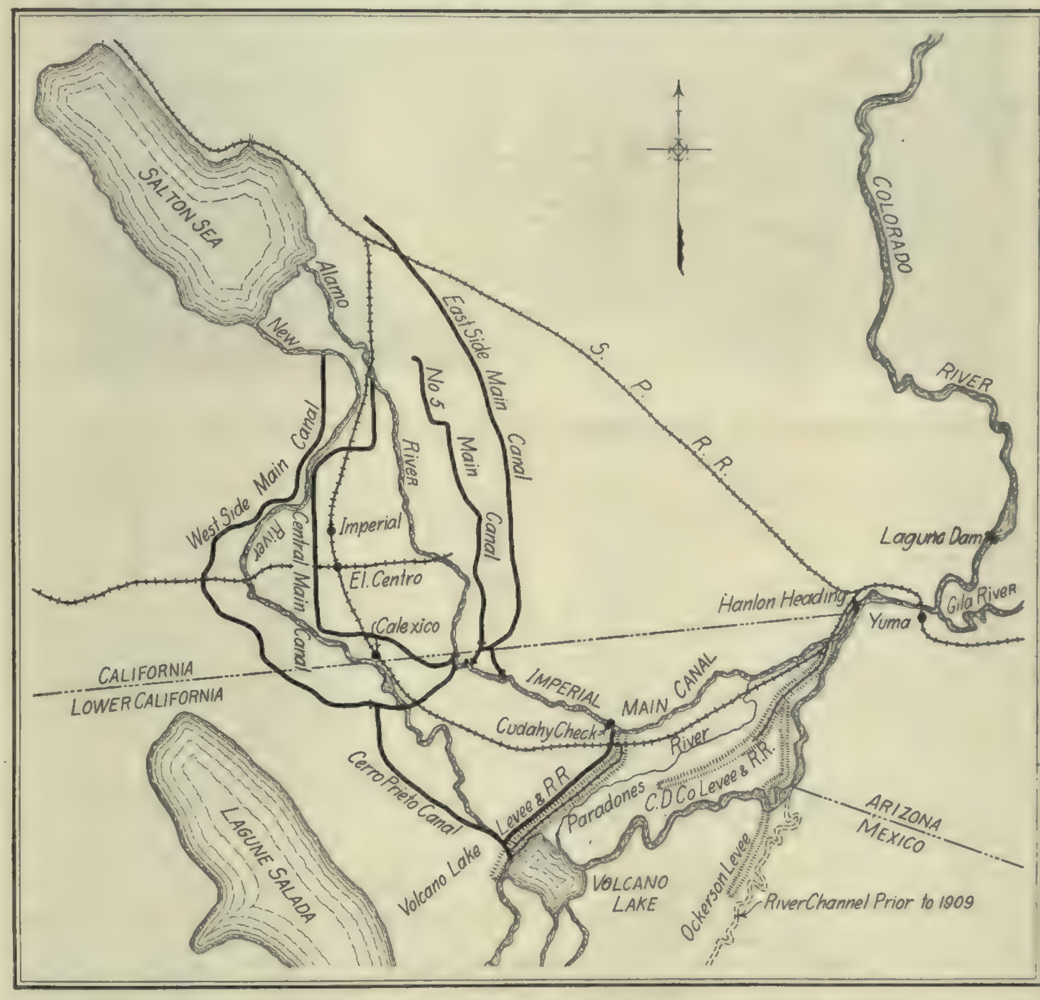
Water Meter Rate Decision Pending in San Francisco

About four months ago the Spring Valley Water Company of San Francisco decided that in order to trace unnecessary waste it would be advisable to meter a large portion of the city service. Accordingly, about 12,000 meters were installed throughout the city. The meters have increased consumers' bills in certain cases and there have been protests to the Railroad Commission of California. In an order dated Nov. 2 the Railroad Commission instructs the company that "while metered service under proper rates is undoubtedly desired, the commission believes it is neither fair nor proper that the Spring Valley company should begin charging under meter rates until the consumer has had an opportunity to adjust himself to the new situation and the commission to pass upon the fairness of the meter rates."

The commission directs the company to charge consumers according to the flat rates heretofore in effect, and not according to meter rates, until Feb. 1, 1917.

Reopen Long Sault Water-Power Case

The U. S. Supreme Court Oct. 31 heard reargument of the fate of a water-power project at Long Sault Islands in the St. Lawrence River, said to be capable of developing 600,000 hp. The Long Sault company's charter was annulled in Governor Sulzer's administration. The case was lost in the federal courts, and was brought to the Supreme Court, where the first argument was heard last April without a decision being reached.



GENERAL MAP OF IMPERIAL VALLEY DISTRICT SHOWS LOCATION OF CANALS, DAMS AND RIVERS

What Imperial Valley Canals Need

Report of Board of Consulting Engineers Discusses Nine Improvements—Total Cost to Be $750,000

As a result of the detailed examination of the Imperial Valley canal system, the consulting engineers, C. E. Grunsky and George G. Anderson, have submitted a report recommending that work be undertaken at once on improvements which will cost about $750,000. The problem of greatest urgency is that of securing an adequate supply of water for the district during 1917. The proposed method of providing this is expected to obviate the difficulties under which the main trunk canals are now operated. The recommendations do not require the construction of a temporary dam across the river next year nor will the work be wasted in case it should, at some later date, be desirable to connect the Imperial Valley system with a supply from Laguna dam.

Conditions affecting the water supply are at present considered more adverse than ever before. The deposits of silt in the upper portion of the main canal are very heavy. There are larger volumes of water with probably more silt in the Colorado River than is usual at this time of the year, and the natural erosion of the canal bed ordinarily experienced in the low-water season is probably less than normal.

It is not probable that the works proposed for reducing the amount of silt entering the canal can be constructed before the season when the demand for water usually cannot be fully met owing to silt deposits in the head of the canal. Because of these facts, the proba-

bility that permission to temporarily dam the Colorado River will not be renewed, and in view of the naturally increasing demand for water, amelioration of the water supply situation after high water next year can best be secured by centering effort on the reduction of canal bed elevations, beginning at the point of diversion from the river.

Recommendations

The recommendations for accomplishing this are discussed under eight heads as follows:

(1) Extend the canal upstream from Hanlon Headgate about 1¼ miles and there control the intake by a structure arranged to admit the river water over the top of flashboards. This is to reduce the amount of sediment entering the canal by increasing the width of intake and to afford a length of canal above the headgate from which the sediment can be removed readily by a dredge of large capacity.

(2) Dredge material from the canal bed in its upper reaches to the limit of dredger capacity, particularly between the Hanlon Headgate and the railroad bridge. There may be early need for two new suction dredges—certainly for one to be placed immediately in this part of the canal.

(3) Remove the trestle obstruction now in the canal about 3½ miles below Hanlon Headgate at the railroad and highway crossing. The trestles should be replaced by structures that will not cause the deposit of material above and below.

(4) Shorten the Alamo River canal above the Cudahy check by cutting off bends wherever a material reduction in length can thereby be effected. The several reductions in channel length which are feasible will cause a lowering of the canal bed at upstream points and this will in a short time make itself felt at the head of the canal where it will ultimately amount to 4 or 6 ft.

(5) Improve the regimen of the Alamo River canal by contracting its width at the points where bank erosion has occurred and the adjacent channel has widened and created broad sand bars with shallow depth. There are stretches, totaling several miles in length, where the channel is wide and flat, reducing velocity and inducing deposits. The effect of this repair will be to increase the scouring velocity and maintain a nearly uniform section.

(6) Make all necessary repairs at Hanlon Headgate. It is believed that there has been some undercutting of the concrete foundations and it is known that the granite on which the gate structures rest is not solid throughout. Although there has been no recent change in the situation every precaution should be taken to thoroughly safeguard the structure.

(7) If topographic conditions permit, connect the old Alamo River with the Alamo River canal so that this old channel may supplement the present canal to the extent of its capacity. Also, if conditions warrant, provide a wasteway leading to Paradones River.

(8) Make studies and prepare the plans for upstream extension of the Cerro Prieto canal to a connection with the Alamo River canal at the Cudahy check. An early decision on this improvement must be made because the extension would afford opportunity to waste water from the Alamo canal aiding in the scouring of the main canal; it would relieve the burden upon that canal below the Cudahy check; it would provide economical service to the west side canal system, and when its north levee is brought to full contemplated height, would afford additional protection against floods from the south.

Conclusion

Particular attention is called to the fact that the bed of the Alamo River canal for more than a mile below the Hanlon Headgate now has an average elevation higher than the original sill of the gate. Recommendations 2, 3 and 4 are made for the primary purpose of lowering this average canal level before July, 1917.

A dredger of the suction type should be put to work immediately between Hanlon Heading and the railroad crossing. All sand that can be excavated here before next July will not only help directly in improving the water supply situation for 1917, but the cost of removing heavy silt by the larger dredger will be less than in the lower reaches of the canal by more expensive methods. The rehabilitation of the dredger Delta, of the long-boom, clamshell type, is recommended.

The early execution of the foregoing recommendations is expected to preclude the likelihood of any water shortage in 1917 and the engineers recommended that the $750,000 necessary to carry out the work be made available as soon as possible. The report was read Oct. 25 at a meeting in El Centro. It was generally believed that the directors of the district will at once take steps to raise the needed funds.

Paints Proposed Hydroelectric Development on Picture of Site

TO SHOW his clients how their project will look when completed, an engineer recently had a view of the hydroelectric development painted on a picture of the power site as shown.

The proposed installation is to be at the mouth of the White Rock Cañon of the Rio Grande River in New Mexico. As no rock was found, although the borings were carried down 186 ft. below river level, it was necessary to design a light, hollow structure supported on a mattress. A cutoff wall, consisting of sheet piling, and a solid concrete wall 15 ft. thick form a seal between the toe of the dam and the clay strata located about 50 ft. below the river level. The buttresses in the dam vary from 48 to 16 in. in thickness and are spaced 25 ft. on centers. The deck consists of a series of shallow arches 54 in. thick at the bottom and 16 in. at the top. The total height of the dam, measuring from the bottom of the mattress at the deepest point to the bridge on top of the dam, is 155 ft.; the width of the base of the dam, 200 ft. and the distance between the cañon walls, 400 ft. The dam therefore stands on a girder 400 ft. long and 200 ft. deep, which has been designed to carry the horizontal pressures due to the water and the cutoff over on the cañon walls. The power house has been designed in the Spanish mission style which prevails in New Mexico. The project will cost $2,200,000 and will develop 25,000 hp. A. G. Hillberg, consulting engineer, of New York City, designed the plant, which will be built by the Rio Grande Light, Heat & Power Company, of which Charles G. Wilfong of Philadelphia is president.

Road Builders Elect Officers

The following officers were elected Nov. 3 by the American Road Builders' Association at the meeting in the Automobile Club of America, New York City: President, Arthur W. Dean, chief engineer, Massachusetts Highway Commission; vice-presidents, W. H. Connell, chief of Bureau of Highways of Philadelphia; Austin B. Fletcher, state highway engineer of California, and Arthur H. Blanchard, professor of highway engineering, Columbia University; secretary, E. L. Powers, editor of *Good Roads;* treasurer, W. W. Crosby, consulting engineer, of Baltimore, Md. The directors elected are: T. R. Agg, professor of highway engineering Iowa State College; W. E. Atkinson, state highway engineer of Louisiana; Fred E. Ellis, manager, Essex Trap Rock & Construction Company, Peabody, Mass.; R. H. Gillespie, chief engineer of sewers and highways, Borough of the Bronx, New York City; B. Michaud, deputy minister, department of roads, Province of Quebec, Canada; Paul D. Sargent, chief engineer, Maine highway commission.

State Control of Power Suggested at Pennsylvania Conference

A committee to draft legislation in collaboration with the Pennsylvania Water Supply Commission was authorized at the recent conference on flood control and water conservation at Harrisburg. The committee will prepare bills for regulation of the control of state waters and report to another conference to be held before the next Legislature meets.

Provisions for flood prevention, impounding of waters to furnish a regular supply and state control of water power were urged by Governor Brumbaugh. Among those who took part in the discussion were Morris Knowles, consulting engineer and member of the Pittsburgh Flood Commission; Col. Edgar Jadwin, Corps of Engineers, U. S. A.; Frank Sutton, of the U. S. Geological Survey; Forestry Commissioner Conklin, and R. A. Zentmyer, water supply commissioner.

Welfare and Efficiency Conference November 21 at Harrisburg, Pa.

The fourth annual Welfare and Efficiency Conference to be held Nov. 21, 22 and 23 at Harrisburg, Pa., under the direction of the State Department of Labor and Industry and the Engineers Society of Pennsylvania will constitute a symposium of interest to manufacturers and the engineering profession. Dr. John Price Jackson, former dean of the engineering department of Pennsylvania State College and now commissioner of labor and industry in Pennsylvania, will preside.

Among the engineers who will speak will be William D. S. Ainey, chairman of the Pennsylvania Public Service Commission; R. Boone Abbott, president of the Engineers' Society of Pennsylvania and superintendent of the Harrisburg division of the Philadelphia & Reading Railway; Francis D. Patterson, chief of the division of hygiene and engineering of the department of labor and industry, and L. A. DeBlois, of the engineering department of E. I. du Pont de Nemours & Company.

May Cut Seattle Bridges to Permit Passage of Dredges

Lieut.-Col. J. B. Cavanaugh, Corps of Engineers, U. S. A., at Seattle, has served notice on A. H. Dimock, city engineer, that government dredges will pass through the Lake Washington Canal and through the Latona and Stone Way bridges between Nov. 7 and 10. Mr. Dimock in turn has referred the matter to the city council, which will be forced to devise means for caring for vehicular and street-railway traffic now passing over these bridges. As there are no drawspans in either structure, it will be necessary to cut them, suspending traffic entirely.

Engineering Society Activities

Canadian Society of Civil Engineers held its monthly meeting Nov. 2, at which G. L. Dobbin, of the Royal Montreal Regiment, delivered an address on "Bombing in the Front Line Trenches." Specimens of bombs were exhibited and their uses explained.

Western Society of Engineers will hold a meeting Nov. 13 at Chicago. C. J. Humphrey will discuss decay in timber and its growing importance to the engineer and architect. At the Nov. 20 session the importance of the relation of solid surface and liquid films in some types of engineering construction will be emphasized by Clifford Richardson. The construction of a narrow-gage railroad was Aaron S. Zinn's subject for his lecture at the Nov. 6 meeting.

Seattle Association of members of American Society of Civil Engineers held a meeting in the chamber of commerce rooms Nov. 1 to further discuss the proposed state water code and make recommendations in regard thereto.

Engineers' Club of San Francisco held its annual meeting and dinner Oct. 27. A paper on "Curtis Turbines Applied to Cargo Boats" and illustrated with stereoptican views was presented by W. J. Davis, Jr. The officers elected for the ensuing year were: President, C. T. Hutchinson; vice-president, William H. Shockley; second vice-president, B. P. Legare; treasurer, A. H. Griswold, and secretary, C. E. Grunsky, Jr.

Brooklyn Engineers' Club will meet Nov. 16 to hear Augustus J. Koehler, attorney, outline the history of the lien law and rights and remedies of engineers thereunder. At last Thursday's meeting Walter E. Heibel presented a paper on air conditioning in industrial plants.

Civil Engineers' Society of St. Paul will meet next Monday evening in the City Hall. George L. Nason will read a paper on landscape engineering.

American Society of Civil Engineers, at the Nov. 15 meeting in New York City, will discuss a paper on "The Yale Bowl" by Charles A. Ferry, consulting engineer, of New Haven.

New Chapter of Engineering Society at Gary, Indiana

Nine members of the American Association of Engineers recently conducted a meeting at the Y. M. C. A. Building, Gary, Ind., which was attended by thirty-seven engineers not identified with the movement and by three members at present employed in that city. After the objects, methods and results secured by the association during its sixteen months of existence were explained, twenty-one applications for membership were received and the temporary organization of the Gary chapter was effected. This is the first instance of the association succeeding in organizing a chapter during one evening's effort. The total membership is now 1335. When it reaches 1500 the initiation fee will be increased to $4.

What Engineers and Contractors Are Doing

ELMER FOLSOM and MILO C. TAYLOR have opened consulting engineering offices in the Peoples Bank Building, Bloomington, Ill.

EDWARD A. CLARK, consulting engineer, of New York City, has withdrawn from the firm of Giles & Clark. He will continue as consulting engineer and contractor for diamond drill and wash borings.

EDGAR F. ROBINSON has been promoted from chief engineer of the Buffalo, Rochester & Pittsburgh Railway to become general manager. Those formerly reporting to the chief engineer will hereafter report to the general manager. Mr. Robinson has been chief engineer since 1907 and has served the Buffalo, Rochester & Pittsburgh since 1902, when he was appointed engineer of track. After graduation from Rose Polytechnic Institute in 1894 he entered the service of the Cleveland, Cincinnati, Chicago & St. Louis Railway. From then until his appointment with the Buffalo, Rochester & Pittsburgh he was, at various times, employed by the engineering departments of the Indiana & Illinois Southern, the New York Central, the Chicago, St. Paul, Minneapolis & Omaha and the Butte, Anaconda & Pacific railways.

RICHARD E. FROISETH, formerly engineer for the Pittsburgh-Idaho Hydraulic Manufacturing Company of Boise, Idaho, has become associated with R. W. Rea, consulting engineer, of Portland, Ore. Mr. Froiseth received his engineering education from the International Correspondence Schools. In 1906 he joined the engineering staff of the Nevada Consolidated Copper Company. Two years later, after a brief experience with the U. S. Coast and Geodetic Survey, he went to the Utah Independent Telephone Company. While in that firm's employ he had charge of the construction of the Salt Lake City underground and overhead cable systems. In 1912 Mr. Froiseth joined the engineering staff of the Kittitas Reclamation District and later in that year went to the Kettle Valley Railway. That was followed, in 1913, by his appointment as assistant engineer for the Cascade Irrigation District in Washington. His appointment with the Pittsburgh-Idaho Hydraulic Manufacturing Company came soon after.

CARL J. RHODIN, formerly civil and hydraulic engineer on the San Francisco staff of the J. G. White Engineering Corporation, has resigned to open consulting offices in the Alaska Commercial Building, San Francisco. Mr. Rhodin is a graduate of the Royal Technical University of Stockholm, Sweden, class of 1900. A few months as assistant engineer in the department of public works of Gothenburg, Sweden, was followed by his appointment as assistant engineer to the chief of the Upper North District, Royal Department of Roads and Canals. After coming to the United States in 1902, Mr. Rhodin entered the employ of Snare & Triest, New York City, but resigned a few months later to become assistant engineer for C. MacDonald & Company on pier and foundation construction on the Thebes bridge across the Mississippi River. He went west in 1904 to take a position with the Atlantic, Gulf & Pacific Company, in charge of bids, estimates, plans and design of bridges, dredging machinery, foundations and wharves. For a few months in 1906 he was in charge of construction for the Pacific Gas & Electric Company, following which he was engineer of design and construction on several large buildings in San Francisco. Early in 1907 Mr. Rhodin joined the engineering staff of the California highway department, but resigned the next year to engage in private practice, which he carried on until 1910. He then became engineer on investigations for hydraulic projects for the Southern Pacific Company. Since March, 1911, he has been in the San Francisco office of the J. G. White company.

F. T. CUMMINGS has formed a partnership with L. C. Bishop, county engineer of Converse County, Wyoming, to engage in consulting practice at Douglas, Wyo. Since late in 1910 Mr. Cummings has been engineer for the Rock Creek (Wyo.) Conservation Company and will continue to act as the firm's consulting engineer on its 80,000-acre irrigation project in the southern part of the state. For ten years previous to 1910 Mr. Cummings was employed in the maintenance-of-way department of the Union Pacific Railroad, attaining the position of assistant engineer at the time of his resignation.

A. P. WYMAN has resigned as assistant engineer for the Maine Central Railroad to become civil engineer for the Texas Steamship Company at Bath, Me. Mr. Wyman had been in the employ of the engineering department of the Maine Central since graduation from the University of Maine in 1907.

C. J. ULLRICH, assistant state engineer of Utah, has just finished a trip of investigation of water filings in various counties. Owing to the lack of railroad facilities he went by motor car, covering 1000 miles.

L. B. STEPHENSON has been appointed county highway engineer at Spirit Lake, Iowa, to succeed C. S. Arthur, resigned.

Obituary Notes

JOHN F. O'CONNOR, formerly a government contractor and builder of the jetty system at Galveston, Tex., died in Chicago, Nov. 3, at the age of seventy-two.

GEORGE P. WOODHALL, civil and mining engineer for the Utah Copper Company, was killed Oct. 30 at Bingham when a surveyor's tape he held came in contact with a high-tension wire. He was a graduate of the Missouri School of Mines, class of 1901. From 1906 to 1911 he had been assistant engineer for the Oregon Short Line and during 1913 and 1914 served as assistant state engineer of Colorado.

WILLIAM COOPER CUNTZ, general manager and director of the Goldschmidt Thermit Company of New York City, died Nov. 2 at Auburndale, Mass. Mr. Kuntz was born at Hoboken, N. J., in 1871. He attended the Hoboken Academy and Stevens Institute of Technology, being graduated from the latter institution in 1892. He then became connected with the Pennsylvania Steel Company's bridge and construction department and later with the sales department, which he represented in Boston, Philadelphia, London and other large cities. In 1910 he severed his connection with the Pennsylvania Steel Company to become a director and general manager of the Goldschmidt Thermit Company. At the time of his death he was also director in the Goldschmidt Detinning Company.

SYDNEY W. HOAG, who retired from the service of New York City about two years ago, and who had since carried on a consulting practice in that city, died Nov. 3. He had been in the city's employ for 30 years, entering the park department after graduation from the College of the City of New York. After a short term in the park division, Mr. Hoag was transferred to the Department of Docks and Ferries, in which he was made assistant engineer. He was promoted to deputy chief engineer of the department in 1905, from which position he retired with a pension a few years ago. Since retirement Mr. Hoag had engaged in consulting practice. He was a native of New York City and was born in 1858.

Barrel Elevator Installed Without Deep Pit

A barrel elevator which eliminates the need of a deep pit under the foot sprockets, and is therefore particularly adapted to conditions where the entire machine must be above the floor, has been designed by the Chain Belt Company of Milwaukee. The device has been adopted by the Standard Oil Company's Milwaukee works.

The machine is used to elevate empty barrels from the wash-house and deliver them

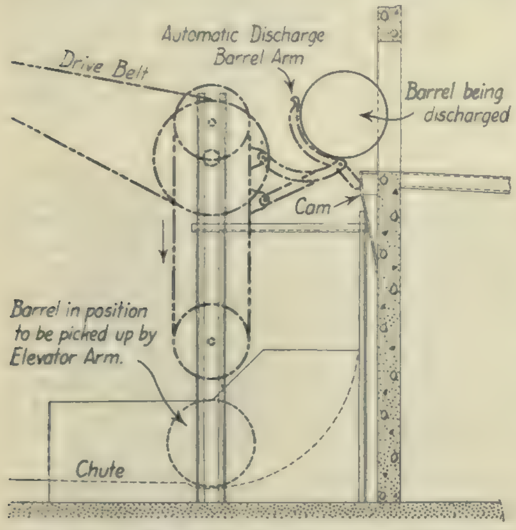


DIAGRAM SHOWS ELEVATOR IN RELATION TO SKIDS, WITH ARM IN DISCHARGING POSITION

upon an inclined skid, on which they roll by gravity about 100 ft. to the filling room. This barrel elevator has the special feature of being able to pick up the barrels from a curved chute underneath the foot sprocket.

The barrels are rolled out of the tank and are picked up by the arm, one at a time, as it sweeps around the bottom of the chute. The barrel arm is attached to two strands of Griplock Chain Belt, which carry it around the head and foot sprocket. The arm is of the automatic-discharge type, which trips by means of a pair of cams engaging the ends of the curved lever arms which carry the barrels. These cams are placed on the upcoming side of the elevator, just in the opening in the wall through which it is desired to discharge the barrels. The Chain Belt is provided with suitable attachments for the crossbars of the barrel arm, and the whole machine is mounted on a structural-steel frame with necessary guides for the Chain Belt and supports for the shafting.

NEW BARREL ELEVATOR

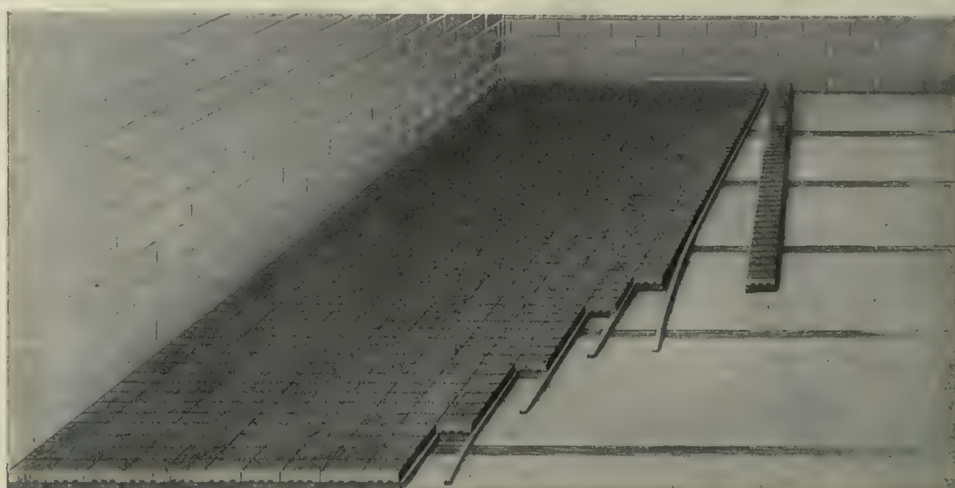
About 1 hp. is required for driving the elevator. The power is taken from a line shaft in the building by a belt coupled up to the elevator countershaft. The machine, which can be adapted to almost any conditions where it is desired to transfer barrels from one building to another, has a capacity of 120 bbl. per hour.

Make Smokestack 55 Feet Long in One Piece

A smokestack 50 ft. long was recently made in one piece for the city of Chicago by the Standard Spiral Pipe Works of that city. A piece of Standard reinforced spiral pipe was used. Later the Standard company made two one-piece 20-in. stacks 55 ft. long, using only one set of guy wires. A recent windstorm furnished a severe test which the Standard smokestack is said to have survived admirably.

Makes Floors of Wood Blocks Dovetailed to Base

The "welding" of wood blocks on end to the face of baseboards so that no other base is required (thus saving the tedious and expensive laying of single blocks) and making possible its use over timber joist are the features of a new type of flooring for use in mill buildings, factories, warehouses, station platforms, freight houses, bridges and docks. The illustration shows the construction—wood blocks dovetailed to a baseboard with a spline nailed to the floor joist or nailing strip to hold the 8-ft. sections together. The standard sections are made from Southern pine blocks 1½ x 3½ in. on the surface and 1 to 2 in. deep. The baseboard is 1 or 2 in. deep.



LAID ON CONCRETE, THE NAILING STRIPS FOR BLOXONEND ARE SPACED FAR APART

Sections of the flooring laid two years ago in front of the elevators in the Emery, Bird, Thayer Dry Goods Company's store in Kansas City are said to have given good service.

Bloxonend, as the new type is called, is made by the C. J. Carter Lumber Company, Kansas City.

Take Turns Driving and Sleeping to Deliver Trucks on Time

Facing a critical blockade in freight shipments due to the threatened railroad strike, the Norton Grinding Company of Worcester, Mass., prepared to meet the crisis by purchasing a fleet of three 5-ton White motor trucks, which was done through the White Company's Worcester representative. It was stipulated that the trucks were to be delivered in Worcester within three days, independent of railroad service.

Simultaneously with the signing of the contract a crew of six men in charge of a foreman from the Boston office was dispatched to Buffalo to meet the boat bringing the machines and to drive them from Buffalo to Worcester. A prearranged schedule called for the departure of the trucks from Buffalo on Sunday noon and their arrival in Worcester at the same hour on Tuesday. The trip was made in exactly 48 hours, which, so far as is known, is a record for continuous running for trucks of this capacity. Records showed that all three trucks made better than 11 miles to a gallon of gasoline on the 500-mile trip. Stops were made only to replenish the gasoline and oil supply and permit the drivers to eat. The army bodies with which the trucks were equipped were filled with hay and the drivers took turns at sleeping and driving.

Trade Publications

The following companies have recently issued trade literature:

United Brass Manufacturing Company, Cleveland, Ohio. Catalog D1, 72 pages, illustrated. Compiled especially for engineers and contractors interested in water works design and construction. Contains tables giving proportionate delivery of pipes from ⅛ to 10 in. diameter and other data.

Sprague Electric Works of the General Electric Company, New York City. Bulletin 48906, 8 x 11 in., 32 pages. Gives ratings, weights and specifications for electric hoists of one-half ton and one-ton capacity. Also shows many uses of that equipment.

Warren Webster & Company, Camden, N. J. Catalog, 8 x 10 in., 144 pages, illustrated. Enumerates advantages and describes design and installation of Webster vacuum system of steam heating. A typical system is described and illustrated, and the specific features of the Webster system are discussed. Special Webster heating systems and appliances also are illustrated and described.

William B. Scaife & Sons Company, Pittsburgh. Booklet, 8 x 11 in.; 72 pages. An illustrated treatise on the purification of water by means of the Scaife and We-Fu-Go systems.

The American Steel & Wire Company has issued a 150-page manual, illustrated, dealing with the treatment of water by the sulphate of iron and lime process. The book has been prepared by the company's water purification bureau, organized to exploit the use of sulphate of iron at filter plants. It is replete with useful data for sanitary engineers and city officials. There is a thorough discussion of the chemical phases of water purification in addition to many tables of discharge through orifices, heads and pressure equivalents, alkalinity and hardness equivalents and conversion charts. On filter operation a great deal of valuable information is given. Some of the subjects are coagulation, air wash troubles, strainers and manifolds, rate controllers and chemical difficulties. The book gives evidence of painstaking and intelligent preparation and should be in the library of every engineer or municipal official who has anything to do with the water supply of his city.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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A Momentous Investigation

THERE will begin in Washington next Monday hearings that may have a most important influence upon one of the leading American industrial activities—the operation of our railroad system. The last session of Congress authorized, in accordance with the recommendation of the President, a joint commission of Senators and members of the House to review the railroad situation with reference to government regulation and government ownership. If predictions are correct, the railroad representatives will make some very far-reaching recommendations, while from the public's side one may expect all sorts of fantastic plans. It is too much to expect, no matter how thorough the hearings, that any quick solution of our railroad ills will result from the committee's work. Its report, however, should be the starting point, at least, of a better handling of our railroad problem. Relief is needed. Let us hope that the work of the Newlands committee will bring to regulators—state and national—a realization of the real needs and the fundamentals of a correct solution.

Experts Overnight!

THIS JOURNAL has had occasion in the past to criticise the practice of cities sending committees of laymen on trips of inspection, presumably for the purpose of securing data upon which to base recommendations for public-works construction. A recent press report from a Middle Western city states that a party consisting of two aldermen, the city attorney, two commissioners and two members of a township board has begun a pilgrimage—at the city's expense, it is safe to infer—for the purpose "of making a further investigation of sewage-disposal plants in the East." We are informed that this delegation "will visit Brooklyn, Rochester, Philadelphia, Boston, Cleveland, Akron and other Eastern points where sewage-disposal plants are in operation." What a merry little junket this will be! And think of the valuable data on the technical features of sewage treatment which these studious aldermen and township-board members will amass during their trip! How the city will profit by the advice these officials will bring back with them! They will become sanitary experts almost overnight. What need for a town to engage a consulting engineer to solve its technical problems when aldermen, city attorneys and commissioners are available—and in fact eager—for this service? Of course the city will pay a fat expense account in railroad fares, hotel bills and "sundries," and may be forced to replace ill-advised apparatus which experience shows will not work. But what does this amount to as compared with the broad education in sanitary engineering which the aldermen and the city attorney will have received?

The Concrete Institute

AS READERS of this journal well know, the American Concrete Institute has passed through many vicissitudes. Two or three times powerful friends have come to its support and lifted it out of bankruptcy. The management was inefficient, however, and again and again it slipped back. Now it appears a better day has dawned. Since the transfer of the management to Boston, the finances have reached a sound basis. Funds are on hand for publishing the three delayed volumes of proceedings and all of them are to appear before the close of the year. The committees are displaying a new activity, a good promise of a worth-while convention next February. The present condition of the institute warrants for the organization a wider support than it is receiving. Despite its past financial disabilities, it has rendered invaluable service. Its work on the method of finishing concrete surfaces, on insurance, on standard specifications for various forms of concrete construction has been notable and useful. In order that this work may be continued and the scope enlarged, engineers and contractors interested in concrete work should lend their support financially and morally, by taking membership in the institute and participating in the committee work.

Educational Efficiency

THE outside investigator generally commands attention when a man of equal ability in the organization or community cannot get a hearing. Possibly, then, the report made by a commission for the Federal Bureau of Education on the higher educational institutions of Iowa may bring about a reform which local agitation was unable to effect. The commission investigated the whole question of higher education in the state and as part of its assignment considered the duplication involved in the maintenance by the commonwealth of two engineering colleges. The conclusion might readily have been anticipated. The commission disapproves of the duplication and recommends that the two schools be united. Iowa is not the only state which has this problem of duplicate institutions. Several of the other states are thus afflicted. Possibly in these states, too, the federal bureau's report may have a salutary influence. Incidentally, the summary, which is all that has been issued to date, recommends an "average departmental salary for professors and instructors" of $2,000. The summary does not explain what is meant by these words. The mere statement, however, is sufficient to secure the attention of all interested in technical education. Not only because of the larger problems it touches, therefore, but because of this intimate, though less important one, the report when issued is sure to receive very close scrutiny.

Political Reflections

IN the present political rejoicing and sorrowing there is opportunity for all right-minded citizens, irrespective of party, to join in felicitation over some of the results of the election. Returns indicate that despite extraordinary, and in some cases unscrupulous, efforts of the labor organizations they did not succeed in delivering to the President the labor vote. There were some results from the propaganda, without doubt, but the returns do not justify Mr. Gompers' hope of landing the whole labor vote in the Democratic column. Labor still insists upon thinking for itself. Other reasons for felicitation are found in two well-done deeds in Illinois. Frank S. Buchanan, congressman from the Seventh Illinois District, prominent for his labor activities and now under indictment in New York State, was defeated. Likewise Clyde H. Tavenner, congressman from the Fourteenth Illinois District, author of one of the bills to prevent the increase of efficiency in government establishments, will afflict the congressional halls no more. Despite what may be one's political faith, therefore, there is reason for all having some satisfaction over the results of the election. Without doubt, many such instances can be cited, but those referred to are distinct gains for better citizenship.

Radical Redesigning

FORTUNATELY for the ultimate success of the project, the original plan of the French engineers for the dam and power station at the Narrows of the Yadkin River was not completed. As described in the article on page 610, changes of a radical nature were found necessary when, after two years' cessation of work on account of the war, construction was resumed. Striking confirmation of the need for the changes was afforded after the relocation of the power house had been decided upon and the new foundation carried well along toward completion. The July flood, which caused such a large amount of damage throughout the middle South, did not spare the Yadkin River Valley. The flood water

exceeded by 25 per cent the maximum flow assumed by the French engineers, and not only washed away construction equipment, but wrecked the old power-house foundation. The changes in design include the abandonment of a completed power house, the adoption of vertical instead of horizontal turbines, and the substitution of a bypass leading around a rocky ledge above the new power house for the inadequate wells and their connecting tunnels. On account of these changes, the description of the new work in this issue will be of more than ordinary interest to hydraulic engineers.

Pipe-Joint Leakage

SUPPLEMENTING his statement made at the convention of the New England Waterworks Association at Portland, Maine, two months ago, Frank A. Barbour, at the society's meeting in Boston last week, again emphasized the importance of a thorough investigation of pipe-joint leakage and urged members to forward to the committee of which he is chairman information which can be used in developing methods for reducing the enormous annual waste from this cause. His statement of the case, on page 616 of this issue, is so convincing that it should bring forth a hearty response from waterworks men who, in the past, have been too complacent in accepting great losses from leaking pipe joints as inevitable. Presumably a thorough diagnosis of the trouble will suggest a remedy, but before Mr. Barbour's committee can recommend improvements in present practice it must have all the facts in the case before it. Upon the members of the association rests the obligation of supplying them. It goes without saying that all loss cannot be eliminated and that the relaying of existing pipe-line systems is financially impossible. The committee's work will affect future rather than past construction. Nevertheless, waterworks men should realize that they are carrying the burden of the waste and that the present condition of affairs does not speak well for standards of management. Water unaccounted for, amounting to 20 per cent even in systems fully metered, should be analyzed and the causes responsible for this waste definitely determined. Thus far the data submitted to the committee have not been sufficiently specific to be of great value, although there is undoubtedly a large amount of information in the country which, with proper co-operation, could be made available. The committee's work suggests a number of interesting queries. Are lead joints, as ordinarily made, the best joints which can be developed? What effect has temperature upon pipe-joint leakage? Is the loss attributable in large measure to under-registration of meters? Is sufficient care taken in laying and testing pipes? If not, how can present practice be improved? Mr. Barbour estimates that pipe-joint leakage alone is responsible for an annual loss of more than $4,000,000 on 60,000 miles of pipe line in American municipalities. With the leakage in water goes a corresponding leakage in dollars. Surely the subject is important enough to warrant waterworks men enlisting their services in a campaign for making pipe joints more nearly watertight.

Co-operative Engineering Education in England

MUCH SPACE has been devoted in these columns for a year or more to the remarkable industrial awakening in England. The awakening concerns not merely the internal organization of manufacturing plants. This has, indeed, been given much attention, as have also the welfare of the workers and the relations between capital and labor. Of external factors scientific research and technical education have been given much consideration.

Discussing technical training before the Association of Technical Institutions late last month, Sir Trevor Dawson, vice-chairman of Vickers, Ltd., the shipbuilders, suggested a form of apprenticeship combined with technical training which is a counterpart of the Cincinnati co-operative engineering education system developed by Dean Herman Schneider. Curiously, if the published abstracts are to be trusted, Sir Trevor made no reference to the American experience with this type of education; nor did *Engineering* in commenting upon the address. One is led to suspect that they do not know that ten years of experience are available with that method of preparing men for the industries.

Sir Trevor suggests for the consideration of the association a plan whereby boys in pairs would alternate between the shop and the school. Instead of alternation in weekly or biweekly periods, as is the practice here, he proposes daily alternation. This does not affect the principle of the Cincinnati method, but imposes difficulties in the works which those who may attempt the scheme will quickly discover. Sir Trevor suggests, moreover, that the plan be put into effect with boys in their earlier years, or during what we would call the high-school course. At Cincinnati the plan is applied only with those of college grade. Nevertheless, the application of the method to high-school students would not be a novelty in this country, since the Fitchburg technical high school has been operating on the plan for about ten years. Moreover, New York City for two years has used the co-operative system in high-school work.

It is interesting to note, too, that Sir Trevor realizes keenly that special effort should be made to fit young men into the positions for which they are best adapted. How much again does this sound like an echo from Cincinnati! There, above all places in this country, has consideration been given to the guidance of students into right lines and to predetermination, if possible, of a man's aptitude.

For these reasons we most earnestly recommend to Sir Trevor and to the Association of Technical Institutions a careful study of the co-operative systems of education so successfully worked out at Fitchburg and Cincinnati. Our British brethren can save themselves much experimentation by drawing upon the ten years of experience available here.

Incidentally, those who have had a part in developing the co-operative system, and particularly Dean Schneider, may well feel gratified that the system has been put forward by so successful an industrial administrator as Sir Trevor Dawson and that it has had the hearty approval of Lord Haldane and of the British engineering journals.

Pulling Sheet Piles

THAT inverted hammers can be used to pull the longest steel sheeting, if it has been properly driven, has been conclusively proved in the removal of the cofferdam for New York City's Forty-sixth Street pier, described on page 627 of this issue. Here many 72-ft. piles came out with a direct pull of 40 tons, and it is doubtful if any but the key piles required more than the equivalent of 100 tons.

It is fair to say that the most troublesome feature of the use of steel sheet piling has been getting it out again after its purpose has been served. This problem has always been before the makers of steel sheeting, since the economy has generally depended on the salvage to be realized in extracting the piling at the end of the job. Pile-pulling mechanisms, from the old driver-foreman's expedient of facing two pile drivers across the piece to be pulled and jerking it out with both runners to the trench foreman's rig of a plank lever and chain, have been tried and developed. Washington patent attorneys have derived no small sum from eager inventors of apparatus for starting the refractory pile.

Some years ago, about the time the American contractor was ruining good hoisting engines in jerking out piles, a British firm was working on an extractor designed to reverse the process of driving, by hammering them out of the ground. This invention, a simple inverted steam hammer with a grip for catching the top of the pile, is now coming into wide use in England because the scarcity of timber has put a premium on old piles. Its American cousins, however, slumber undisturbed in the files of the patent office because an American contractor went the Britons "one better" on a New York subway contract by extracting his steel sheeting with the identical hammer (turned upside down) which had driven it. From that day levers, jacks, ginpoles, gallows frames and heavy cranes were out of date for pile pulling, although that fact is not yet appreciated in all quarters.

Like every new process, this method has been tried unfairly and judged wanting. One case that comes to mind is the government work on the Hudson River at Troy, N. Y., where relatively short sheeting failed to come out with the hammer. In this case the editor, who discussed the question with the men in charge, more than suspects a little prejudice against the method. Moreover, it is doubtful if the hammer equipment was in the best of condition, as frequent breakages caused much of the trouble.

Moreover, steel sheet piling can be driven on rock so that nothing will extract it. If

the sheeting has been set out of plumb, driven down full length one piece at a time, has been seriously deflected at points by boulders or has been overdriven on rock so as to curl up at the bottom, the interlocks may become jammed so that it is a waste of money to unthread them. It has been demonstrated that driving on rock with a drop hammer is likely to produce this result, and also that it is worse than useless to beat on a pile with an air hammer after the sound clearly indicates that rock has been struck. The curled, bent and split ends of the few piles that were overdriven at the Forty-sixth Street pier and the extreme difficulty with which they were pulled form an object lesson to contractors and pile inspectors.

If simple and well-known precautions are taken to avoid these troubles, not only will a stronger cofferdam be secured with less effort, but the deepest cofferdam ever driven can be pulled at a profit with inverted hammers. In short, it is not the ground friction, which can always be relieved by jetting, but the interlock friction that offers the real resistance to pulling steel sheet piles. Experience with the longest steel sheeting yet put down has proved that proper driving can keep this friction for all but key piles well below the equivalent of a steady 75-ton pull, a matter within the capacity of a 15-ton derrick equipped with an inverted hammer.

New Jersey's Roads

NEW JERSEY was at one time the premier state in the matter of good roads. It was the Mecca for those who wanted to learn about design, maintenance and administration. But that was all changed by the advent of the automobile. Designs were inadequate for the new service demands; administration broke down when roads ceased to be merely local-circulation avenues and became carriers for through traffic that knew not the bounds of townships or even counties. And for five years New Jersey has continued to drop back in the list of good-roads states. There has been no lack of highway work, nor of the expenditure of money; but the work has been poorly planned and the funds inefficiently spent. Now the state is taking inventory of its highway situation, in order to map out a sound and far-reaching policy. A commission will report its findings to the governor this winter, and while it has been at work the State Chamber of Commerce has likewise been making studies, co-operating with the official body. Extracts from the chamber's report will be found on page 623.

While the document shows that more than $100,000,000 has been spent on the state's improved roads, with little to show for the expenditure, the most important statements relate to the inefficient administration responsible for present conditions and to the financing of the future system. Not less than 500 different authorities, unco-ordinated, frequently unsympathetic, are spending the people's highway money. That fact is sufficient to explain conditions.

On the matter of financing we commend to the attention not only of engineers but to public officials that part of the report which condemns bond issues for road work. We know of no plan that will force a closer scrutiny by the public of road expenditures than of putting the financing on a tax rather than a bond-issue basis. In that direction only lies escape from excessive highway costs and a future financial burden that may seriously interfere with public-works expenditures in the next generation.

A Profit-Sharing Plan for a Gas Company

A PROFIT-SHARING plan in the operation of a public utility is an inducement to consumers and an encouragement to capital. There are justifiable differences of opinion as to the fair basis of division, but the Engineering Record has no hesitation in commending the principle as a wise element in sound public policy. In the new franchise terms for the Peoples Gas Light & Coke Company of Chicago, which are now under consideration, a distribution of earnings to users of the service is a conspicuous feature. It is of particular interest because of the changing conditions in the gas industry and the opportunity which they offer to put that utility before the public as a representative of modern spirit and enterprise.

It is true, of course, that profit-sharing arrangements can be appraised at their precise value only after a demonstration of their worth in actual experience. The individual cases, however, are the foundation of the broad doctrine that a division of earnings is popular with the public. The proposition of the Chicago company is that all normal operating expenses as heretofore are first to be deducted; then bond interest and 6 per cent per annum on future securities issued under authority of the Illinois Public Utilities Commission are to be allowed; and the remainder is to be divided in the proportion of 85 per cent to the company and 15 per cent to consumers in rate reductions. Certainly the principle of sharing the profit with consumers is commercially wise, and it will stimulate consumption.

In several respects the proposition of the Chicago company is notable as an exposition of the changing conditions in the gas industry. It illustrates in a large way the purpose of the pending movement to apply more modern commercial and rate-making ideas to the old established gas utility. While the tangible result of the proffered terms, if accepted, will be a reduction in rates in Chicago, the result, which will be of greater significance to the country at large, is the conspicuous progress in transition from a lighting-unit standard to a heat-unit standard, with all that this implies of benefit to the industry generally. Instead of a flat rate of 80 cents per 1000 cu. ft., there will be a sliding scale schedule based on a primary rate of 75 cents for an initial monthly consumption varying from 2100 to 6000 cu. ft., according to the meter capacity; a secondary rate of 65 cents per 1000 cu. ft. for the next 7000 cu. ft. and a tertiary rate of 35 cents per 1000 cu. ft. for the excess. A minimum monthly charge varying from 45 cents to $1.20, according to the meter capacity, will be made. Such a differential system of rates, graded according to the volume of consumption, means the use of gas for industrial purposes on a scale which would be impossible under the flat rate.

For years the gas industry has seen its business in illumination drift in increasing amount to the electric utility, which had the advantages of novelty, convenience, popularity, ease in adaptation to varied requirements, and last but not least, persistent advertising and commercial exploitation. Against the arguments of the electric utility the gas industry waged for a long time a losing contest. Electric utilities expanded rapidly and steadily, partly because of scientific rate-making, which automatically encouraged consumption. While the gas industry clung generally to the flat-rate system, the electric utility reached into the limitless field of industrial power and even heating by reducing its rates for larger-volume consumption. More recently the companies selling manufactured gas have given increasing consideration to the possibilities of scientific rate-making, and advance in this direction is reported in several localities. The Wisconsin, Massachusetts and New York (Second District) public regulating commissions have approved—and in some cases ordered—the adoption by gas companies within their jurisdiction of the heat-unit basis instead of the lighting unit, thus furthering the progress toward larger markets which the gas industry is now anticipating.

Other features of the arrangement which the Chicago company has proposed to the city authorities are in harmony with its advanced attitude on profit-sharing and rates. Necessarily, the plan involves the construction of a plant for the manufacture of coal gas, coke and byproducts. The required expenditure is estimated at $12,000,000. This heavy capital outlay would equip the company to provide gas for public consumers and also to make the coke and the valuable byproducts for which it would be able to develop a market. It would be a serious omission to minimize the value of plants so equipped for the national defense in the event that this country should be in peril of invasion. Our gas industries, of course, must be so operated as to justify themselves commercially—in other words, to pay—during the normal times of peace. If while rendering the service which the public demands they can in addition be potentially of great military advantage, this is good national insurance.

As a whole, the offer which is now receiving consideration is of unusual importance. It represents a commendable public-spirited effort to develop the natural markets of a gas utility located in a large community requiring varied and graded services; to stimulate the gas industry by the application of manufacturing and commercial ideas that shall enlarge its functions, and to meet the public cry, which frequently arises without regard to possible higher costs, for lower rates.

Modern Turbines and New Power House Replace Earlier French Design of Yadkin River Power Project

Twin Tunnels and Vertical Wells in Sidehill Rock Planned for Flood Flow to Be Abandoned and Bypass Used—July Flood Justifies Engineer's Decision

RADICAL changes in the earlier design by French engineers mark the American engineer's solution of the problem of completing the Yadkin River dam, 200 ft. high, begun in 1912 for the Southern Aluminum Company. A spillway for passing flood water over the dam was added; the new power-house location and layout involved the abandonment of a nearly completed structure; vertical turbines were designed instead of horizontal turbines, and old runners were remodeled, and a bypass for flood water is to be used instead of two vertical wells 60 ft. in diameter connecting with twin tunnels already completed.

This dam is located at the Narrows, near Badin, about 30 miles southeast of Salisbury, N. C., and is now approaching completion at the average rate of seven lifts, or about 2500 cu. yd. of concrete per day. It is expected to begin operation early next year. The Tallassee Power Company, a subsidiary of the Aluminum Company of America, bought out the French company after the latter ceased construction owing to war conditions in 1914, when the power house had been practically completed and about 50,000 cu. yd. had been placed in the west end of the dam.

New Design Justified

Striking confirmation was afforded of the soundness of the decision of the company's engineer to abandon the old power house and the twin tunnels originally intended for discharging flood waters, when the high water on July 15 (the biggest flood since 1814 according to marks set over 100 years ago) carried out several of the contractor's derricks, flooded and overtopped the cofferdams, washed out the railroad trestle and nearly carried away the 150-ft. steel span of a construction bridge on the downstream side and wrecked the east wall of the original power house. The new power house, with parts of one of the 27,000-hp. units already in place, came through the flood without injury.

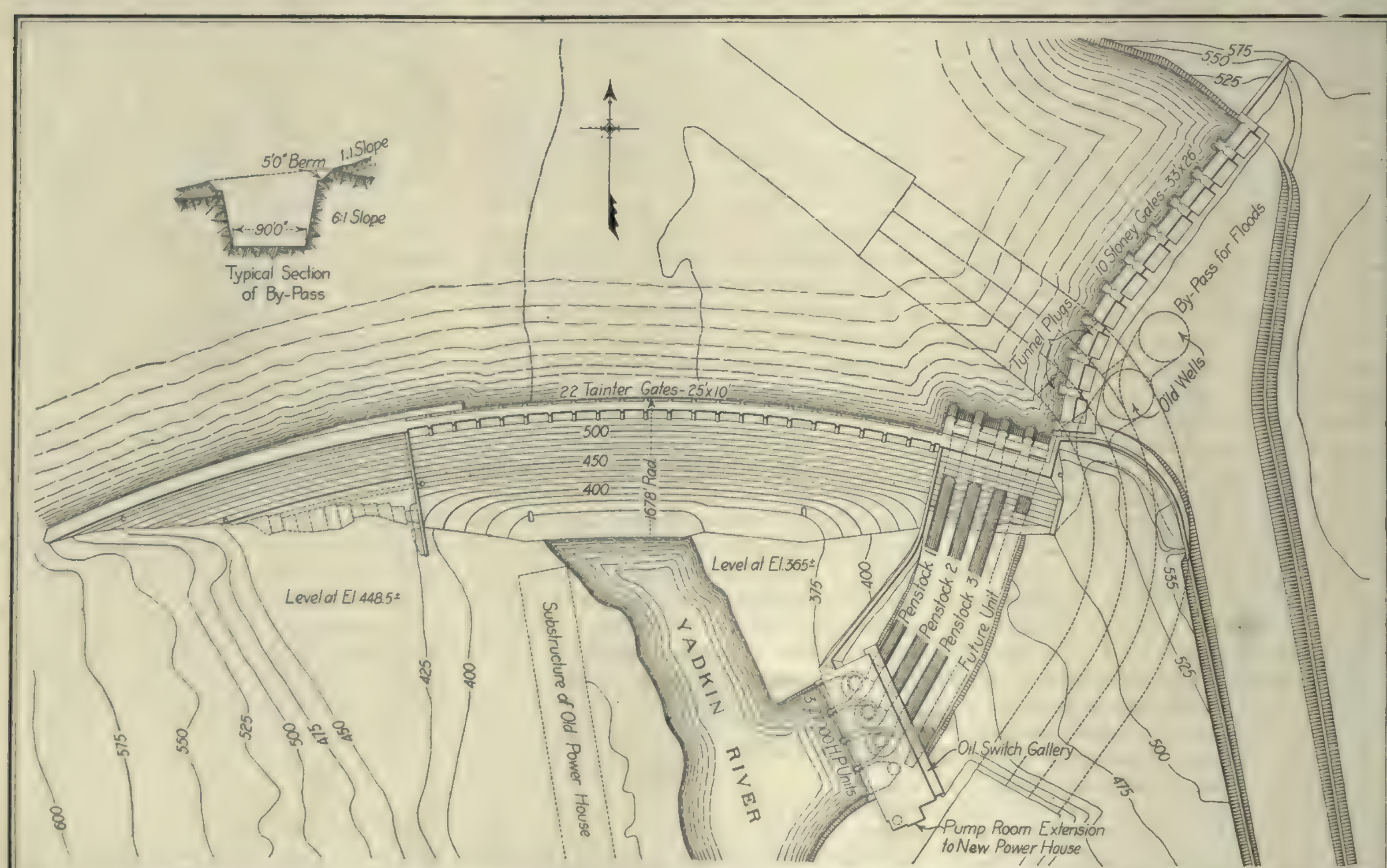
Construction Features

The main construction features of the dam include the placing of alternate sections by the use of guyed derricks handling 2-yd. or 4-yd. buckets brought to the work by dinkey engines and flat cars from two concrete plants—one of which contains two 4-yd. Smith mixers, the largest in the country. Belt conveyors transport sand from a hillside storage pile to the mixing plant. Economy is found in the use of unit-slab forms so bolted to the displacers embedded in the concrete that ease of removal and rapid shifting is attained.

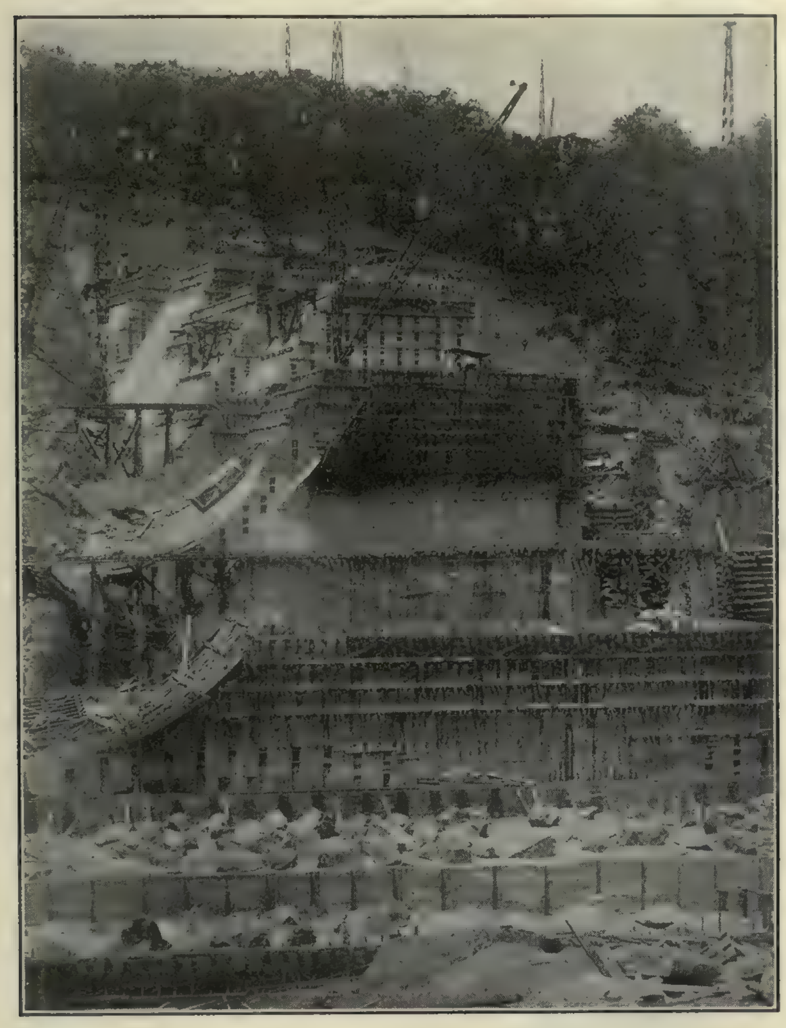
The design of the dam and flood gates, with runoff provisions, contemplates a safety factor 100 per cent greater than the biggest flood since 1898 and 65 per cent greater than the biggest flood of the past century. Arch section was not considered in the computation of the main sections, which were analyzed as for a pure gravity type.

Brief History of Projects

The earliest attempt to develop the power at this portion of the Yadkin River, where the fall is about 25 ft. per mile, was by George Whitney, who in 1908, with Pittsburgh capital, started an elaborate cut-stone masonry dam about 38 ft. high across the river 4½ miles above the Narrows. This work was abandoned in 1910 and, except for salvage of stone now being taken out, will be a complete loss. In 1912 the Southern Aluminium Company, controlled by French capital, started work on a high dam at the Narrows with the object of developing about 90,000 hp. The French engineers placed the power house on the west side of the river and designed it for twin-runner center-discharge turbines on horizontal shafts. They provided for flood flow by designing two vertical wells 60 ft. in diameter connecting to rectangular twin tunnels 40 ft. wide and 34 ft. high driven in the sidehill rock on the east side and used as diversion channels during the construction of the dam. These were completed by the construction company, timber and rock cofferdams were built, the power-house foundations of concrete completed, the steel frame erected, and about 50,000 yd. of cyclopean



PLAN OF DAM SHOWS LOCATION OF OLD AND NEW POWER HOUSES, AND TUNNELS AND WELLS OF THE EARLIER DESIGN



VIEW OF DAM ON JUNE 4 SHOWS VARIOUS STAGES IN CONSTRUCTION

DERRICKS RAISED TO TIMBER PLATFORMS ON DOWNSTREAM FACE

concrete placed in the dam on the west side, using a 1:3:5 mix. When the war broke out in 1914 all work ceased on account of war conditions.

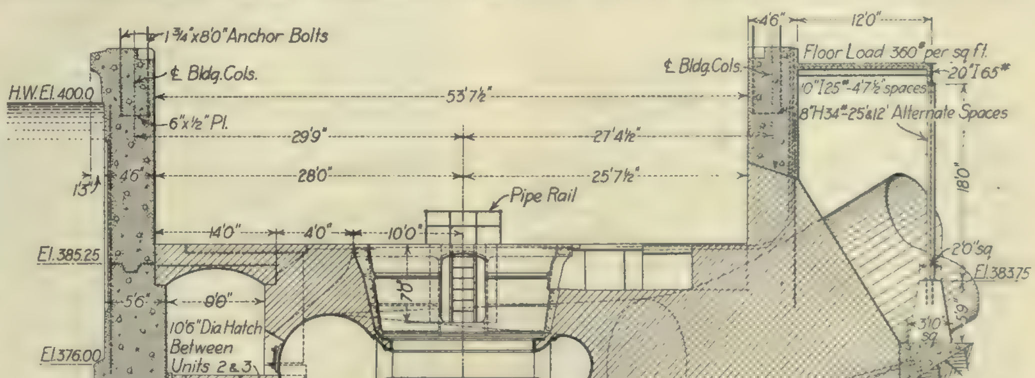
The Tallassee Power Company bought out the French company in 1914, and began work on the completion of the project in January, 1916. This company's engineer decided to use the part of the dam already completed, but to abandon entirely the original power house and flood-water provisions of the French engineers, just described. It was felt that the French engineers did not provide for a large enough flood and that the tunnels were unsafe. Hence it was necessary to build the bypass and also provide for part of the floods by a spillway over the dam. The old power house was only 20 ft. from the toe of the dam, entirely too close for safety, as the standing wave below the dam would wreck the foundations. The French engineers did not contemplate passing any water over the dam, so that the old power-house location was all right for such conditions. The discharge from the tunnels during floods would interfere with the flow of water that passed over the dam, and this would cause a dangerous rise of water in the river opposite the old power house and would have wrecked it had the old scheme of using the tunnels been adopted.

This view of the French engineers' inadequate provision for floods was vindicated when the 1916 flood, about 25 per cent greater than the maximum flood assumed by them, wrecked their power-house foundation.

New Power House

The new power house, placed on the east side of the river, is 180 ft. long and 57 ft. wide as before, so that the old steel frame could be used again, the columns being reinforced by steel channels on the inside. The foundations are entirely remodeled to conform to vertical-shaft turbines direct-connected to alternating-current 13,200-volt 36-cycle generators of 27,000 hp. each, three units to be installed now and one unit later. The 5200-kw. direct-current 520-volt generators for the original power house were remodeled into rotary converters, a change which necessitated the odd frequency of 36 cycles. The four draft tubes, after making the usual bend of 90 deg., discharge from the west side of the power house. A complete system of air tunnels provided for the cooling system is located above the draft tubes to keep the hot air out of the generator room.

Design of turbines and generators was based upon a minimum head of 165 ft. and a maximum head of 180 ft. Railroad facilities will be provided by a track over a



CROSS-SECTION THROUGH CENTER OF UNIT, SHOWING POWER-HOUSE FOUNDATIONS

ERECTING STEEL SPAN FOR DOWNSTREAM CROSSING—UPSTREAM CROSSING IN BACKGROUND

BUILDING FORMS FOR DRAFT TUBES

bridge crossing the river and entering the power house at floor level. Two 50-ton cranes are installed, with 10-ton auxiliaries, and access to the wheel chamber is permitted by a tunnel and adit in the concrete encasement. The turbine setting is designed for removing a runner from the lower side of the turbine by telescoping the cast-iron part (the top) of the draft tube into the lower (or concrete) part of the draft tube. This arrangement provides for renewing a broken runner without moving any of the generator parts. Riveted steel scroll cases are embedded in the foundation concrete.

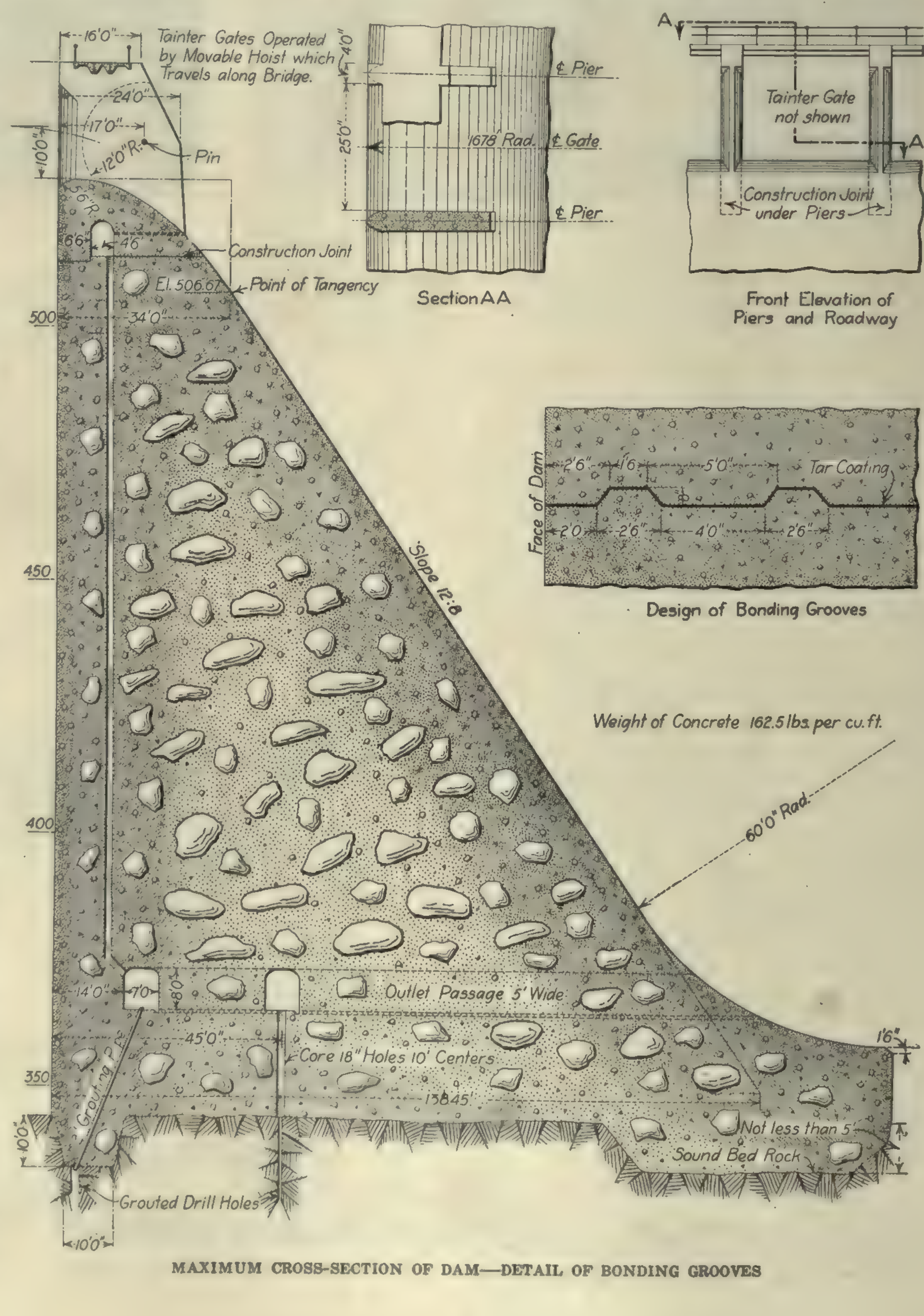
The construction of the power-house superstructure is being done by the company forces. Concrete from the downstream plant is used in the foundations. The brick walls and rolled-steel sash are being placed, a dark-brown mortar obtained by coloring matter improving the appearance of the brickwork. Air drills are removing the rock ledge in the tailrace, the rock being sent to the crushers and incorporated in the concrete or embedded as large blocks or displacers in the heart of the dam.

Design of Dam

Although curved in plan to a radius of 1678 ft. and supported by rock foundations on the sidehill, arch action was not considered in the design. Vertical contraction joints in a radial direction are introduced by constructing alternate blocks 45 to 50 ft. long, each block designed as a pure gravity section. At the ends of the dam the downstream face is curved to throw the water toward the central stream bed, as indicated by the contours on the plan view herewith. Bonding grooves between the blocks are spaced about 5 ft. apart, and the concrete surface is painted with tar to prevent adhesion, thus insuring contraction cracks in a vertical plane and preventing any possibility of interior uplift on diagonal cracks developed by contraction. Drain holes and inspection galleries, shown on the sectional drawing, were introduced near the upstream face of the dam.

In analyzing the stresses in the dam several different assumptions as to water pressure were made. The most severe case considered was uplift at the heel equivalent to full head of water in the reservoir, decreasing uniformly to full uplift at the toe caused by maximum tail water. The least severe specification assumed was that considering no uplift whatever beneath the dam. These two extremes were varied so as to study every possible combination of water pressure and uplift, but in no case was the arch action considered as lending stability to the structure.

Holes for grouting were drilled from 30



MAXIMUM CROSS-SECTION OF DAM—DETAIL OF BONDING GROOVES

to 40 ft. into the ledge along the upstream side of the dam. However, grouting was not done until the concrete had been carried up approximately 50 ft. above the ledge to provide sufficient weight upon the foundations to prevent the grouting pressure from blowing out the rock. This grouting was done from the upstream lower inspection gallery, pipes for the purpose being carried up from the open drill holes to this gallery. The grout holes were 10 ft. on centers. For the most part a mixture of grout consisting of 1 part water to 3½ or 4 parts cement was used, grouting being done under a 95-lb. pressure. As the rock underlying the dam is unusually dense, very few seams and cavities were discovered in grouting.

SAND STORAGE AND CONVEYOR

Sand at the rate of 900 yd. per day hauled 60 miles by rail, in itself makes a problem in storage and handling at this site, where the concrete plant is about 200 ft. below the railroad. By building a simple timber retaining wall on the hillside and using a timber trestle, the cars are dumped into a 15,000-yd. storage space. A 16-yd. hopper was built and a guyed derrick with three-drum hoists to operate a 1½-yd. grab bucket keeps this hopper filled. A Robins belt conveyor 18 in. wide carries the sand about 800 ft. by gravity, with motor control to prevent runaway of the loaded belt, to the bottom of the hill. A second belt on an uphill slope to the storage bins at the upstream mixing plant is operated electrically.

Two stone quarries were established downstream, and a tunnel section was left through the dam to allow the rock to be transported by skips on the flat cars to the upstream mixing plant, where stone crushers are located. The cement is delivered by train, and stored in a timber storage house at the plant. Two plants are being used; the upstream plant on the west side consists of four 2-yd. Austin cube mixers and the downstream plant of two 4-yd. Smith mixers located on the east side of the river. The concrete is mixed rather dry, and 1½ min. is required in the mixer. Cement storage for 50,000 bbl. for one month's use is provided, 40,000 bbl. at the upper plant.

FORTY-THREE DERRICKS ON JOB

All materials are handled by the American Hoist & Derrick Company's guyed derricks and by buckets or skips on cars, as indicated in the photographs. Forty-three derricks are used, twenty-eight at the dam, two at the downstream mixing plant, two at the east quarry and eleven at the west quarry. These derricks generally have masts 115 ft. high and 100-ft. booms; 65 miles of guy wires are used and 15 to 16 miles of railroad track. Twenty-two dinkey engines haul 100,000-lb. flat cars carrying six 2-yd. or four 4-yd. concrete buckets or the skips filled with displacers. The rock is either transported to the crushers or picked up by the derricks and deposited in the concrete of the dam, using blocks from 2 yd. up to the 15-ton capacity of the derricks.

As the alternate sections are completed to greater heights than the derricks in their original positions on the low cofferdams can reach, new positions are provided on the downstream face of the dam by inserts in the concrete. These are occupied by the derricks, and the upper lifts of adjacent blocks poured by the intermediate derrick. All these derricks are operated by compressed air. A compressor plant of eight units with 8-in. main on the west side near the top of the hill furnishes this air through long pipe lines.

Cyclopean concrete, using a mix of 1:2½:5 determined by test to give maximum strength for the materials used, and about 22 per cent displacers form the dam proper, carried down to the solid rock, as shown by the cross-section herewith. The displacers are any size up to 15-ton weight placed 6 in. from each other or 2 ft. from the outer forms. Alternate blocks are constructed in lifts of 5 ft., the unit forms being 6 ft. high and 16 ft. long, fastened as indicated by one of the photographs (see "Hints for the Contractor" pages of this issue). The overlapping of the lower form over the one above and the use of one rod and blocks at the intersection of adjacent units resulted in great economy in form setting. About 250,000 cu. yd. has been placed, out of a total of 490,000 cu. yd.

As already mentioned, the new design contemplates the abandonment of the inadequate method of providing for flood flow

SCROLL CASE UNINJURED BY FLOOD

Water flooded interior of new power-house foundations after part of this unit was in place.

by the twin wells and tunnels on the east side. Instead, it was found that the rock formation made the excavation of the bypass around the east end quite simple. This requires only a short curved guide wall of concrete connecting to the east end of the dam, and the construction of eleven concrete piers for the flood gates, which are of the usual Stoney type, 35 ft. wide by 26 ft. high. Concrete is hauled across the river over the upstream bridge and by switchback up to this level. The old wells were filled with rock after the lower ends had been sealed with concrete arches 6 ft. thick at the crown. An 18-in. pipe was left in these wells to allow concrete plugs about 50 ft. long to be placed in the tunnels after the water is diverted to the closure tunnel near the center of the dam.

Closure will be made after shutting off the water from the twin tunnels now being used as diversion channels by building a cofferdam, and using a closure tunnel through the dam, where double steel gates have been installed near the center. These gates consist of 24-in. 100-lb. I-beams spaced to provide for pressure due to a full reservoir. This condition of loading could occur in case of a big flood immediately following the closure of the gates. The water impounded will probably be 12½ billion cubic feet and will back up about 5 miles. On the spillway, which is 640 ft. long, 22 Tainter gates 25 ft. wide by 10 ft. high will be used to increase the head. These gates are operated by a traveling hoist, as noted on the cross-section drawing herewith. The three 15-ft. steel penstocks seen in the photographs carry the water to the steel turbine scroll cases in the concrete foundations of the power house under a head of about 165 ft.

The work is being constructed for the Tallassee Power Company, a subsidiary of the Aluminum Company of America. Edwin S. Fickes is chief engineer, under whose direction the main works at Badin were designed, with G. F. Murphy as his principal assistant. William Hoopes, chief electrical engineer, and T. J. Bostwick, his principal assistant, elaborated the complete plans for the electrical installation. James W. Rickey, the chief hydraulic engineer, and Charles B. Hawley, his principal assistant, elaborated the complete plans for the hydraulic installation. J. E. S. Thorpe is the resident engineer at Badin, N. C. Mr. Thorpe is in direct charge of all work in connection with the Narrows dam. The work at Badin is in charge, under Mr. Thorpe's direction, of R. R. Stevenson. This work includes not only the building of the industrial plant but of the town. The Hardaway Contracting Company, Inc., of Columbus, Ga., is the contractor for all work at the dam; S. S. Scott is superintendent in charge. The contract for the bypass excavation was sublet to Rinehart & Dennis. The generating units were furnished by the Allis-Chalmers Manufacturing Company, of Milwaukee.

Make New Record in Mine-Shaft Work

Vertical Shaft at Homansville, Utah, Sunk Through Limestone and Lined for a Distance of 261 Feet in 31 Days

A VERTICAL shaft on the Homansville (Utah) properties of the Chief Consolidated Mining Company was recently sunk and lined for a distance of 261 ft. in 31 days. The shaft consists of three compartments, according to the *Mining and Scientific Press*, two of which are each 4 ft. 2 in. square inside and are used for hoisting skips. The third, or manway compartment, measures 4 ft. 2 in. by 3 ft. 2 in. inside. The lining consists of 8 x 8-in. timbers with 2 x 12-in. lagging, the sets being spaced 6 ft. apart. The material encountered was limestone varying from hard to soft and lying in almost horizontal strata.

The work was carried on by three shifts, each consisting of four machine men, one topman and one engineer. In addition to these, on the day shifts two timbermen put in the lining. Sullivan and Denver rock-drill sinking machines were used, the average drilling being about two 5-ft. rounds of 22 holes each per day. The hoisting was done by means of two 15½-cu. ft. buckets, used alternately. These were automatically dumped at the surface by a mechanism attached to the headframe.

The timbermen worked on what was termed a "suspended bulkhead and shooting set," which added to the speed and safety of the work. It consisted of a set of 8 x 8-in. timbers with ¼-in. sheet iron plates bolted on the bottom of the two outside compartments. This device was suspended by means of 1-ton chain blocks hung from two sets above. The tackle was long enough to allow the bulkhead to be lowered so that a new set of timbers could be put in place without stopping the work of the machine men and shovelers.

READY TO BEGIN THE LAUNCHING OF ONE OF THE 122-FOOT CONCRETE MATS

Experimental Concrete Revetment Proves Feasible and Economical

Major E. M. Markham Describes Plant by Which Eight Concrete Mats Have Been Constructed and Launched in Mississippi River

BELIEVING that concrete revetment for protecting the banks of the lower Mississippi would be more effective and durable than a fascine structure without necessarily being more costly, especially in view of the inadequacy of the willow supply throughout the lower river, Major E. M. Markham, Corps of Engineers, U. S. A., obtained from the Mississippi River Commission in 1914 an initial allotment of $2,500 for experimental revetment. Based on the results obtained from this a further allotment of $25,000 was granted the following spring. The experiments have convinced Major Markham of the feasibility and suitability of concrete revetment, and he describes and discusses them in the November-December *Professional Memoirs*, from which these notes are taken.

Slabs Cast on Barges

Under the first allotment eight concrete slabs were cast on barges with inclined decks. They varied in size from 14 x 18.6 ft. to 100 x 40 ft. All were 4 in. thick, reinforced by strand and mesh, variously clipped and wired together. Crude though this experiment was, it showed that the desired results could be obtained.

With the larger allotment in 1915 a plant was developed consisting of two barges on which to construct the slabs and a third to carry the necessary machinery to launch the slabs. The general proposition contemplated the formation of the slab or mat on the inclined deck of a barge, the barge later to be withdrawn under mechanical power, substitute support being simultaneously provided from a series of overhead trusses hinged upon a fixed mooring barge and having wheel bearings on ways of the barge withdrawn. Lines would run from the trusses to trip connections with loops formed in the mat. The mat would be lowered into the water between the barges and tripped when desired, control after tripping being provided by shackle connections from the upstream edge of the mat.

The slabs were to be reinforced with but strand and mesh, so that as they reached the bottom they would crack into irregular areas and thus conform to the inequalities of the bank. Subsequent erosion would cause further breaking up of the areas as the mat adjusted itself. The principal strand of the reinforcement would be extended to the high-water bank and anchored. Thus the revetment would be essentially monolithic from shore edge to deepest water.

Although for convenience slightly smaller sizes have been used, the plan was designed for slabs 125 x 50 ft. x 4 in. The barges were constructed so that with 180,000 lb. of water in a ballast compartment at the toe the upstream edge of the mat would start about 12 in. above the water surface upon the beginning of the mat-barge withdrawal, becoming submerged within a few feet of the movement. The several suspension lines are fixed of such length as to take weight only when it has been reduced to the extent of the water buoyancy.

Transverse ways 8 ft. 4 in. on centers are provided on the inclined decks of the mat barges, and between the ways platform sections are so mounted on supporting timbers as to be readily lowered or raised about 4 in. In the raised position these platforms are flush with butter or launching boards, about 11 in. wide, which themselves rest on rollers inserted in the ways. When the concrete in the slabs has sufficiently hardened the platforms are dropped, the slab thus resting entirely on the butter boards. To launch a slab it is therefore necessary only to overcome the axle friction of the rollers. The ways are steel shod to receive the wheel bearings of the overhead trusses.

The mechanical and structural equipment, which is mounted on a barge 124 x 30 x 7 ft., consists of a 35-hp. boiler, a double 7 x 7-in. engine, rigged with drums and winches, five intermediate trusses from which to suspend the slabs and two end trusses carrying sheaves and lines for manipulating the mat barge. All of the trusses are hinged near the downstream edge of the mooring barge and have wheel bearings upon the ways of the mat barge. They may be raised or lowered in unison. The trusses are of the five-panel-point Pratt type, spaced on 25-ft. centers, the interval being subdivided by side stirrups from each main truss. The mat is suspended from each panel point of both main trusses and stirrups, forming rectangles 8 ft. 4 in. x 10 ft. Thus there are five supporting lines across the mat, each involving fifteen suspension points.

LOWERING THE MAT FROM THE TRUSSES

Launching Details

The supporting lines consist of ⅜-in. cable, end-wedged on the outside trusses, passing through two fixed sheaves and one movable sheave above each suspension point to drums of a shaft located on the center truss. Lines from one side pass under and those from the opposite side over the drums. Prior to launching the lengths of these lines are fixed for support of the mat at the desired submergence. As the mat lowers with the withdrawal of the barge, the supporting lines come successively into play and the total weight is automatically distributed. As a precaution against mishap involving the main plant, the strength of the mat loops and supporting lines is less than any element of the carrying structures.

The device employed at the suspension points, suggested by the Bucyrus Company, consists of a trigger attached to the housing of a movable sheave, and carries a pin held by a spring in a locked position. To hook up a mat for launching, this pin is withdrawn by hand sufficiently to pass the mat loop between pin and jaw. Connected to the tops of the trigger pins are chains attached to the overhead trusses, of such lengths as to retain the slack when the running suspension cables have taken the weight, all the chains being adjusted for as nearly the same amount of slack as is practicable. To trip the mat from suspension it is necessary only to throw the brake at the end of the shaft on the center truss, whereupon the weight of the mat itself overhauls all suspending cables, taking up the slack of the top chains, and the pins are pulled practically simultaneously.

How Mat Is Controlled

To prevent the mat from moving with the barge when the latter is withdrawn, shackle attachments are made from its upstream edge to trolleys designed to travel vertically upon spuds of the mooring barge. The mat, upon being tripped, will therefore continue to be controlled with the withdrawal as desired of shackle pins. Backhold lines prevent the slab from racing off the barge.

Eight mats have thus far been constructed and launched. They were reinforced by ½-in. strand around the edges and on the lines of suspension and normal thereto, 5/16-in. strand running diagonally through the suspension points and triangular mesh over the whole area. The last six mats have each been 122 x 42 ft. x 3 in., weighing 192,000 lb. each.

The slabs were launched over a shelving bank in inshore depths of from 8 to 18 ft. and outer depths of from 20 to 50 ft. All reached the desired positions within reason-

able limits of error. Three slabs launched during high water have since been partly exposed. They are to all intents intact, cracked only to the extent necessary to fit bank inequalities, which they follow very closely.

It is conservatively estimated that one handling plant should dispose of five or more slabs in a ten-hour day, at a probable cost of about 60 cents per square yard. A comparable figure for willow-fascine construction is from 70 to 80 cents.

On the lower Mississippi fascine mattresses at least 250 ft. wide are installed. Concrete revetment in single sheets this wide is believed entirely feasible, as additional outshore dimensions would be met simply by additional supporting trusses and suspension points. A limit in the other dimension would be reached by the width of the mat barge and the length of the trusses.

U. S. Office of Public Roads Reorganized

Director L. W. Page Issues Memorandum Defining Various Branches of Department and Outlining Scope of Duties for Engineering Personnel

EFFECTIVE Nov. 1, 1916, the following instructions, issued by Logan Waller Page, director, are to govern the organization of the U. S. Office of Public Roads and Rural Engineering, the responsibilities of which have been vastly increased by the recent passage of the $85,000,000 Federal-Aid Road Act:

The organization of the office shall comprise two main branches—(1) engineering and (2) management and economics. The chief engineer shall have charge of the engineering branch. He shall report to the director, and in the absence of the director he shall be the acting director. The chief of management shall have charge of the management and economics branch. He shall report to the director, and in the absence of both the director and the chief engineer he shall be the acting director. The general inspectors shall inspect field operations upon instructions from the director, and shall report thereon to the director.

No change shall be made in the work in progress, nor shall any new work be undertaken by employees in either branch, except by direction of the chief of the branch involved. No employee shall conduct, except through his immediate superior, any official business with other employees. Instructions to the chief engineer and the chief of management shall be given only by the director or by the acting director.

Should the director find it necessary to make a suggestion or give instructions to any employee of either branch, such employee shall forthwith give to his immediate superior a written memorandum covering the suggestions or instructions, which memorandum shall be submitted promptly, through the proper channels, to the chief of the branch in which he is employed. This restriction shall not apply to general inspectors.

The organization as shown by the accompanying chart became effective Nov. 1, 1916.

ENGINEERING BRANCH

The engineering branch shall comprise the following lines of work: (1) Road construction and maintenance; (2) road-material test and research; (3) farm-irrigation investigation; (4) farm-drainage investigations; (5) rural engineering.

Road construction and maintenance shall comprise: (1) Road-construction and maintenance investigations authorized in the Agricultural Appropriation Act and (2) Federal-aid road construction and maintenance.

Road construction and maintenance investigations shall comprise: (1) Supervision of object-lesson road and bridge construction, (2) co-operative road maintenance, (3) maintenance of experimental roads and (4) inspection and advice concerning various field problems of road and bridge construction and maintenance.

Federal-aid road construction and maintenance shall comprise: (1) Post-road construction under the Federal-Aid Road Act and (2) surveys, inspection, construction, and maintenance of forest roads under Section 8 of the Federal-Aid Road Act.

District engineering work shall comprise: (1) All engineering work assigned to it by the chief engineer, including federal-aid roads, object-lesson roads, experimental roads, advice to state and county officials; (2) all surveying, inspection, and supervision of construction and maintenance work under Section 8 of the Federal-Aid Road Act in the National Forests in collaboration with the forester; (3) such studies of road economics, made at the request of the chief of management, as are assigned to the district by the chief engineer; and (4) such other duties as may from time to time be assigned by the chief engineer.

FIELD DISTRICTS CREATED

The following field districts, each in charge of a district engineer who shall report directly to the chief engineer, are established:

District 1 includes Washington, Oregon and Idaho; District 2, California, Nevada, Arizona, and New Mexico; District 3, Montana, Wyoming, Utah and Colorado; District 4, North Dakota, South Dakota, Minnesota, and Wisconsin; District 5, Nebraska, Kansas, Missouri, and Iowa.

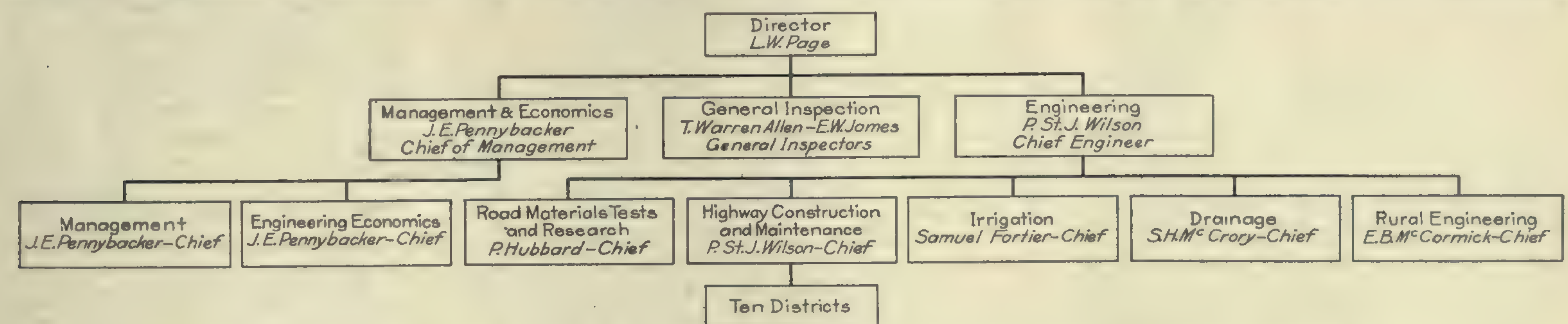
District 6 includes Arkansas, Louisiana, Oklahoma, and Texas; District 7, Illinois, Indiana, Kentucky, and Michigan; District 8, Florida, Georgia, Alabama, Mississippi, South Carolina, and Tennessee; District 9, Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont; District 10, Pennsylvania, Ohio, West Virginia, Virginia, Maryland, and North Carolina.

Road-material tests and research shall comprise investigations, reports and advice upon (1) the chemical and physical character of road materials; (2) classification of rocks according to their mineral constituents; (3) standardization of methods of testing bituminous and nonbituminous road materials; (4) occurrence, manufacture, and properties of dust preventives and road binders; (5) nonbituminous road materials; (6) the use of concrete for road and bridge purposes; and (7) the making of field experiments.

Farm-irrigation investigations shall comprise investigations, reports and advice upon (1) the utilization of water in irrigation; (2) kinds of power and appliances for irrigation; (3) the development of irrigation equipment; (4) the flow of water in ditches, pipes, etc.; (5) the duty, apportionment and measurement of water; (6) customs, regulations and laws relating to irrigation and (7) the drainage of irrigated lands.

Farm-drainage investigations shall comprise investigations, reports, and advice upon (1) farm drainage; (2) the drainage of swamps and wet lands; (3) the removal of surplus water; (4) the development of drainage equipment and (5) the making of field experiments.

Rural engineering shall comprise investigations, reports, and advice upon (1) farm domestic water supplies; (2) drainage disposal; (3) construction of farm buildings; (4) rural engineering problems involving mechanical principles; (5) traction tests on highways and (6) construction and repair of instruments used in investigative work.



THE REORGANIZATION OF THE OFFICE OF PUBLIC ROADS INDICATED BY THIS CHART BECAME EFFECTIVE NOVEMBER 1

MANAGEMENT AND ECONOMICS BRANCH

This branch shall comprise (1) management and (2) engineering economics.

Management shall comprise the following: (1) Co-operation with solicitor's office; (2) correspondence and files; (3) accounting; (4) editorial and library and (5) quarters, equipment, and supplies.

Engineering economics shall comprise the following: (1) Economic investigations and advice; (2) legislative digests, compilations and advice; (3) statistical investigations; (4) lectures, addresses and exhibits and (5) model-making and illustrations.

Co-operation with the solicitor's office shall comprise the handling of questions of a legal and administrative character arising from the Federal-Aid Road Act and other legislation affecting the office.

Committee Wants Data on Pipe-Joint Leakage to Check $4,000,000 Annual Loss

Frank A. Barbour's Figures Indicate Excessive Waste in American Cities Which Might Be Reduced by Better Methods of Construction

STATISTICS indicating enormous annual losses to cities by leakage of water from pipe joints were presented at the meeting of the New England Waterworks Association in Boston Nov. 8 by Frank A. Barbour, chairman of the society's committee which is investigating this subject. If the members of the association co-operate in supplying information to the committee, this economic loss, it is believed, can be materially reduced. The following remarks by Mr. Barbour at the Boston meeting supplement his statement presented in September at the annual convention of the association in Portland, Me. (see Engineering Record of Sept. 23, pages 369 and 385).

20 Per Cent Loss in Metered Systems

In entirely metered systems, or in systems where the meters exceed 85 per cent of the services, at least 20 per cent of the water furnished is, on the average, unaccounted for. Should we be content with such a condition?

We all know that the total unaccounted for water in unmetered systems is enormous. Presumably we all agree that metering is the great remedy, and yet, as reported by the United States Department of Commerce, only 40 per cent of the services are metered in 201 cities, containing 26,000,000 people and having an average per capita consumption of 139 gal. per day.

The total population in the United States supplied with water from public works may be taken, for present purposes, at 50,000,000 people, and the average amount of water furnished per day at 100 gal. per capita. The total water supplied daily by public works is therefore, in round figures, 5,000,000,000 gal. It is probably safe to state that 50 per cent of this quantity is wasted; and assuming the actual cost of furnishing the useless 2,500,000,000 gal. to be $25 per 1,000,000 gal.—and this is an extremely low figure—the cost per day of the water wasted is equal to $62,500, or $22,800,000 per year, which is equal to the interest on an investment of $500,000,000. Figured in this rough way, the results do not speak very well for our present-day standard of management of water systems.

As already stated, metering is the great means of reducing the total waste on which the previous figures are based, but there remains the fact that in the fully metered systems, on the average, at least 20 per cent of the water furnished is unaccounted for, and probably if more accurate data were available this percentage would be shown to be materially greater. Emil Kuichling estimated 2500 to 3000 gal. per mile per day as the leakage from well-laid mains; Dexter Brackett estimated a leakage of from 10,000 to 15,000 gal. per day in the Metropolitan District, and John R. Freeman stated that his best guess of the underground leakage in New York was from 25 to 35 gal. per day per capita, equal to from 20,000 to 30,000 gal. per day per mile of pipe. In six cities, with 95 per cent of the services metered, reported by Brackett in 1904, 36 per cent of the water was unaccounted for, equal to an average loss of 11,300 gal. per mile of pipe. James H. Fuertes, in the 1906 report to the Merchants Association of New York, presented statistics from thirteen cities in which, on the average, 82 per cent of the services were metered, which showed that 31 per cent of the supply was unaccounted for, equivalent to approximately 18,000 gal. per mile of pipe.

What part of these losses is chargeable to the mains is unknown, but from the results of such leakage surveys as have been made, and from the reported actual losses discovered in some cities, it is probable that 7500 gal. per mile of pipe per day is a conservative estimate of the water lost by leakage from the 60,000 miles of mains now in use in the public supplies of this country, or 450,000,000 gal. daily. At $25 per 1,000,000 gal., this is equal to a daily loss of $11,250 or $4,110,000 per year, or the interest on $100,000,000.

Is Loss Preventable?

In the light of this economic waste it would appear that the subject of leakage from mains is worthy of careful consideration. The committee on water consumption of the New England Waterworks Association reported in 1913 that "in general it may be said that if in a well-metered system the water unaccounted for does not exceed 25 per cent of the total pumpage, the practice is good." Doubtless this should be interpreted to mean that a 25-per cent loss is good compared with the average present practice. But is it good compared with the standard which should be set up in this age when we hear so much about conservation? Should we complacently accept a loss of 25 per cent as inevitable, and if this loss cannot reasonably be much reduced in the systems already constructed, what about the possibility of better methods of construction in the pipe to be laid in the future?

It is, of course, out of the question to consider the relaying of present systems or to do more than make leakage surveys and check the larger losses, but in the light of present knowledge, is it not time to undertake seriously an analysis of the causes responsible for the present large percentage of water unaccounted for? If these losses are chargeable to under-registration of meters, then this should be definitely made known, and consideration given to the possibility of developing more sensitive or more accurate measuring apparatus.

Are we taking sufficient care in testing pipe for water-tightness when laid? About 60 per cent of those replying to the circular of the committee state that the pipe is tested when laid, and all but six make the test before backfilling. In the writer's experience, testing before backfilling in the ordinary work of laying distribution systems is rare, and it is undoubtedly from the practice of simply turning on the water without any test that a considerable part of the present leakage develops. The standard of those who test, as indicated by the replies received, is "absolute tightness," but in the writer's experience this result is not easy to obtain, and only possible where the joints are gone over several times after the pressure is applied.

Where pipes are backfilled before testing the allowable leakage, as determined by such tests, has varied greatly in different specifications. John H. Gregory at Columbus made the limit 500 gal. per inch-mile per day. At Akron 200 gal. per inch-mile per day was specified, while actual results at Akron showed about 70 gal. per inch-mile per day. E. G. Bradbury, in his paper before the New England Waterworks Association in 1914, proposed 100 gal. per inch-mile per day as a reasonable standard for the allowable leakage in testing after backfilling, and he figured that the difference between 500 and 100 gal. per inch-mile per day, estimating the cost of the water at $25 per 1,000,000 gal., would equal a yearly cost for water lost in a city of 100,000 people of $5,256, or, in other words, the city could afford to spend $470 per mile in order to save 400 gal. of leakage per inch-mile per day.

Are Present Jointing Methods Best?

Again, are the present jointing methods the best qualified to maintain tightness after periods of use? Who knows anything about the comparative leakage when pipe is laid and after it has been in service several years? In this latter connection the history of the work at Grandview, Ohio, is of interest. As reported by Mr. Bradbury, the supply is measured by a tested meter and all service pipes are metered. The 5.5 miles of pipe originally laid were tested before backfilling and the leakage before any connections were made amounted to 131 gal. per inch-mile per day; in other words, the system was practically watertight. Subsequently 0.9 mile of additional mains were laid, and gradually in the four years since the date of original construction the services have increased to the present number of 205. Either by less careful work in the extension or by depreciation of the original work, or by under-registration of the gradually increasing number of meters, the unaccounted-for water has increased until at the present time it averages about 150 gal. per inch-mile per day.

Unaccounted-For Water

An interesting feature in connection with these records is that the unaccounted-for water, based on three years' observations, averages 60 gal. per inch-mile per day during the six months from October to April and 213 gal. during the six months from April to October. In other words, the records indicate in this system that the unaccounted-for water is three times as great during the summer as during the winter months. Whether some local explanation can be found for this result, or whether it is a reasonable result of temperature changes is not known, but data from other systems showing the unaccounted-for water during periods of varying temperature would be of considerable interest.

Any information of definite tests of leakage from observation of mains after periods of use or of the effect of temperature on leakage or the results of tests of leakage from lead joints with different shapes of bell and spigot or of other types of joints will be of value to the Committee on Leakage, and it is hoped that if any members have such information they will forward it to the committee.

[*Data should be mailed to Frank A. Barbour, chairman of the committee, whose address is* 1120 *Tremont Building, Boston, Mass.* —Editor.]

Reaëration Held to Be Important in Self-Purification of Streams

Prof. Earle B. Phelps, of U. S. Public Health Service, Contends That Dilution Ratio Is Not the Essential Factor in Preventing Nuisances

THAT the dilution ratio is not the essential criterion in determining the capacity of a stream to receive sewage without causing a nuisance is the view expressed by Prof. Earle B. Phelps, of the U. S. Public Health Service, in a paper presented at the annual convention of the American Chemical Society in New York City, Sept. 27. Reaëration is a determining factor, and yet, according to Professor Phelps, it has received little or no scientific attention.

UNDERLYING PRINCIPLES

In his discussion of reaëration as a factor in the self-purification of streams Professor Phelps enunciates certain underlying principles:

1. Pure water exposed to the air, at given temperature, will dissolve atmospheric oxygen up to a maximum amount, this value being known as the saturation value.

The solubility of a gas in water is proportional to the gas pressure. Since the oxygen pressure in the air is approximately one-fifth an atmosphere, the true solubility of oxygen in water exposed to pure oxygen at atmospheric pressure is about five times as great as the so-called saturation value. In the presence of green plant life, exposure to nearly pure oxygen is frequently observed and oxygen values of several hundred per cent of saturation are frequently recorded. A correct knowledge of the true physical relation existing is quite necessary to the understanding of the apparently abnormal results which have often in the past been ascribed to faulty chemical analysis. The solubility of oxygen is also a temperature function. Tables of saturation values are to be found in any standard work on water analysis. Approximately 10 parts by weight of oxygen will dissolve in 1,000,000 parts of water at 16 deg. C., and the solubility increases roughly by about 2 per cent for each degree Centigrade decrease in temperature, and vice versa.

OXIDATION OF ORGANIC MATTER

2. Self-purification in a polluted stream is the result of the biochemical oxidation of organic matter and requires oxygen for its consummation. The more concentrated the organic matter the greater the rate of oxygen depletion.

American sewages have a biological oxygen demand of from 200 to 400 parts per 1,000,000. This means that if diluted with saturated water at 16 deg. C. they would exhaust the oxygen supply of that water in dilution ratios of 1 part of sewage in from 20 to 40 parts of water. With greater dilutions corresponding partial oxygen depletion will result.

3. A stream saturated with oxygen will withdraw no more oxygen from the atmosphere. If partly depleted it absorbs additional atmospheric oxygen, and the rate of such absorption or reaëration while dependent upon many other factors is directly proportional to the state of depletion.

4. Under any given condition of pollution and reaëration a point of maximum oxygen depletion is reached, somewhere downstream, at which the rate of depletion and the rate of reaëration are equal. This will be termed the critical point, since it determines the maximum effect of the pollution.

Above the critical point the oxygen content of the stream is diminishing, below it is increasing. The location of this point is evidently conditioned by the time of passage or by distance in hours rather than in miles. It is also a temperature function, since depletion is accelerated by higher temperatures. As the velocity of stream flow is usually at its minimum during the hottest months, the critical point moves upstream rapidly with increasing temperatures.

5. The condition of the stream at the critical point, representing a balance between rate of depletion and rate of reaëration, is at constant temperature, a function only of pollution and of reaëration.

6. The capacity of a stream to dispose of sewage within any specified limits of nuisance is obviously measured by the condition of the stream at the critical point. It is at a minimum at maximum temperature and minimum stream flow, and under fixed temperature and flow conditions is a function of reaëration.

7. The capacity of a stream for reaëration under extreme conditions of high temperature and low stream flow therefore measures its capacity to receive and dispose of sewage by self-purification within any prescribed limits of stream depreciation or nuisance.

In the past, although the relation of dissolved oxygen to the condition of a stream, as well as the fact of reaëration, has been fully recognized, the relations set forth in the foregoing principles have been partly or wholly overlooked because of imperfect ideas of the rôle of oxidation.

APPLICATION OF DATA

The application of observational data, obtained upon running and comparatively shallow streams where conditions are ideal for reaëration, to deep canals with sluggish flow and minimum reaëration conditions cannot but lead to unsatisfactory results. A large part of the residual oxygen found in streams of the former type can now be shown to have been derived from natural reaëration. If it be assumed that such residual oxygen was initially present and had not been utilized by the sewage, the capacity of the sewage to consume oxygen is thereby underestimated and the application of the data to streams of the second type with deficient reaëration will lead to insufficient dilution and a condition of nuisance not anticipated.

As early as 1900 Palmer found the dissolved oxygen at the lower end of the sanitary canal in Chicago in August to be 5.88 per cent of saturation, increasing to 70 per cent after passing the dam. Wisner reported in 1911 the frequent absence of oxygen for many miles above the lower dam at Lockport with a dilution of about 3.3 sec.-ft. per 1000. Passage over the dam increased the dissolved oxygen to about 19 per cent of saturation. The relative importance of dilution and reaëration will be appreciated if it be noted that simple passage over the dam had the effect of a 19 per cent increase in saturated dilution water, or was equivalent to raising the dilution from 3.3 to 4.1 sec.-ft. per 1000.

The problem of the moment deals not so much with the present conditions as with the future. It is of the utmost importance to determine the future effect of gradually increasing pollution upon any given stream. In connection with purification treatments it is highly desirable to know what degree of stream improvement may be anticipated from any specified degree of purification in order that the cost of various treatments may be properly balanced against the benefits to be expected. Finally there frequently arises the problem of the effect of a very large pollution of a hitherto unpolluted or slightly polluted area, following the location, for example, of new intercepting lines and discharge points.

THE REAËRATION FACTOR

The essential elements of the specific and the general solution are as follows: Determination of the extent of pollution at a given point, measured in terms of the new sewage chemistry which deals with oxygen relations, and of the degree of self-purification and amount of residual oxygen at some lower point, together with temperature and hydraulic data, furnishes the basic facts. The oxygen requirement and rate of oxygen depletion are then known. The condition of the lower station in the same terms is calculable. The actual condition compared with the calculated gives the reaëration factor for the stretch. This must be determined for the same stretch over a considerable period of time in order properly to include the variations in hydraulic conditions.

In particular reaëration is a function of depth, velocity of flow and degree of turbulence. Similar data may be obtained at the same time over other typical stretches and the relation of the reaëration factor to other physical and hydraulic conditions noted. From such a comprehensive study there will be obtained eventually the necessary data for the determination of the reaëration constant of the stream in question under various physical conditions. Then the result of increasing or decreasing pollution, always measured in proper terms of oxygen demand, will be readily calculable. Repetition of the study upon another stream will give similar data for that stream and also permit some study of the effect of stream type upon reaëration.

SEWAGE CAPACITY WITHOUT NUISANCE

With accumulating data of this sort it is not unreasonable to anticipate that the fundamental constants will ultimately be derived with which the capacity of any stream to receive and dispose of sewage within stated nuisance limits may be determined in advance. Such constants furnish the only rational basis upon which to estimate the effect of increasing or decreasing pollution, or the degree of purification necessary or desirable in any case. As these matters have been shown to be of primary importance in any application of the principle of conservation to streams, the importance of work of this character is obvious.

In the foregoing discussion it will be noted that no reference has been made to either of two distinct phases of the pollu-

tion problem, the matter of dangerous bacteria and that of sludge deposits. Both are separate and distinct problems capable of solution independently of the problem of oxygen supply and leading to nuisances of distinct character. The presence or absence of these factors does not influence the methods or conclusions of this discussion, although the matter of deposits does enter the analytical problem.

EFFECT OF TURBULENCE

An important conclusion of this discussion will be touched upon briefly in passing. Reaëration is conditioned among other things by the degree of turbulence of the stream. In quiescent water a diffusion gradient is established which practically stops reaëration. The effect of dams and rapids in increasing aëration is not so much dependent upon the momentary exposure of the water as it is upon the mixing action whereby the diffusion gradient is broken up and reaëration permitted to proceed. In artificial canals turbulence is avoided as largely as possible. The effect of a single dam upon deaërated water has already been shown to be equivalent to a large increase in initial dilution. Where dilution is for any reason limited, the capacity of sluggish and non-turbulent streams can be greatly augmented by providing an artificial turbulence at certain points in their course. Such turbulence need not be of the character of a fall, nor need it cause a serious loss of head. A number of mere overturns or "boils" will be found more efficient than a single large fall.

The determination of the reaëration coefficient of a stream has been undertaken for the first time in connection with the investigation of the Ohio River now being made by the U. S. Public Health Service under the direction of P. A. Surgeon Wade H. Frost. The actual analytical problem is exceedingly complex and the mathematical reduction and analysis of the results is both complicated and laborious. The work has progressed to a point at which it is indicated that results of value, consistent with the theory here stated, have been obtained.

Integral Waterproofing Compounds Favored

By far the greater number of the 2628 replies received as a result of a mail canvass of 10,000 architects and engineers, recently reported by *Structural Conservation*, are in favor of the use of integral waterproofing compounds. In answer to the question, "Do you favor the use of integral waterproofing compounds in concrete subjected to hydrostatic pressure?" 2025, or 94.2 per cent, replied in the affirmative and 126 in the negative. To the question, "Has your practical experience indicated that in cases where the integral waterproofing compound was not used, the concrete was absorbent and permeable?" 1809, or 92.7 per cent, replied in the affirmative and 142 in the negative. Similarly, to the question, "Have you observed that the use of an integral waterproofing compound was beneficial in correcting absorption and the porosity of the concrete?" 1602, or 91.8 per cent, replied in the affirmative and 142 in the negative. In a number of cases, as the returns indicate, all questions were not answered, which accounts for the disparity in totals.

Viaduct 170 Feet High Erected Without Falsework by Special Steel Struts

Deck Truss Spans 102 Feet Long Supported Temporarily at Center and Built as Cantilevers to a Bearing on Next Tower

AVOIDING the use of expensive falsework by designing special steel struts to be used in connection with guy cables and supported half way up on the towers, rapid and economical erection of a steel viaduct 170 ft. high at the center and 680 ft. long was accomplished with a light timber derrick having a 60-ft. steel boom. By supporting the center panel point of the main steel truss spans 102 ft. long and erecting the overhanging half as a cantilever, the trusses were built out to a bearing on the next tower partly erected to receive them. The tower was then completed and the traveler advanced to erect the next strut and the 102-ft. span.

The viaduct was constructed for the transportation of coal-mine cars across the inaccessible valley of Pinnacle Creek in Wyoming County, West Virginia, for the United Pocahontas Coal Company. All the members for the viaduct had to be transported on mine cars about 1 mile through the old drift of the Zenith Coal Company, which was extended northward to the face of the mountain. Thence the cars were to be carried over the new viaduct crossing to the coal fields recently acquired by the company.

TIMBER TRAVELER WITH 60-FOOT STEEL BOOM ERECTING TRUSSES

LIMITING CONDITIONS

As all material, including the erection equipment, had to be transported to the site through the Zenith mine, it was decided to use a light timber traveler for the erection. This necessitated the erection of the trusses piece by piece, which would normally require the usual falsework. To avoid this expense, inclined struts or booms were designed, with the lower ends pin-connected to temporary wing plates bolted to the columns of the main towers and the top ends held in position to receive the bottom chords of the truss span at midpoint by the use of 1¼-in. wire-rope cables, as indicated by the drawing herewith.

The original design for this viaduct provided 33-ft. towers and 70-ft. plate girder spans alternating, and one 175-ft. truss span at the center. This design was rejected on account of the excessive column loads at the ends of the truss span and the cost of the falsework necessary to erect such a span. The second design provided 37½-ft. and 75-ft. plate girder spans, alternating; but it was rejected because of the number of towers and the fact that two towers interfered with the right-of-way of a proposed railroad underneath the viaduct. The final design with the special erection scheme described is believed to be the best for the given conditions.

The assumed live load was an electric motor weighing 50,000 lb. distributed equally to two axles on 6-ft. centers, preceded and followed by a uniform load of 1000 lb. per linear foot beginning 6 ft. from each axle. Traction force was taken at 20 per cent of the motor load, and the impact was assumed at 50 per cent of the live load.

SCHEME OF ERECTION

A material yard was located along the Indian Ridge Track adjacent to the end of the bridge and the air plant set up. A total of nearly 20,000 rivets had to be driven. The traveler, of the gantry type, had a 60-ft. steel boom and side frames directly over the trusses, with the engine and working platform above. It was arranged so that the material could be delivered on push cars underneath the frame and carried forward to a position to be handled by the boom.

Beginning at one end, the first tower was erected, the plate girder spans set, and then the erection struts placed and guyed in position. The first truss span was built up to a point just beyond the center, the traveler moved forward to the center of the span and the next tower built up as indicated on the drawing. The remainder of the span was then built out as a cantilever,

THIRD TOWER COMPLETED AND 102-FOOT TRUSS BEING ERECTED

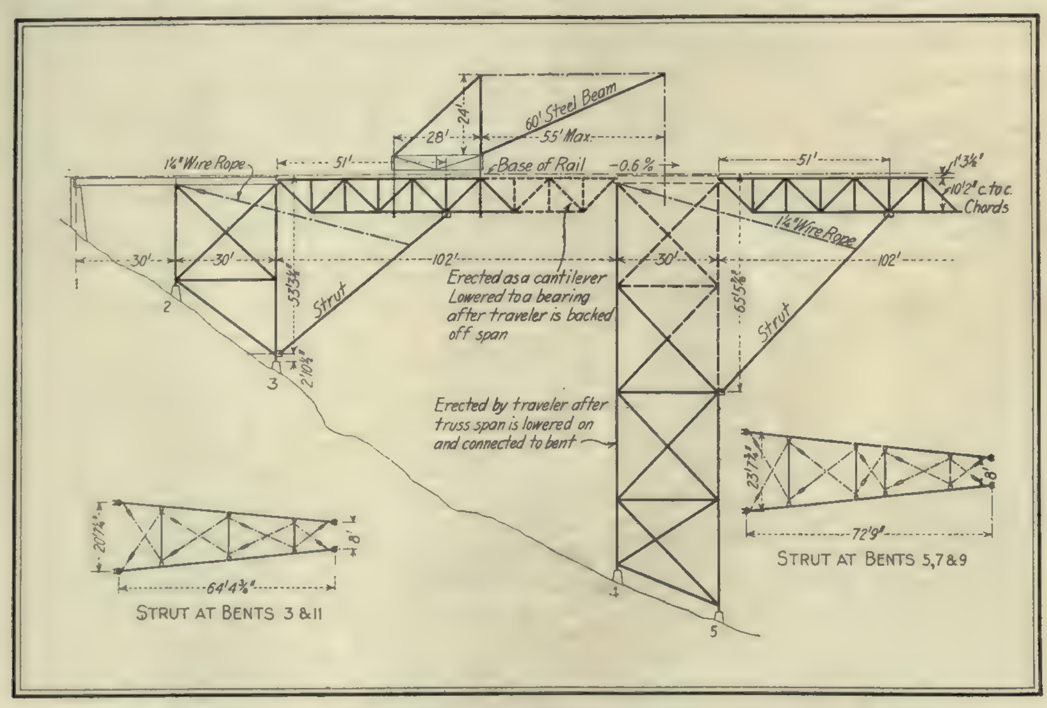
the traveler was backed off the span and the erection struts removed and transferred ahead to the next tower, which was completed, and the operations repeated for the whole length of the viaduct.

The struts were designed of proper length to give the desired camber in the truss spans, and no difficulty occurred in placing the last sections of the top chords. The scheme of erection worked out well, the entire viaduct, which weighed about 340 tons, being completed in 34 working days by an average force of 34 men.

The viaduct was designed by P. A. Blackwell, assistant chief engineer, and the scheme of erection was developed by H. S. Cowell, erection engineer of the Virginia Bridge & Iron Company of Roanoke, Va., which fabricated and erected the structure.

Plan Survey of Concrete Roads

The Portland Cement Association is planning to undertake in the near future a comprehensive survey of all concrete roads in the United States. Their condition will be determined and local authorities everywhere will be conferred with as to the maintenance such roads may need. It is intended to so record the findings of this survey that there will be in existence a real history of the concrete roads in the United States.



PART ELEVATION INDICATES SCHEME OF ERECTION—STRUTS BUILT UP AS SHOWN

Vitrified Pipe with Asphaltic Joints Used as Force Main

John B. Hawley Describes Results of Tests for Pressure Line in Texas Sewerage System

TESTS have demonstrated that 12-in. vitrified pipe, double strength, with asphaltic joint filler, is suitable for a sewage force main operating under a maximum internal pressure of 7½ lb. per square inch, according to a paper read at the recent convention of Texas engineers by John B. Hawley, consulting engineer of Fort Worth. This fact was developed in connection with the design of the new sewer system for Shreveport. The result was that vitrified pipe was used for the work instead of cast iron, at a considerable saving in cost. A summary of Mr. Hawley's observations and conclusions follows:

VITRIFIED PIPE TESTS

To determine the safety of the vitrified pipe, two lengths of double strength were put together. A strand of jute was tightly calked into the joint, so as to leave a 1½-in. depth for asphalt. A mixture of 58 penetration Texaco asphalt and lime dust, in proportion of 1 lb. of asphalt to 1¼ lb. of lime dust, incorporated at 300 deg. Fahr., was poured flush-full. Prior to calking in the jute, the inside of the bell and the outside of the spigot ends were painted with a thin coat of the same asphalt dissolved in gasoline.

Tight "round heads," with gaskets, were applied at the ends and through-bolted with three 5/16-in. steel bolts. An accurate pressure gage was attached to one head and a water connection made from a nearby tap. Upon application of pressure, very gradually, the joint showed signs of slowly pushing out, and at the end of about an hour, at 32 lb., one of the pipes, which had sweated considerably, failed. The joint had only oozed slightly at time of failure.

Another pipe was substituted, and a new joint mixture—1 lb., 35 penetration, to 1¼ lb. lime dust—was used, with paint coat and jute as before. Pressure was gradually applied, and at 40 lb. two of the 5/16-in. through bolts failed at the thread shoulder, stopping the test. Both pipes were intact and the joint held firmly, without any observable ooze.

SPECIFICATIONS

After this experiment, double-strength vitrified pipe was adopted for the lower end of the outfall, and specifications were written for joints as follows:

"All adjustment to line and grade, of pipes laid directly upon the bottom, must be done by scraping away, or filling in the earth under the body of the pipe, and not by blocking or wedging up. Before laying, the interior of the bell shall be carefully wiped smooth and clean, and the annular space shall be kept free from dirt, stones or water. A gasket of dry Eagle packing shall be calked into each joint sufficiently tight to prevent the least intrusion of asphalt into the pipe. Such gasket shall be in one or more pieces, if the engineer so direct; shall be of ample length to reach entirely around the pipe, and of a thickness to bring the bottoms of the two pipes to the same level. No joint shall be poured until the gaskets of at least the two next joints in advance are properly inserted.

"All joints in vitrified pipe shall be asphalted. The mixture shall be composed of any standard refined asphalt 99 per cent soluble in CS_2, penetration 35 to 40, and sufficient cement mill lime dust or Portland cement incorporated hot, to a homogeneous mass of specific gravity 1.60.

"Before lowering into trench, the inside of the bell and outside of spigot of each pipe shall be well treated to a substantial 'naphtha coat' made by cutting asphalt above described with gasoline. Bell and spigot surfaces shall be 'bone dry' when the naphtha coat is applied.

"Fiber jointer, greased against adhesion of asphaltic joint material, shall be used in making joints. All asphaltic joint work must be done under conditions of perfect dryness of joints. The engineer will order underdrains, if needed to secure dryness, which will be paid for according to prices bid by contractor."

Mr. Hawley is fully convinced that double-strength 12-in. vitrified pipe is perfectly safe for the service mentioned, provided, of course, that each length is sound in body, bell and spigot. It further seems certain that asphaltic joint filler compounded as above, and hot poured onto asphalt painted surfaces, is wholly dependable. Its cost is said to be about 25 per cent that of asphaltic material sold under various trade names.

Dryness Essential

It will be noted that the specifications provide for underdrains (to be paid for by the city) if necessary, to insure perfect dryness during the pouring of hot asphaltic joints. Such dry conditions, with proper asphaltic filler, paint coat and careful workmanship, will, Mr. Hawley believes, result in sewer mains and laterals of nearly perfect tightness against leakage from within and infiltration from without. It is within the possibilities, he states, that further study of rational methods of compounding and making asphaltic joints in vitrified pipes may result in the utter abandonment of cement-mortar joints, with their inevitable leakage. Nevertheless, a molten asphalt, at 300 deg. Fahr. or at any temperature above 212 deg. will not make a sound joint in the presence of moisture, as steam will surely be generated, causing porosity, poor contact, and even blowouts.

Lines and Grades

A few more paragraphs from the Shreveport specifications are quoted, as follows: "Pipes and specials shall be so laid in the trench that after the sewer is completed the interior surface thereof shall conform accurately to the grades and alignment fixed and given by the engineer. Limits of error will be allowed as follows:

"Alignment—All pipe of whatever size shall be laid within 0.1 ft. of true line, in any 50-ft. station.

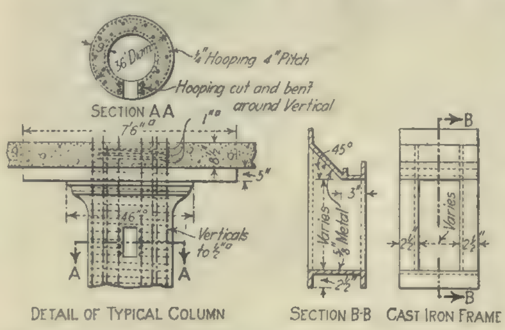
"Grade—On grades of 5 ft. per 1000, or greater, an error of 0.62 ft. at any point will be allowed. On grades of 3 to 4.99 ft. per 1000 an error of 0.015 ft. at any point will be allowed. On grades of less than 3 ft. per 1000 an error of 0.01 ft. at any point will be allowed." While first-class sewer construction is to be insisted on, Mr. Hawley explains, this clause is to inform the contractor that sewer building necessities and standards are contemplated, and not those of watchmaking.

The words "true line and grade," according to Mr. Hawley, are so frequently used by enthusiastic, academic, young, inexperienced and sometimes malicious engineers, to the utter defeat of common sense and ordinary justice in the administration of sewerage construction, that these paragraphs were deemed of economic value, as the "consumer pays the freight" eventually, even, as Mr. Hawley puts it, on engineering asininities.

Hollow Reinforced-Concrete Columns for Ford Plant

New Extensions to Detroit Factory Ventilated by Complete System Using Columns as Ducts from Fan Rooms on Roof

HOLLOW COLUMNS reinforced with vertical bars stayed by two spirals, with cast-iron outlets at each floor just below the ceiling, were adopted for the interior columns in the two extensions (29 and 30) for the Ford Motor Company's plant at Detroit. In spite of the special type of these interior columns, and the relatively difficult details at the crane-runway girder connections to columns and steel monitor framing over the craneway here shown, record speed was made in the construction of these buildings, as described in the Engineering Record of Oct. 7, page 430. The hollow reinforced-concrete columns here described should be compared with the cast-iron hollow columns used for the same purpose in the Victor Building at Camden, N. J. (see Engineering Record of Nov. 27, 1915, page 656).



TYPICAL DETAIL OF COLUMN REINFORCEMENT AT DUCT OPENINGS

The new Ford Building, 864 x 162 ft. in plan, with 20-ft. square panels, consists practically of two reinforced-concrete structures 62 ft. wide separated by a craneway 38 ft. wide, with a steel-frame monitor and skylight. In the design of the floors the usual flat-slab or mushroom type with four-way reinforcement was used, the typical slab being 8½ in. thick, with drop panels 7½ ft. square over the columns. The steel at the top of the slabs near the columns is bent around the openings for the vertical ducts, and three rings are inserted to reinforce the concrete in compression. Spandrel beams on all outside edges of the slabs carry loads to the rectangular exterior columns.

Hollow Columns for Ventilation System

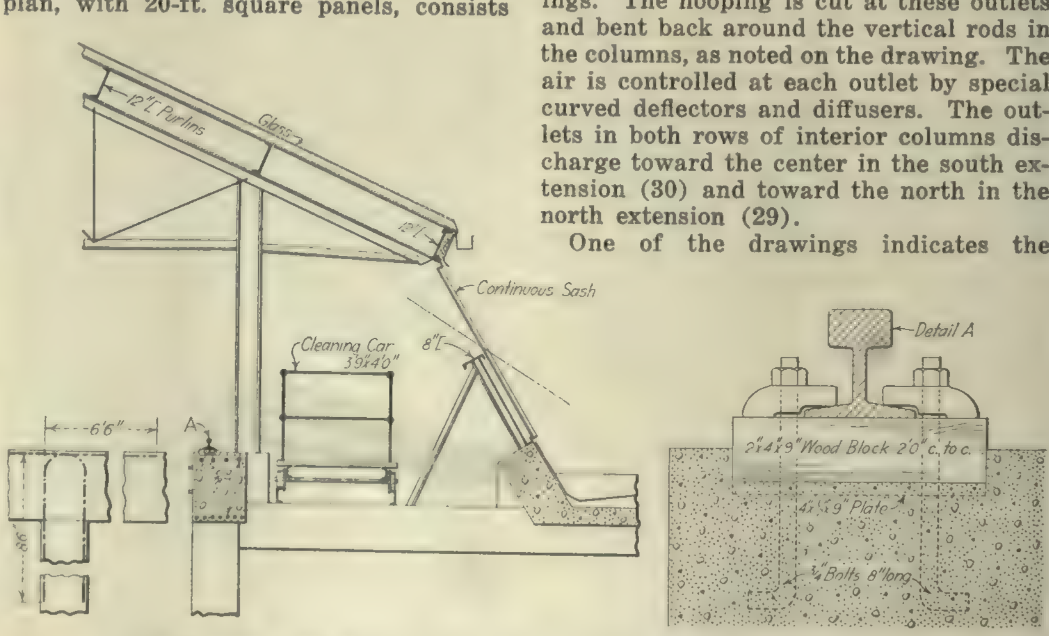
One of the most distinctive features of the design is seen in the use of reinforced-concrete hollow columns with vertical rods and spiral reinforcement near the inside and outside surface of the concrete ring. Sheet metal forms were used, the inside tubes remaining permanently in place, forming the air ducts leading from the fans on the roof to the cast-iron outlets embedded in the sides of the concrete columns below the floor level. As illustrated by the detail at a column head shown on the accompanying drawing, these typical interior columns are 36 in. in outside diameter and 18 in. in inside diameter for the lower section, decreasing to 35 in. outside and 22 in. inside at the top.

The air of the ventilating system is forced down through the columns, after passing through air washers, by fans in the eight fan rooms located symmetrically in pent houses on the roof. Each fan unit consists of a Sirocco fan and air washer having a normal capacity of 68,500 cu. ft. of air per minute. The air is heated by hot water at 155 deg. circulating through 100,000 sq. ft. of cast-iron Vento heaters. The system is designed to deliver 55 per cent of the total air supply to the first floor, 15 per cent to the second, and 7½ per cent to each of the third, fourth, fifth and sixth floors, from which it is drawn up through the craneway to the recirculating inlet.

Cast-Iron Outlets

The outlets consist of rectangular cast-iron collars flanged on the inner and outer ends, detailed as shown in one of the drawings. The hooping is cut at these outlets and bent back around the vertical rods in the columns, as noted on the drawing. The air is controlled at each outlet by special curved deflectors and diffusers. The outlets in both rows of interior columns discharge toward the center in the south extension (30) and toward the north in the north extension (29).

One of the drawings indicates the



PART SECTION THROUGH MONITOR OVER CRANEWAY—CRANE GIRDER DETAILS

method used for reinforcing the 5-ton crane-runway girders of reinforced concrete and connecting them to the columns to insure continuity. The rails are supported on wooden blocks embedded in the concrete and are secured by the clips shown in the large-scale detail. Ample light from above is provided by the glazed roof of the monitor over the runway and continuous sloping sash on the aisle, as indicated by the part section.

The engineering and mechanical features of the building were designed by Albert Kahn, architect, of Detroit. The construction was carried out under the supervision of the architect by the George A. Fuller Company, of New York City.

Standard Forms Prepared for Traffic-Count Data

BASED upon information gathered from all the principal cities, standard forms for traffic counts have been prepared by a committee of the American Society of Municipal Improvements. This body consists of James C. Hallock, chairman, A. P. Folwell and Harland Bartholomew. In the accompanying diagrams the standard forms are shown. They are claimed to be simple, economical and complete and will facilitate equitable comparisons between counts in various cities.

Commenting upon the committee's work, Mr. Bartholomew points out that the increasing problems of traffic regulation necessitate constant study of the character and movement of traffic on all city streets. Systematic records of the character and volume of traffic will greatly assist in improving rules for traffic regulation; in determining the method and means of street cleaning, street planning, etc. For these reasons a uniform method of making traffic counts in all cities will greatly facilitate comparisons between conditions in various parts of one city or between various conditions in different cities.

Begin Studies to Find Cause of Concrete-Road Cracks

Periodic Measurements to Be Made of Vertical Movement of Pavement Slabs at Kenilworth, Ill.

By WILLIAM M. KINNEY
Assoc. M. Am. Soc. C. E., Chicago

REALIZING the need of a more thorough and scientific study of the cause of cracks in concrete pavements, an experiment to obtain data regarding the vertical movement of pavement slabs is being conducted by the Promotion Bureau of the Universal Portland Cement Company on a pavement constructed this year on Sheridan Road, Kenilworth, Ill., extending from the northern limits of Wilmette to the southern limits of Winnetka. This experimental study is being carried on in a manner somewhat similar to that suggested by S. Whinery in his article in the Engineering Record of Oct. 28, page 529, under the title "Tests Needed to Verify Concrete-Road Cracking Theory." It is a coincidence that these tests should have been started at practically the same time as the above-mentioned article appeared; in fact the first readings were taken Oct. 27.

The experiment consists in determining the elevation at various seasons of the year, particularly when the frost is entering and leaving the ground, of points on the center line and near the curb in each slab. The ends of the slabs being protected by steel plates firmly anchored into the concrete, it was not considered necessary to set plugs in the pavement. A ¼-in. hole was drilled in the top of each plate at the center line of the road and at a distance of 4 ft. from the back of each curb, giving six points at each joint on which readings are taken, three on each joint plate. There is a total of 87 joints in the concrete pavement under test, thus making 522 readings. The majority of the joints are placed from 30 to 36 ft. apart, while the spacing of several of them is upward of 50 ft. Five benchmarks were established from which precise levels were taken in accordance with methods employed by the United States Coast and Geodetic Survey. Prof. William H. Burger of Northwestern University, Evanston, Ill., took the readings.

It is planned in addition to the readings already taken to take readings from the same points directly after the frost enters the ground and once every month thereafter until next spring, when readings will be taken more frequently to determine, if possible, the exact movement of the slabs as the frost leaves the ground. An accurate survey of the surface will also be kept in order to note if there are any signs of cracking.

CHARACTER OF PAVEMENT

The pavement under test is a 40-ft. concrete pavement with integral curb. Two-course construction was used, with a thickness at the sides of 7 in. and at the center of 10 in. The concrete for the base consisted of a mixture of 1 part cement, 2½ parts sand and 4 parts pebbles. The concrete for the top wearing surface consisted of 1 part cement, 1 part sand and 1½ parts of ¼ to ½-in. granite.

It is hoped, by making a careful and accurate survey of this road, to determine whether frost action is responsible for the longitudinal cracking of concrete pavements. Many engineers are of the opinion that this cracking is caused in many instances by the action of the frost entering and leaving the soil under the edges of the slabs, first causing a movement through the expansion of the soil and later settlement due to subsequent contraction. This experiment should throw considerable light on this subject.

_______ DEPARTMENT | Traffic Census Observation Report | Direction _______
City of _______ | | On _______ St. or Ave. Between _______ St. or Ave. And _______ St. or Ave.
Date ___ | Weather ___ | Observer ___ | Pavement ___ | Condition Clean/Dirty ___ Damp/Dry ___ Slippery/Safe ___

			8 to 9	9 to 10	10 to 11	11 to 12	12 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7		
Iron Tires	1 Horse Vehicle	Light													
		Heavy													
	2 Horse Vehicle	Light													
		Heavy													
	3 or More Horse Vehicle														
	Total														
	Street Cars														
Rubber Tires	Motorcycles (or Bicycle)														
	Passenger	2 Pass													
		3 or More													
	Freight, Large	Loaded													
		Empty													
	Freight, Small	Loaded													
		Empty													
	Total														
Grand Total															

On _______ St. or Ave. Between _______ St. or Ave. And _______ St. or Ave.

Date	Kind of Pavmt.	Date Laid	Width of Road	Wet or Dry	No of Hours	Vehicle Data: Total Per Day, Horse	Total Per Day, Motor	Total Per Day, Total	Average Per Hour, Horse	Average Per Hour, Motor	Average Per Hour, Total	Maximum Hour, Number	Maximum Hour, Hour	Average Per Minute Per Foot—Width Of Pavement, Travelled Width	Average Per Minute Per Foot—Width Of Pavement, Total Width	Tonnage Data: Total Per Day	Average Per Vehicle	Average Per Min. Per Foot Width of Road	Total Per Year Per Foot Width of Road	Percent of Traffic, Horse	Percent of Traffic, Motor	No. of Street Cars	Traffic Units Per Min. Per Foot Width of Road

THESE STANDARD FIELD AND OFFICE FORMS RECOMMENDED FOR TRAFFIC COUNTS ARE CLAIMED TO BE SIMPLE, ECONOMICAL AND COMPLETE

Coal Tar Helps Maintenance of Metal Flumes

Reclamation Engineer on Uncompagre Project Experiments with Seven Coatings—Life May Be Doubled If Properly Applied

EXPERIMENTS with various paints to preserve metal flumes carried on by engineers of the U. S. Reclamation Service indicate that coal tar and its compounds give the best results. Fred D. Pyle, project manager, Uncompagre Valley Project, on Sept. 19 outlined the tests to the conference of project managers at Denver. His paper appears in the November *Reclamation Record*. The metallic portion of flumes on timber superstructures supported on concrete piers costs 25 to 30 per cent of the total cost. The concrete portion is permanent except when it comes in contact with shale; the woodwork is good for twenty years at least, and by replacing individual pieces is good for twenty-five years. Indications are that unprotected galvanized steel flumes will have a life of ten or twelve years, except under the most trying conditions, namely, high velocity of water carrying sand and fine gravel, where the life in one particular instance was only four seasons' use.

PAINTS NOT SUFFICIENTLY TESTED

Tests of various kinds of paints and other protective coatings have not been carried on for a sufficient period to give definite results, but it appears that the life of the metal may be doubled by their use. Galvanized steel has been employed in all cases, except for a small quantity of ungalvanized steel and Keystone metal placed for experimental purposes.

The principal difficulties met in operating metallic flumes are of two classes—those due to accidents and those due to wear. In the first class can be counted settlement of approaches and of foundations; buckling or pulling apart of flumes resulting from inadequate expansion joints; washouts caused by floods in drainage channels crossed, or as a result of breaks in canals at the ends of flumes. In the second class can be included deterioration of the flume due to action of water, sand and atmosphere. The erosive action of sand or grit carried at velocities over 3 ft. per second is very pronounced, especially in the flumes having rough interior joints, first removing the galvanizing, thus exposing the steel to both rust and erosion, so that it is soon pitted and in extreme cases can readily be punctured with a lead pencil.

If galvanizing is not of the best quality it may allow the rusting of the underlying metal with the characteristic pitting, which in time destroys the usefulness of the flume. The pitting in some cases commences during the first season's use. The progress of the pitting is slow, however, unless there is sufficient sand in the water to scour off the rust. The pitting and rusting often occur in the joints. Ordinarily the rusting in the joints may be the most dangerous on account of being the most difficult to detect. The action of the atmosphere is almost negligible and may be disregarded, and for this reason the outside of the flumes need not be painted.

EXPERIMENT WITH SEVEN PAINTS

On March 23 a newly completed No. 60 galvanized steel flume was painted with seven paint and tar mixtures as an experiment to determine the relative permanence of each mixture. Seven 36-in. sheets were painted with each mixture, three unpainted sheets being left between some of the sets for observing the condition of the galvanizing.

On Sept. 15 Mr. Pyle made an examination of the flumes and found the following conditions:

African Black—Traces left in bottom, none at water line; slight traces above water line. Became lifeless and flaked off; rubbed off in powder. Paint on east side of flume in worse condition.

Egyptian Black—Same condition as African black, except a little more paint was left on the metal.

Elastic Graphite—In fair condition both above and below water line; also at water line. Lacks body; dry. May or may not be good for another season.

Green Graphite—Peeled at water line; dry and flaking off below; fair condition above.

Tar Compound—In good condition; undoubtedly good for another year; not affected by water; less body than coal tar.

Coal Tar—Excellent condition; good body; not affected at water line; tacky.

Green Paint—Peeled at and above water surface; checked and lifeless below water, with considerable flaking off.

Unpainted Sections—Showed pitting and loss of galvanizing on 10 per cent of the area below water line.

From the foregoing it will be observed that the coal tar, coal-tar compound and elastic graphite were the only mixtures that could stand one season's use, and there was some doubt as to the elastic graphite standing another season.

Discover Uses for Bark of Trees

The U. S. Forest Products Laboratory at Madison, Wis., has found a way to use even the bark of trees. By a new process waste bark can partly replace expensive rag stock in the manufacture of felt roofing. It is already being used commercially by mills co-operating with the laboratory experts. The bark thus used is that remaining after the extraction of the tannin for leather work. The same waste bark has been used successfully for making wallpaper. Experiments now in progress indicate that the hemlock bark may be used for sheathing paper, carpet lining, bottle wrappers and deadening felt.

Truck with Steel Tires Solves Difficult Haulage Problem

Halves Cost of Transporting Stone Over Mountain Road, Covered Deep with Dust, That Baffled Teams and Motor Truck

AFTER experimenting with both horse-drawn and rubber-tired vehicles, the A. A. Haskins Dolomite Company of San Francisco, California, owner of the largest pure dolomite quarry in the United States, has cut down the cost of transporting 40 tons of stone daily $10\frac{1}{2}$ miles to the railroad from \$58.21 to \$28.71 by using a White Good Roads truck and 5-ton trailer. The truck operates 24 hours a day over a crooked mountain road covered for four-fifths of its length with fine dust 6 in. deep. To load a car of material a day with horses required five 8-horse teams,

STEEL-TIRED TRUCK SOLVES HAULAGE PROBLEM ON ROUGH MOUNTAIN ROADS DEEP IN DUST

and the cost of \$1.45½ per ton is stated to have been prohibitive.

The quarry is located in San Benito County, and the road from it to the railroad is one of the worst in the country. On the 8-mile stretch mentioned there are grades of 8 and 10 per cent, ranging in length up to $1\frac{1}{2}$ miles, in which are many sharp turns. The last quarter of a mile of the road is across the deep sand and gravel bed of the Salinas River, which is always dry in summer. In order to give the truck better traction, this section has been packed with straw.

After it was found that the cost of transportation by means of horses was too great, a rubber-tired truck was purchased. This truck was not able to operate efficiently on the rough roads. The steel-tired truck finally solved the problem.

The truck and trailer are loaded direct from a chute at the quarry in about three minutes. To reach it, the truck climbs a 10-per cent grade in 12 in. of dust. As tonnage and dependability are more essential than speed, the drivers are not allowed to exceed 5 miles an hour. There are two shifts of drivers and the truck uses 44 gal. of gasoline and 4 gal. of oil a day to haul 40 tons, traveling a total distance of 84 miles. As the summer days are extremely hot and the nights cool, 12 gal. of gasoline per round trip are consumed in the day time and 10 gal. at night. On the basis of daily saving of \$29.50 as compared with the cost of team haulage, the truck paid for itself in the first seven months of operation.

Highway Conditions in Pioneer Good-Roads State Unsatisfactory

New Jersey, After Spending $100,000,000, Has Inadequate System, Inefficiently Administered—Good Arguments Advanced Against Bond Issues

BEFORE the advent of the automobile New Jersey held first rank among the states in the matter of good roads. To-day conditions are changed. With inadequate highway laws the various civil divisions have been unable to cope with the road distress caused by fast-moving motor vehicles.

Realizing the seriousness of the situation, the governor last spring appointed a commission to make a study of the road problem in all its aspects and to report to him on ways and means of relief and of putting the highway work of the state on a sound basis. Simultaneously the New Jersey State Chamber of Commerce began a survey of road legislation, administration and needs, co-operating with the commission appointed by the governor. The work of the chamber is now completed and the results have appeared in a report over the signature of Harry Meixell, Jr., assistant secretary of the chamber's Bureau of State Research.

Scope of Report

The report reviews, first, the expenditures already made on New Jersey roads, pointing out that on the improved roads alone not less than $100,000,000 have been spent in 25 years. Jurisdiction, when studied, is shown to be divided between 500 different administrative units, which on account of inadequate laws do not co-ordinate their efforts.

The highway needs of the state and the principles on which a sound road policy must be based are then studied. It is concluded that an adequate state system must include 1500 miles of road, to construct which to proper standards would require the expenditure of $30,000,000. The financing of this expenditure forms the final chapter of the report. A strong argument is made against highway building through bond issues.

The following extracts give the meat of the main divisions of Mr. Meixell's report:

Expenditures

According to estimates prepared by the State Chamber of Commerce, the location, construction, reconstruction, resurfacing, repairs, maintenance, financing and administration of New Jersey's 9,147.56 miles of improved roads have cost at least $100,000,000 during the past 25 years. The figures are stupendous, yet very conservative. Indeed, Bulletin 386 of the U. S. Department of Agriculture estimates that New Jersey's improved roads have cost us $140,000,000. These figures represent expenditures for a period during most of which the units of traffic were comparatively few and light. Now traffic units are increasing in number, speed, size, and road destructibility daily, and these units no longer circulate locally, but throughout the entire state.

Last fiscal year alone—exclusive of expenditures by towns, cities, townships, boroughs and villages—the state and counties of New Jersey are estimated to have spent over $4,000,000 for work on improved roads. In 1914 the expenditures by the state and its civil divisions are estimated to have been $7,208,287 for improved roads. This year the figures will mount even higher. Individual counties are bonding themselves for as high as one-half million dollars for highway expenditures, the state is giving them many thousands more for aid in construction, reconstruction and so-called repairs, and the smaller governmental units of these counties are raising thousands more to be spent for the same purposes. At this rate, if present methods prevail, the next 25 years will see every penny of $200,000,000 spent on New Jersey's improved highways.

It is impossible to tell how much money has been expended upon the 6,123.24 miles of graded roads in the state. In like manner, no financial data are available for the 5,174.69 miles of unimproved roads.

Jurisdiction and Control

There are 21 counties in New Jersey, 235 townships, 180 boroughs, 4 villages, 24 towns, and 43 cities.

In each one of these governmental divisions is some sort or other of a road organization. The personnel of these organizations, as a rule, is untrained, inefficient, and indifferent. Standard and coordinated effort in road matters between county, township, borough or other municipality is impossible. There are numerous instances where on a single 5-mile stretch of road three or four different types of jurisdiction and control have exclusive authority over portions of that road. They construct these portions when and as they see fit, they maintain them or not as they choose and when they choose, and apply ready-made systems of financing and administration.

The selection of road routes, the choice of materials; the awarding of contracts, the inspection and certification of the job; the acceptance of the completed work, the raising of the funds to pay for it, the subsequent maintenance and administration of the roads; these important matters and many more, all of which, particularly at the present time, require the intelligent consideration of highly trained experts, are left to the care of seven different types of governmental authority, which in turn delegate this authority to over 500 diversified units of these various types of government. The numerous diversified units in their turn pass these vital road powers, duties and responsibilities onto the local politicians.

Old Road Laws Vague

This jurisdiction and control scattered among the civil divisions of the state is based upon a great conglomerate mass of road legislation composed of numerous original acts which have been greatly aggravated and complicated by subsequent amendments, supplements and revisions. The provisions of these road laws are often vague and indefinite, frequently too narrow or restrictive in scope, and more often conflicting in their own paragraphs or with the paragraphs of other acts. Most of them were framed to meet the conditions obtaining before the advent of the automobile.

In a new system there must be, first of all, an intelligent selection of the routes for the highway system. With a road mileage of over 20,445.44, or an average of 2.72 of a mile of road for every square mile of area, it is obvious that for some time to come there will be very little necessity of acquiring new rights-of-way for the improvement of the roads that will enter into our system. Additional property may be necessary for widening certain roads, for avoiding bad grades, eliminating sharp turns or for shortening distances, but the chief difficulty will be the proper selection of routes from a number of possibilities. This will be particularly true in the choice of routes for the main arteries of travel which must be the foundation so to speak for the entire road system.

State-Wide Traffic Census Undesirable

Some persons advocate a state-wide traffic census, taken at different intervals and at different seasons of the year on all the roads throughout the state, and then selection by this method of roads which show the heaviest traffic. Such a procedure is open, however, to very serious objections. Given roads No. 1, No. 2, No. 3 and No. 4, it may so happen that the condition of road No. 1 during the course of the year is so much better than that of the other roads that traffic will go several miles out of the way and use up considerable time in order to travel on this particular highway. A mere traffic count would seem to indicate road No. 1 as the logical one for a main artery of travel. Road No. 2 may be shorter, road No. 3 may tap a more prosperous and more thickly populated district, road No. 4 may be in reality the ideal road for a highway artery. The poor condition of road No. 4 has discouraged traffic, and the traffic count apparently proves it of less importance for a main artery than No. 1. How can a proper selection therefore be made?

A road, as has been said before, is primarily the physical expression of the transportation needs of the community. It is evident therefore that these needs, so far as they are general and state-wide, should receive careful consideration when planning the selection of routes for the state highway system and particularly for the main arteries of travel. What are the economic factors in the state which now or in the future will give rise to state-wide or even nation-wide road transportation? Where are the sources or destinations of actual or potential state-wide traffic? What is or will be the character of this traffic? Must the freight have direct and rapid transportation, as is the case with perishable farm and other food products, or will it admit of longer and more indirect routes? These and many other similar questions must be answered in seeking ideal locations for the routes of our state highway system.

Must Serve General Needs

It is vitally important that in this system the great arteries of travel be selected with all due regard to the transportation needs of the entire state. Individual counties, individual divisions within the county, must lay aside their purely selfish or sectional interests and co-operate in the effort to locate these main trunk-line roads along the routes which will bring the greatest economic benefit to the whole state.

The same intelligent selection of routes must be made in choosing for development and improvement feeder roads to the main arteries of travel. The importunities of

some particular township, borough or village, or its political influences, must not be allowed to hinder the economic development of any community where that development is directly dependent upon the proper selection and improvement of feeder roads to the great arteries of travel.

As for the branches of the feeders, here again the only justification of their existence as public roads and of expenditures upon them, and the only order in which they should be selected for improvement, is their relative importance in serving the transportation needs of the country they penetrate. To locate any single unit of the state highway system where it will not in a thorough and economical way accommodate the actual and potential traffic along its route, or to place any such unit where it will not co-ordinate perfectly at all times with the rest of the system, is to ruin the effectiveness of such a state highway system.

SURVEY

Our highways laid out and built to accommodate the local, light and slowly moving traffic of bygone days are inadequate for modern transportation conditions with heavy loads, high speeds and state-wide circulation. Steep grades, narrow pavements, deviation from a straight line and bad curves cause a heavy wastage of time, increased wear and tear on vehicles, and added consumption of motive power. Disregard of topography, climate and drainage have and are accelerating road disintegration. There must therefore be a road inventory, so that every element that directly or indirectly can have a bearing on the effectiveness, the economy and the safety of our system may be analyzed and amply provided for.

The relative cost, availability and durability of road building materials must be considered, as well as their suitability for climate, soil, drainage and other conditions existing in the parts of the state where they are to be laid down.

FINANCING

The greatest problem which must be confronted by the people of New Jersey in establishing and operating a high-grade comprehensive state highway system will be the financing of such a system. It will require a lot of money, and this is particularly true at the present time when the cost of materials and the wages of labor are at a very high level. The great danger will be that these conditions will either prompt the people to postpone the establishment of the system or to build up only a small portion of it, or perhaps to put down an inferior system, or to adopt precarious methods of financing the system. To adopt any one of these courses will be wasteful folly.

The economic development of the state demands that a highway system be put into working order within the next few years. Fairness to every portion of the state demands that the system be comprehensive and that it be available for every resource of the state which is worth developing. The outlook for the future demands that the roads of the system be constructed not merely with a view to sustaining actual present traffic, but the traffic of the next 15 or 20 years. Finally the future solvency of the state and its civil divisions, and ordinary decency, demand that we do not shift the burden of the cost of the system upon our children. We of to-day are paying the interest and principal of road bonds contracted for improvements whose usefulness has long since disappeared. Our financing from now on must proceed along more intelligent and scientific lines, and the state highway system is a good place for the state to begin and set the proper example on the main arteries of travel for its counties and other civil divisions to follow in their road affairs.

On a maximum estimate to take over 1500 miles of main arteries of travel during a period of five years and to bring this mileage up to the standard of the state highway system and maintain them in that condition will cost the State of New Jersey $30,900,000.

EXPENDITURES FOR NEXT FIVE YEARS

The computation for road funds derived from general appropriations, the motor-vehicle fund and federal aid during the next five years is $12,276,400. This presupposes that not a dollar of this money will be spent for state aid to counties or other civil divisions for construction and maintenance, and that every penny will be expended on the main arteries of travel only as they are taken over and brought up to standard by the state.

It is obvious that the state must make up by some method or other the balance of $18,623,600 if the proper basis of a comprehensive state highway system is to be established. A state-road tax is the only sensible solution to the problem. No doubt a cry for an issue of bonds to provide for this balance will be raised. But why a bond issue, with its burdensome interest and other carrying charges? Why a bond issue which in the last analysis must be financed like the road itself from true and actual receipts?

Yes! But the main arteries will be fairly permanent, and surely it is good finance to spread the great cost of their improvement over the number of years that we can be sure they will last.

That argument was advanced in justification for 30-year bond issues on macadam roads, laid down five years ago and later. We still have the bond issues; where are the roads? That same argument is justifying bond issues to-day for certain types of roads, which every sign of the times tells us will go to pieces long before the bonds mature.

MOTOR-VEHICLE TRANSPORTATION

We have not passed the threshold of motor-vehicle transportation in New Jersey. We are simply standing in the doorway. No one can foretell the strain which our main road arteries must bear within the next five or six years. No one can predict that a certain type of road will not need rebuilding within that period. Let us play safely and pay cash for our state highway system, spreading the cost over a five-year period of construction.

According to the 1915 report of the state comptroller the ratables of the State of New Jersey for the year ended Oct. 31, 1914, were $2,583,953,595.29. Between the five fiscal years 1917-1921 during which the state highway system will be constructed the ratables of the state will doubtless average three billion dollars or more. On this basis of three billion dollars of ratables over a five-year period it is evident that a road tax of 1 mill on the dollar would yield an average of $3,000,000 annually, or a total of $15,000,000 over a five-year period.

Here, then, are the means of obtaining $27,276,400 over a five-year period for the construction and maintenance of the 1500 miles of main arteries of travel of the state highway system. There would still be $3,623,600 necessary to meet fully the requirements. We could meet this problem by postponing the construction of 180 miles one year.

NO NEED FOR BOND ISSUE

At all events the plan obviates entirely the need for a bond issue, and a road tax of 1 mill on the dollar will hardly prove a burden to any taxpayer. But even if it should, 1 mill on the dollar is only $1 in the thousand, and what owner of property will not have the value of his property increased many times that amount by the establishment of a state highway system with high grade arteries of travel built, maintained and managed by the state?

Don't let any taxpayer who is partial to bond issues for financing these main arteries of travel forget that $1 at 4 per cent doubles itself in 25 years. Is it possible that he fails to see that if he authorizes bond issues for that length of time, he and his children will be obliged in the long run to pay direct taxes far in excess of those required for immediate cash payments? A bond is a debt, and, although many persons dealing with public affairs think otherwise, debts must be paid. Let us not therefore lightly incur a lot of burdensome bonds in establishing and financing the main arteries of the state highway system or indeed in establishing the feeders and branches of the system. The experiences of one of our neighbor states ought to warn us against such procedure in road matters.

MAIN ARTERIES FIRST

In the foregoing discussion it has been insisted that the expenditures of the state should be strictly limited to the main arteries of travel of the state highway system. This should be rigidly adhered to until all the main arteries of travel are brought up to standard. When the counties are entirely relieved of the financial burden of constructing, reconstructing, repairing and maintaining these main arteries, they will have large sums available for improving and maintaining first the feeders to the main arteries and lastly the branches to the feeders. Any surplus funds which the state might have after the construction of the 1500 miles of main arteries, or any annual balance that may be left after these main arteries have been properly maintained, might then be used for state aid on the feeder roads or perhaps be used for extending the mileage of main artery roads.

Bituminous Coat in Concrete Road Should Be Laid in Warm Weather

Experience with concrete street surfaces in Athens, Ga., reported by J. W. Barnett, city engineer, shows that the application of a bituminous coating (½ gal. of Tarvia to the square yard and coarse, sharp sand applied at once) gives most satisfactory results when the materials are all hot—that is, in warm summer weather, and when the concrete surface is roughened by a broom before it has set hard. If the materials are too cold, the coating peels off and leaves unsightly patches.

Queen & Crescent Has Carried Out Extensive Program to Improve Drainage of Roadbed

Cross-Drains and "Shooting" of Fills Stop Sliding—Borrowpits Were Drained and Water Was Diverted—Steam Ditchers Widened Cuts and Fills

By J. T. BOWSER
Maintenance of Way Department, Queen & Crescent Route, Danville, Ky.

THE Cincinnati Southern Railway, which is owned by the city of Cincinnati and is operated under lease by the Cincinnati, New Orleans & Texas Pacific Railway as a part of the Queen & Crescent Route, was constructed by the city of Cincinnati in the '70s. At the time of its construction it may be said to have represented the last word in construction methods as to grade and alignment and as to roadbed, considering the topography of the country traversed. The changed conditions which have come about since the construction through increased weight of equipment, the increased volume of traffic and the increased train speeds, together with the development of the science of railway engineering in recent years, seemed to require improvements in the way of drainage, cross-section of roadbed (which is so closely related to drainage) and other items involved in the economic maintenance of track.

Furthermore, considerable trouble had for many years been experienced with settling and sliding fills and with soft track on certain parts of the line, notably the 60-mile section between Ludlow and Rogers Gap, Ky. This trouble began to assume serious proportions when the heavier types of engines were put in use on this section of the line in 1912. It was at this time that serious attention began to be given these conditions with the view of permanently remedying the trouble, at least at the worst places.

DRAINAGE PROGRAM

In order to bring about conditions that would permit the economic maintenance of track through this section a general program of work was adopted embodying not only the drainage of the wet fills and soft places but also the widening and strengthening of embankments, the widening of cuts and track ditches, the installation of subsurface tile drainage and the improvement of conditions in other ways, involving practically the reconstruction of the track at certain points.

While a certain amount of widening of cuts and embankments could be, and was, done immediately where no trouble had been experienced or was to be expected with soft track, it was obviously desirable that all subdrainage designed to eliminate soft spots and wet fills be effected before this drainage was done. In cuts where trouble was experienced with soft track, drain tile was laid at a depth averaging about 7 ft., the distance from the track varying with conditions, but in the main being about 10 ft. from the center of the track. This tile was very carefully laid as to grade and alignment, an excavation in the natural ground in the bottom of the trench being shaped to fit the pipe. Backfill over the tile was made with cinders, slag or other porous material.

Each sliding or settling fill was a problem in itself, and various methods were used to cure the trouble. In each case careful consideration was given the location of the fill, the material therein, the drainage of water toward and away from it, the presence of springs and seeps in the vicinity, the condition of existing culverts and the necessity of additional openings.

A number of these fills were located on more or less pronounced slopes, and the trouble in these cases was found to be due either to the slipping of the material in the fill on the top of the original ground surface or the slipping of the material underlying the fill on some inclined stratum. In either instance the presence of water was the immediate cause. On fills of this kind well drills were placed on the downhill side and holes were drilled in a line parallel to the track, across the sliding portion of the fill, into rock if this was found at a reasonable depth, or failing in this, into solid hardpan. These holes varied from 30 to 70 ft. in depth, and were located from 20 to 40 ft. from the center of the track, according to local conditions. These holes were then heavily shot with dynamite, the usual loading being about 250 lb. to the hole, although this of course varied to some extent with the depth of the hole. This shooting was usually effective in opening up seams in the underlying material, which disposed of the water, and in roughening the slope on which the sliding material had been moving, so that, no water being present, any further tendency to slip was checked.

On other fills, however, the trouble was found to be due to the presence of water pockets in the fills themselves. In such cases cross-trenches, at right angles to the track, were excavated to points well under the track, drain tile was laid in them and a backfill made of one-man stone. In many cases as many as five or six of these cross-drains were considered necessary, and since, owing to the looseness of the material in the fill, the trenches were quite wide, the rock backfill not only provided adequate drainage but also constituted a heavy reinforcement to the fill.

DRAINAGE OF ADJACENT PONDS

Consideration was also given to the drainage of ponds adjacent to embankments, formed by old borrowpits or improperly placed culverts and the like, for even though they were located at some distance from the track they were often found to be acting as reservoirs which supplied the seepage that caused the slides or settlements. Additional culverts were put in where necessary, and where trouble had been experienced in keeping the ends of existing culverts open, due to the filling up of the space which they drained, well holes or catchbasins were constructed over the entrances to raise the level of the openings.

Berm ditches were excavated on the tops of cuts where erosion from the cut face was marked, and diversion ditches were cut wherever water could be turned away from the bases of fills or carried more directly to the culverts. At a number of points the wash of streams or large ditches adjacent to embankments made necessary rather extensive bank protection if the new wider standard for embankments was to be maintained. At such points riprap walls, and in several cases concrete walls, were constructed. Low dry-masonry walls were also constructed at bridge abutments or similar points where a full width of embankment could not otherwise be obtained without prohibitive expense.

TWO DITCHER OUTFITS WERE ORDINARILY USED WITH ONE WORK-TRAIN AND LOCOMOTIVE

DITCHING BY WORK TRAIN

As the work on drainage and preparation of subgrade progressed, the widening of cuts and embankments was carried on where such preparatory work had been completed or was unnecessary. This work was handled by American steam ditchers and by teams and scrapers, the dressing up after these outfits being done by hand.

The ditchers, three of which were in operation, were mounted on their own rails on special flat cars. The excavated material was placed on 16-yd. air-dump cars which were equipped with extension aprons designed to dump the material as far as

possible from the track. One of these cars was located at each end of the flat car supporting the ditcher. The excavated material was dumped on adjacent embankments, and was spread down and roughly dressed by spreader cars, one of which was assigned to each outfit. The majority of the cuts thus widened were long enough to permit the operation of two ditcher outfits with only one locomotive, thus saving the expense of one work train. The unit cost of this work has been quite low, considering traffic conditions, as it varied from 5 to 15 cents per yard, including work-train costs and the cost of spreading. Practically all of this work was done from the main track, and much of it was in rock. Just here it may be said that a close check of the delays sustained by the work trains and the services of a good work-train conductor are of prime importance in keeping down the cost per yard.

Since the ditchers and spreaders could not make a finished job, a gang of laborers followed them and made the standard ditch, dressed the faces of the cuts and fills and made the finished shoulder.

Teams for Shallower Cuts

The work on the shallower cuts and higher fills was handled by teams and scrapers, as the ditchers do not work so economically on a low face, and as on the higher fills the addition is preferably built up from the bottom. In these cases the usual practice for the construction of new fills was followed, and a dressing gang finished up the work.

It was not found advisable to let this class of work by contract on the yardage basis, and it has therefore been handled on force account, the work being supervised by a representative of the railroad company, who also checked up the time.

Slopes Seeded

In finishing up all of this work the dressing was carefully done, and to prevent the wasting of the raw slopes they were seeded down with a mixture of blue grass, red top and English rye seed, while on some of the slopes Bermuda grass sods or honeysuckle slips were placed on 2 or 3-ft. centers. The grasses have done well, and though the honeysuckle has not made so good a showing it is of comparatively slow growth, and there is hope that it may yet become entirely satisfactory.

On certain sections of the line heavy reballasting was considered necessary in connection with this work. At these points the alignment of curves was carefully checked and the track put on proper line. Grade stakes were then given, and the track was raised and reballasted with gravel or crushed stone.

In addition to the normal tie renewals on these sections of the line, such additional ties were renewed as this work was done as would have had to be renewed in the course of the next year under ordinary conditions, so that the new track would not have to be disturbed until absolutely necessary.

Results Beginning to Show

While this work is by no means completed over the entire line of the Cincinnati, New Orleans & Texas Pacific, it has progressed far enough for the results to begin to show. A great number of the sliding or settling fills and soft places have already been treated, and these are now

TEST TRENCH FOR STUDY OF WATER POCKETS
Note penetration of ballast at center of track

giving little or no trouble. Slow orders are no longer common, even in the worst weather, and on account of the excellent drainage afforded by the widened cuts and the ample foundation given by the completed fills, track once "put" up stays "put" much longer, and track gangs are better able to maintain their whole sections in good riding condition than formerly, while the uniform dressing and careful finish have made a marked improvement in the general appearance.

This work is being carried on under the general direction of C. Dougherty, chief engineer, and under the direct supervision of M. J. Connerton, roadmaster, and his assistants, J. F. Whiteside and M. Davis.

Street-Cleaning Costs Compared

The vacuum machines employed by the San Diego (Cal.) street-cleaning department covered, during September last, 139.12 miles at a cost of $5.23 per mile; the rotaries covered 146.14 miles at an expenditure of $8.20, and the "white wings" cleaned 703.15 miles at an outlay of $1.91 per mile. These figures are from the monthly report of F. M. Lockwood, manager of the operating department.

Timber Trusses Substituted for 30-Inch I-Beams

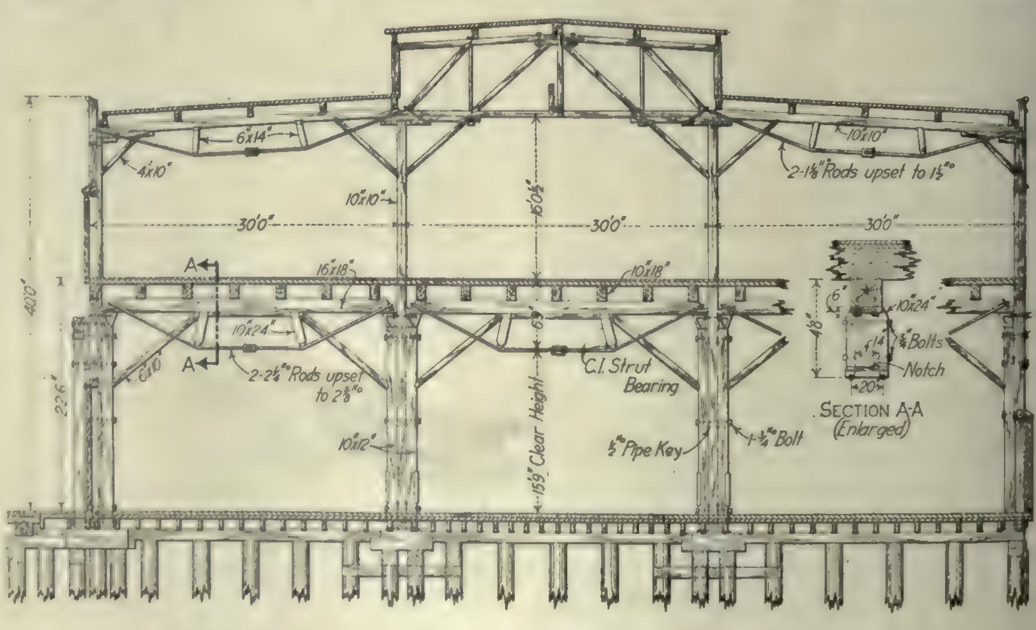
Alternate Designs of Spokane Street Transit Shed, Seattle, Show Economy in Use of Trussed Wooden Beams

IN DESIGNING the Spokane Street transit shed, which is a part of the waterfront-improvement plan being carried out by the Port of Seattle Commission, it was found desirable to have the second floor on a level with the third floor of the adjoining cold-storage warehouse. This gave a total of 22½ ft. between the levels of the first and second floors of the transit shed. Economy of headroom was thus not an element in the selection of the type of support for the second story. A study was accordingly made to compare the advantages of using steel or wood.

The upper floor was required to carry a live load of 300 lb. per square foot, which, with a 30-lb. dead load, made the total loading 330 lb. per square foot. For the 30-ft. span it was found that a 30-in. I-beam would be required if steel construction were adopted, or 16 x 18-in. Douglas-fir timbers with heavy tension rods if a trussed beam were to be used. An analysis of the comparative cost of these two types of construction, which took into account the methods of handling, probable delays in delivery of steel beams and the possibility of serious checking in big timbers, indicated that the 20-per cent saving which would be effected by using timber construction warranted selecting this in preference to the steel. The safety factor of four was considered sufficient to include checking dangers in the timbers. A life of about twenty years was assumed as probable.

Design Adopted

The cross-section of the shed shown in the accompanying illustration indicates the details of the adopted design. Seventy-five of these trusses spaced on 20-ft. centers are now in service in the building. The column footings are supported on an 18 x 18-ft. block resting on a six-pile cluster. The struts between beam and tension rod of the truss are placed at the one-third points and bisect the angle between adjoining parts of the tension rod. The 6 x 10-in. braces, two of which are used with each truss, were put in solely as sway bracing and are not expected to carry any load. An unusual feature is the fact that the heavy timbers



CROSS-SECTION OF FREIGHT SHED SHOWING HEAVY TRUSSED BEAMS

of the trusses rest on cast iron caps which are larger on top than on the bottom and are prevented from slipping by a bolt directly through the central timber. Where the 2¼-in. wrought-iron rods pass around the 2½-in. groove in the strut bearing, a ⅛-in. plate of sheet lead is inserted between rod and casting to distribute the stress evenly.

The trusses were first designed with the 16 x 18-in. timbers lying on the flat side. This was done to secure a larger bearing surface at the ends. A final analysis of the proposed design was made, however, employing the theory of least work and considering the truss under four loadings—one-third, one-half, two-thirds and full-span load. This analysis showed that when the beam was placed flat and full load was applied to half the span there resulted an upward thrust in the strut under the unloaded half of the timber which developed there a maximum stress of 1690 lb. per square inch. The city ordinance required that for Douglas fir this value should not exceed 1600 lb. per square inch. A little study then developed the fact that by turning the timbers up on edge the truss could still be built up of the same material without exceeding the allowable cross-bending stress and the compression stress on the cast-iron shoe would still be within the allowable limit of 400 lb. per square inch in bearing.

The structure was designed under the direction of J. R. West, former chief engineer of the Port of Seattle Commission, by J. E. Shoemaker, assistant engineer. Since this work was undertaken Mr. West has been succeeded by G. F. Nicholson. The metal used was shaped in Seattle, the large wrought-iron rods coming from the Seattle mills of the Pacific Coast Steel Company.

Campanile at Berkeley Is Completed

303-Foot Tower on Campus of University of California Has Been Designed to Resist Earthquake Shocks

AFTER long construction delays, the campanile on the campus of the University of California at Berkeley has been completed, and the photograph reproduced on the front cover shows the general architectural effect of the finished structure. The structural features of the tower were described in the Engineering Record of March 14, 1914, page 312.

The total height of the tower is 303 ft., the length of a side at the base being 34 ft. It is a steel and reinforced-concrete structure with a facing of granite. The omission of the lateral bracing in alternate stories of the steelwork gives a flexibility calculated to resist earthquake shocks. The flexibility does not exist in the ordinary structural-steel framing.

The proportions of the tower were determined after a study of the dimensions of all similar structures on which figures were available, and the scarcity of detailed information on tower construction caused considerable comment among local engineers at the time. Comparatively few structures of the strictly tower type have been built in modern times. Most of the examples whose proportions were compared are in Europe and were erected before the common use of present-day materials of construction.

NORTH CUTOFF WALL BEING PULLED AT RIGHT, LIGHTER WORKING ON MAIN DAM

Inverted Hammers Pull 72-Foot Sheeting at New York Pier

400-Ton Tackle Breaks Out First Pile in Inner Line—Bank and Filling Dredged Only to Float Lighters—Air Jets Used

By C. W. STANIFORD
Chief Engineer, Department of Docks and Ferries, New York City

AFTER a 100-ton lighter from whose derrick boom an inverted hammer was suspended had failed to move any of them, the first pile on the inner arc of one pocket of the cofferdam, within which was built the shore end of the new Forty-sixth Street pier in New York City, was pulled with a heavy gallows frame and tackle having a breaking strength of more than 400 tons. The 3600 tons of Lackawanna steel sheeting driven in this dam, thought to be the deepest unbraced coffer ever pumped, consisted mostly of 12¾ x ⅜-in. single-length piles, 72 ft. long. Driven to rock, and surrounded and filled to a depth of 65 ft. or more with mud, clay and riprap, the sheeting in this dam undoubtedly presented the most difficult pile-pulling problem yet met with in this country. Not only is the piling being successfully removed, which is essential to the completion of the project, regardless of the expense involved, but the contractor states that the value of the 2700 tons so far extracted considerably exceeds the cost of pulling it.

15-TON LIGHTER LANDING 72-FOOT PILE

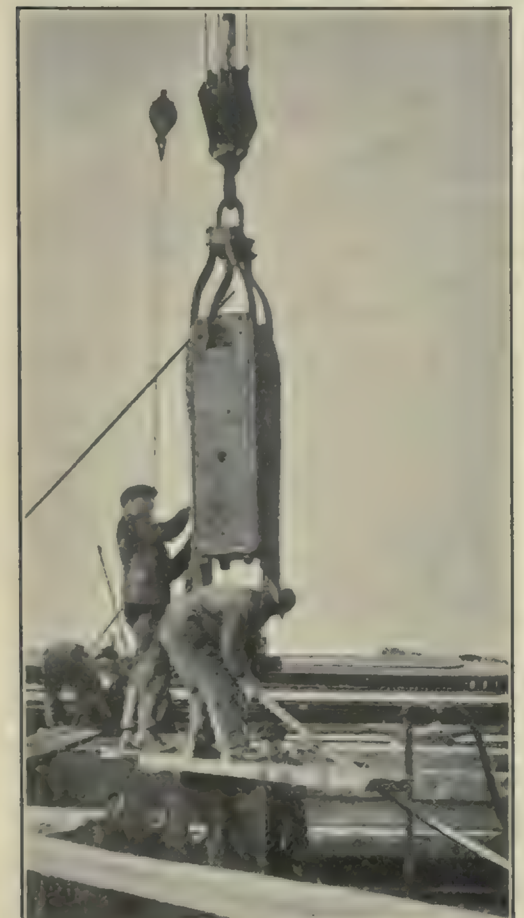
In view of the fact that it has been contended that the process of extracting sheet piles with an inverted steam or air hammer is suitable only for lighter work, where the penetration does not exceed 40 ft., the success of this method at the Forty-sixth Street pier with piling 72 ft. in length is of especial interest. After breaking out the first pile of the inner line, every piece that could not be started directly with the larger lighter employed has been pulled with inverted McKiernan-Terry hammers, operated with air and usually rigged as shown in the photograph. Three of these hammers are used. They are attached to the piles with 3-in., 3½-in. and 4-in. pins, to receive which a single hole is burned in each piece of sheeting about 2 ft. below the top, and also with pile grips. More than one type of grip has been tried, but the most successful is a relatively light one furnished by the Lackawanna Steel Company, which is rigged so that it can be opened by pulling a trailing rope when the pile has been pulled out of reach from the ground. This grip, which catches the pile by the top of the web, has been used continuously by one lighter for all but the hardest pulling. The hammers are handled by a 15-ton and 40-ton lighter and by stiffleg derricks set to reach the piling in the upper and lower arms of the coffer. The 40-ton lighter was able to pull many of the piles in each pocket, after the first one had been extracted, without using the hammer.

FIRST PILE HARD TO PULL

It was recognized that the friction in the interlocks offered the greatest resistance to be overcome which could not be relieved by jetting, and that this friction would be much greater in the first pile to be pulled than in the others. The inner line was the more difficult to break, possibly because the tension in the sheeting while the dam was pumped out had been greater than in the outer line, due to distortion of the pockets. A 100-ton lighter was secured with the intention of using it, with an inverted hammer, to break one of the inside arcs. As

this rig was unable to budge the first inside pile in several pockets, and after working four days had only extracted two pieces of sheeting on the outside of the dam, it was dispensed with. A heavy gallows frame was then erected from which was suspended a 16-part tackle of ⅞-in. wire rope. The capacity of this tackle exceeded 400 tons, and it successfully extracted the key pile with an estimated pull of about 350 tons. The main fall of one of the lighters was luffed to this tackle for pulling.

As it was desirable at times to maneuver the lighters over the line of the cofferdam where the sheeting had already been pulled, the banking on each side and the filling in the cells were dredged down to a point several feet below low tide. No digging was done, however, to relieve the friction on the piles. This was successfully accomplished with air jets, two of which are used with each pulling rig. A 2-in. line from the compressor plant, which operated the drills while the rock excavation inside the cofferdam was being completed, supplies the jets and hammer of each rig. About 100 lb. per square inch is carried at the compressor plant, which reduces to 80 at the jets. In place of the ordinary plug cock for operating the hammer, a globe valve and a lever valve set next to each other in the air line are used. The lever valve, used to stop the hammer, is quicker in operation than a plug cock, while the globe valve makes it possible to regulate the speed of the hammer much more easily than can be done with a plug cock.



HOOKING ON THE HAMMER

Pair of straps below large pin under hammer connect it to pile. Chain is for handling piles after hammer is disconnected. The bent lower end of an overdriven pile shows at right on deck of lighter.

Good Progress Made

A few of the piles were unfortunately overdriven and curled up at the bottom where the rock ledge was struck. These have to be hammered every foot of the way to the top, and in order to handle them with any facility they must be cut into at least three pieces as they are pulled. Striking several piles of this sort in one day, one rig pulled only ten pieces. The usual progress, however, is more than 20 piles a day, and one hammer has pulled 34 in 8 hours. This compares with a record of 65 piles in 6 hours on the upper arm, where the penetration was about 27 ft., and 43 in 8 hours on the lower arm, where the piles were driven from 40 to 53 ft. An oxyacetylene cutting outfit is used with each rig, and is invaluable for burning the pulling holes in the piling and for cutting off bent pieces. Most of the piling extracted is in exceptionally good shape.

The river arm of the cofferdam has been pulled for most of its length and the filling near the middle will now be dredged down to permit the completion of the outer-pile portion of the pier. The upper cutoff wall of the cofferdam, which consisted of a single row of steel sheeting driven to rock, had already been pulled by derricks. The 15-ton lighter will probably be released, and the 40-ton lighter will finish extracting the piles in the upper and lower ends of the river arm and in the two large cylindrical pockets at the southwest corner of the dam. The lower cutoff wall of the coffer, which consisted of pockets of shorter sheeting driven to rock, has also been pulled by derricks, one of which is now pulling part of the nearest cylindrical cell, which is within easy reach of it.

The Forty-sixth Street pier has been built by the Holbrook, Cabot & Rollins Corporation for the Department of Docks and Ferries of the City of New York, of which R. A. C. Smith is commissioner and the writer chief engineer. Thomas B. Bryson is in general charge for the contractors, and Daniel A. Hughes is superintendent.

Activated-Sludge Process Given Preference

Success with Sewage-Disposal Methods Compared by R. V. Orbison on Return from Country-Wide Trip

"SUCH excellent results have been recorded in the past eighteen months with the activated-sludge method of sewage treatment that it seems highly probable that this method will eventually supersede all others where a high degree of purification is necessary." These are the conclusions of T. D. Allin and R. V. Orbison, commissioner of public works and city engineer respectively, of Pasadena, who recently completed a trip over the United States for the purpose of examining and comparing sewage-disposal plants.

"Some plants showed better design and better maintenance than others," the report states. "The Atlanta (Ga.) plants, by reason of their size and excellent maintenance, were the most interesting of the Imhoff plants visited, but the Pennypack plant at Philadelphia, the Fitchburg (Mass.) plant and the Batavia (N. Y.) plant, although of much smaller units, were giving most excellent results. The Fitchburg, Batavia and Mount Vernon (Ohio) plants of the Imhoff type in operation were the most conspicuous by close proximity to habitation. At Fitchburg good residences were at a distance of about 750 ft. from the plant, Batavia 380 ft. and Mount Vernon about 500 ft., with paved streets and a population of about 500 living in good homes within a quarter of a mile." At no Imhoff plant visited were odors detected at more than 200 ft. from the plant, and in most cases the distance was much less.

Activated-sludge plants, it was noted, are also safely operated very near residences. In fact, in Cleveland a plant using the activated-sludge process is within 300 ft. of high-class residences. The application of a press to dewater the sludge, such as is used at Milwaukee, it was observed, leaves no room for doubt as to the possibility of handling it without odor. Whether resort to the activated-sludge method is warranted is a problem to be determined by local conditions, the report points out, and must be settled in each case independently. As opposed to the fact that it probably represents the most perfect process now known for reducing the danger of pollution from the effluent, it is pointed out that it is sometimes expensive to handle the sludge without odor on account of its high percentage of water.

"By comparing the activated-sludge process with the Imhoff tanks and sprinkling filter process," the report states, "we find that the former occupies less space, costs less for construction, gives a better effluent, and is absolutely odorless. The cost of operation, however, is greater than with the latter process, but its sludge has a higher fertilizing value, and the revenue derived from its sale will reduce the difference in cost of operation."

How the Army Used Motor Trucks at San Antonio

Quartermaster and Commissary Departments Had About 150 in Service in Companies of Thirty Trucks Each

THE way motor trucks were used by the army at San Antonio is beginning to be told as the boys get back home. D. A. Tomlinson, quartermaster sergeant, Company A, Illinois Engineers, states that at Camp Wilson the quartermaster's department maintained a section of motor trucks organized in companies of thirty trucks each, attended by an oil-supply truck and repair truck. A squad is composed of ten trucks. About 150 were on hand in the service of the quartermaster and commissary departments, but the number varied as they were distributed along the border and received from the manufacturers.

At San Antonio most of the trucks were Peerless or Locomobiles equipped with bodies made by the J. G. Brill Company. The rated capacity was 3 tons, but Mr. Tomlinson says they looked like the 10-ton trucks in Chicago, and the drivers claimed they would carry 5 tons over any road. In fact, they plowed all over the open fields and rough, muddy roads, he says, without difficulty. On the Leon Springs marches (35 miles) they frequently pulled mule-drawn wagons up steep hills while under load themselves. The batteries used them to haul the field guns, caissons and limbers, one truck sometimes pulling two guns, two caissons and four limbers.

The bodies are patterned after those in use on the wagons, but are much larger. Light frames are provided over which canvas covers may be stretched to protect the loads. Battleship gray, except for the black radiators, is the color of all equipment.

Literature

For the Civil Engineer and Contractor

New Publications

SPECIFICATIONS FOR THE CONSTRUCTION OF VITRIFIED BRICK STREET PAVEMENTS AND HIGHWAYS. Green Concrete Foundation Type. Paper, 6 x 9 in.; 36 pages; illustrated. Sand-Cement Super-Foundation Type. Paper, 6 x 9 in.; 46 pages: illustrated. Cleveland, National Paving Brick Manufacturers' Association.

HANDBOOK—DOMINION BRIDGE COMPANY, LTD., MONTREAL. Flexible leather, 4 x 6½ in.; 115 pages; illustrated. Montreal, Canada, Dominion Bridge Company, Ltd.

CENTENNIAL CELEBRATION OF THE U. S. COAST AND GEODETIC SURVEY, 1916. Cloth, 7 x 10 in.; 196 pages illustrated. Washington, Government Printing Office.

Proceedings at centennial celebration held in Washington, April 5 and 6, including addresses by representative leaders in scientific and engineering life outlining the value of the operations and results of the first century of the Survey's existence.

ANNUAL REPORT OF THE WATER SUPPLY COMMISSION OF PENNSYLVANIA, 1915. Paper, 6 x 9 in.; 403 pages. Harrisburg, Pa., William Stanley Ray, state printer.

Presents data on stream flow and rainfall, flood damages and a comprehensive policy for administering the control and use of Pennsylvania streams and supervising dam construction.

CONTRACTS, SPECIFICATIONS AND ENGINEERING RELATIONS. By Daniel W. Mead, consulting engineer, professor of hydraulic and sanitary engineering, University of Wisconsin. Cloth, 6 x 9 in.; 535 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $3 net.

THE ACCOUNTING AND REPORTING METHODS OF THE STATE OF NEW YORK. Bureau of Municipal Research Bulletin 74, June, 1916. Paper, 6 x 9 in.; 212 pages. New York, Bureau of Municipal Research, 261 Broadway. $1 net.

ECONOMIC SURVEYS OF COUNTY HIGHWAY IMPROVEMENT. By J. E. Pennybacker, chief of road economics, and M. O. Eldridge, assistant in road economics, Office of Public Roads and Rural Engineering. Bulletin 393, U. S. Department of Agriculture. Paper, 6 x 9 in.; 86 pages; illustrated. Washington, Government Printing Office. 35 cents

A compilation and analysis of data in eight selected counties, showing comparative financial burdens and economic benefits resulting from highway improvement during a period of years.

PRINCIPLES OF LABOR LEGISLATION. By John R. Commons LL.D., professor of political economy, University of Wisconsin, and John B. Andrews, Ph.D., Secretary of the American Association for Labor Legislation. Cloth, 6 x 9 in.; 524 pages; illustrated. New York City, Harper & Brothers. $2 net.

Books Reviewed

Final Report on Construction of Los Angeles Aqueduct

Cloth, 8 x 11 in.; 319 pages; 117 illustrations, in addition to several folding maps. Los Angeles Department of Public Service. $1.95.

Several months ago the Department of Public Service of Los Angeles, Cal., announced its intention to publish and distribute, without profit to the department, a final report on the construction of the Los Angeles aqueduct. Before the volume went to press on Sept. 1 more than 2000 subscriptions had been received. This led to a decision to change the size of the edition from 2500 to 5000 copies. From this response but one deduction could be made. Engineers expected to find in the printed pages the same standards of excellence which had characterized the actual construction of the great water-supply conduit. That these hopes have been amply fulfilled is demonstrated by a copy of the report, just issued.

As a matter of fact, the expression "report" does not do justice to the volume. The ordinary conception of an engineering report on municipal work resolves itself into pages of tedious reading, fine type, interminable tabulations of dry statistics —in fact, something no one would think of reading except under the necessity of extracting definite figures for application elsewhere. It is somewhat of a shock therefore to discover that the Los Angeles report, in its general form, actually invites, rather than repels the reader.

It is printed in large, clear type, and instead of the usual blotches which pass for illustrations in printed engineering documents it is embellished on every other page or so by handsome full-page halftone reproductions, 6 x 9 in. in size, their generous proportions and clear-cut detail conveying instantly to the reader's mind an impression of magnitude and difficulties successfully mastered.

Another unusual thing about the volume is that it is written for the reader, not for the author. It gives the man who has not lived on the job a comprehensive understanding of the problems involved and of the various details of design and construction. When will engineers, as a class, realize that this is the only way in which they can secure for their work the appreciation it deserves? The Los Angeles engineers, when the aqueduct was finished, had a real story to tell. They have told it well.

Practical Cost-Keeping for Contractors

Author, Frank R. Walker. Cloth, 4½ x 7 in.; 273 pages; illustrated. Chicago, published by the author, 30 North Michigan Avenue. $2.

Building construction is generally recognized as a most complicated class of work to keep track of from the estimator's point of view. Perhaps for the very reason that such a multitude of trades and such a diversity of materials enter into modern building erection that estimating without accurate data would ruin any contractor, those who do large building work have long since developed excellent cost-keeping systems. Some of these systems far surpass in simplicity and reliability the primitive methods still very generally in vogue among contractors for other classes of construction work. Even some of the largest of these could learn much from their brethren in the building field, had they ready access to the latter's files and office methods.

For this reason a book outlining a cost-keeping and office-record system compiled from the best practice of these building contractors is a most welcome addition to a literature on cost-keeping which already contains too much out-of-date theory and too little up-to-date practice.

EFFECTIVE RECORD SYSTEM

The make-up of the forms for this system strikingly shows that cumbersome sheets of desk-top size are not needed even for keeping costs on the largest work. It also shows that the practice of entering time over and over in a multiplicity of check books, time books, report books, distribution books and finally on the payroll is useless. As it is the general custom to pay off weekly on building construction, the forms are all arranged for that length of pay period. They could, however, be adapted to any other.

One distribution sheet, of the same small size as the payroll sheets, is made up each week for each heading under which labor is distributed. The entries on these cards are made up from the timekeeper's checking and from exceedingly simple report cards turned in by each foreman for his gang. The card made out each week shows not only the total and unit cost for that class of work for the week, but the total and unit cost for that class of work to date. It also shows, in addition to the unit cost in money, the unit cost in hours of each class of labor engaged in that operation for the week and to date, and the unit number of hours required to complete a unit quantity of work. All this information can be set down in logical sequence with little necessity for computation. In fact, the entire system involves far less labor than is usually expended on other systems which give nothing but unit costs in money. The method outlined for performing the actual work of keeping the time is exceedingly simple and effective. Other features of job-office accounting are treated in the book fully as well as the subject of keeping labor costs.

While it is to be regretted that the English of the book is not perfect, and that the expression is not always as clear as might be desired, these matters will be of minor consequence to the contractor who makes use of the work to improve his own cost-keeping system. The opinion is ventured that there are few firms outside of the building field who could not derive a great deal of cash profit from a study of this book.

A Text-Book of Practical Hydraulics

Author, James Park, dean of the faculty of mining engineering at Otago University, New Zealand; professor of mining and lecturer in practical hydraulics. Cloth, 5½ x 7¾ in.; 284 pages; illustrated. Philadelphia, J. B. Lippincott Company. $4 net.

REVIEWED BY A. G. HILLBERG

Hydraulic Engineer, New York City

This book comprises the author's lectures on practical hydraulics at the Otago University in New Zealand, suitably revised and enlarged so as to cover the course of study as now prescribed by the British government for technical colleges and schools of mines.

The author first explains fundamental principles and gives definitions of the usual terms, discusses the flow through orifices and short tubes and then the friction in pipes and channels, giving only the Darcy formula for iron pipes and the Weisbach equation for open conduits. For curves in bends the usual Weisbach formula is recommended. However, the scantiness of the information on this subject has been remedied in the next chapter, which deals with the discharge of pipes, and in which the author discusses formulas devised by Eytelwein, Neville, Hamilton-Smith and Box. The latter formula, used considerably by English engineers, is practically unknown in this country. The flow of water from nozzles is explained in a very elementary way.

In the chapter entitled "Flow of Water in Open Channels" the Bazin and Kutter formulas are given, but there is no information in respect to their limitations.

Numerous folding plates contain diagrams for use in calculating the flow. For calculating the flow of water over weirs and notches the author recommends the formulas derived by Francis, Robert E. Horton, Cippolette and James Thomson. None of the newer exponential formulas is mentioned. Floats, current meters and Pitot tubes are described and their use for measuring the flow of water in rivers explained.

Run-Off and Evaporation

The relationship of rainfall to run-off is briefly dealt with, and for computing the run-off the formulas by Coaley, Dickens and Ryve are given. All of them are notoriously inaccurate and give results so approximate as to render their use of doubtful value. For figuring evaporation the author recommends the Vermeule formula, which includes the total loss of the precipitation, seepage, absorption by vegetation, evaporation, etc. In fact, when figuring the run-off by Vermeule's method these losses are first calculated by the formula given and then the action of the ground storage determined. The result is the flow in inches. Hence, the use of that formula for figuring evaporation is wrong.

Chapter 9 deals with the construction of pipes and their preservation, testing and anchoring. The construction of flumes is the subject of the next chapter. Many details of timber and iron flumes and the various methods of supporting them over gullies and streams are shown. The next chapter deals with the control of ditches.

The chapter on the construction of masonry dams is too brief. The formulas given are those of Molesworth and Maxwell, which now have historical interest only. For curved dams, the author furnishes the usual arch formula based on the assumption that the pressure line goes through the center of the section. The problem is not quite as simple as that. Earth dams are better treated, and information of considerable interest is supplied. For instance, how to figure the height of waves on a reservoir so as to insure the dam against overtopping is discussed.

Water Power and Prime Movers

In the last chapter the author deals with water power and water prime movers. The matter is limited to Pelton wheels and Francis turbines, and several good pictures show such installations. The treatment is brief and intended to give the reader an idea of how such prime movers work. For exhaustive information, references to other books are given. In an appendix are presented some specifications which have been used for work in New Zealand, such as earth dams, ditches, ironwork (mostly piping), and a 30-in. siphon.

Judged as a whole, the book seems to be well adapted for the use of English students requiring some knowledge of hydraulics. Little new matter is presented, and the author avoids as much as possible going outside of England and its possessions for material. A number of new American and European formulas have not been included, which lessens the value of the book.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Heartwood Specification and Density Rule

SIR: I read with interest the editorial in your issue of Oct 28, page 519, entitled "Heartwood Specification Needed to Get Best Grade Timber," as the matter has very recently developed in connection with some boat-building operations.

The U. S. Engineer Office at Washington, D. C., was about to build some scows on barges and wanted a specification to cover suitable timber, as the local grading rules do not provide such timber for boat-building purposes. Of course all heart would have filled the requirements, but it was thought a suitable timber might be secured without necessarily paying for the best heart timber.

The density rule covering the rate of growth and the inspection was considered very good, but the deficiency in the grade of heart timbers was immediately apparent. The desire in the case at hand was to get, especially, a durable timber that did not have sapwood on all four corners, as previous experience with this class of timber has amply demonstrated that it will not stand up in boat-building work.

Accordingly, the following clause, among others, was developed in the specifications to fit the conditions warranted by the use of the timber, effort being particularly made to adhere to the adopted specifications as closely as possible:

For yellow pine, "All pieces of various sizes of timbers shall show all heart on one of the wide faces and shall show at least two-thirds heart at all points across the opposite (wide) face throughout the entire length of the piece."

This clause was also included:

"Douglas fir shall be classified, graded, inspected and accepted under the same requirements, with the same restrictions, etc., of the foregoing specifications for dense Southern yellow pine. The "density rule" of the Southern Pine Association is practically the same as the "grading rule" for Douglas fir proposed by the U. S. Forest Service, published in Engineering Record No. 7, Vol. 73, Feb. 12, 1916."

EDWIN A. SCHMITT,
Draftsman, U. S. Engineer Office.
Washington, D. C.

Paving Petitions—The Right Kind

SIR: With your editorial "Paving Petitions—The Right Kind" in the Engineering Record of Oct. 14, page 458, I most heartily agree. The statements express exactly our experience in this city. For the past four years, at least, this department has maintained that the selection of the type of pavement for any particular street should be a matter for determination by the engineer in conjunction with the city commission, and not by petitions circulated among property owners by persons interested in any particular kind of pavement. The fact is that if any pavement as laid, whether recommended or opposed by the engineering department, prove defective the blame is laid against that department.

I am glad to be able to state that at the present time the types of pavements being laid on the various streets are generally recommended directly by this office, and though there are still some petitions presented for particular kinds of pavement, such types have only been designated by the Board of Commissioners after approval by this department.

It is generally admitted by practically all property owners that they are technically unfamiliar with the qualities of the various pavements and must necessarily depend for their information either upon the engineering department or upon the representatives of some particular paving interests. That it is safer to depend upon the judgment of the city's representative than upon that of some interested party goes without saying.

SYLVESTER Q. CANNON,
City Engineer.
Salt Lake City, Utah.

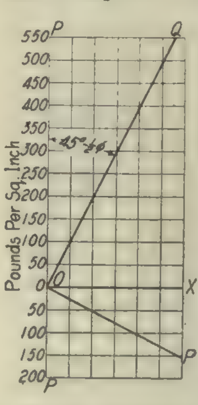
Design of Sand Boxes to Lower Arch Centers

SIR: I beg leave to call to your attention an error that crept into the fourth equation, page 532, of the article "Theory and Tests Presented for Design of Sand Boxes to Lower Arch Centers," in the Engineering Record of Oct. 28, 1916. The equation should have been printed as follows:

$$x = -\frac{1}{m}\log\,(w - mq) + \frac{1}{m}\log\,(w - mQ)$$

FRANK P. MCKIBBEN,
Professor of Civil Engineering, Lehigh University.
South Bethlehem, Pa.

SIR: While reading the article by Prof. Frank P. McKibben on "Theory and Tests Presented for Design of Sand Boxes to Lower Arch Centers" in your issue of Oct. 28, page 530, there occurred to me a simple method of solving the equation $p = q\tan^2(45° - \frac{1}{2}\phi)$ graphically for p after q has been computed by the formula there given.



In the accompanying figure let the straight line OQ be drawn from the origin of co-ordinates making an angle $45° - \frac{1}{2}\phi$ with the axis of ordinates, and let the line OP be drawn perpendicular to OQ.

To determine a value of p find the known value of q as a positive ordinate limited by the line OQ, and read p as the corresponding negative ordinate limited by the line OP. This figure is constructed for $\phi = 36°$, which suits the illustrative problem given in the above article. One value of q found there is 550. On our diagram we see that when the positive ordinate is 550, the negative one, p, is 143. Again for $q = 408$ we find $p = 106$. Similarly the value of p corresponding to any value of q may be found.

JOS. B. REYNOLDS,
Assistant Professor of Mathematics and Astronomy, Lehigh University.
Bethlehem, Pa.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

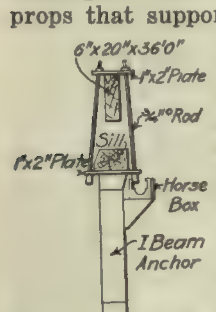
Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Hurters Suspended from Timbers in Concreting Dam Foundation

By KARL H. SCHRIVER
Junior Engineer, U. S. Engineer Office,
Racine, Ohio

THE CAST-IRON hurters and oak sills embedded in the concrete foundation for the navigable pass at government dam 24 on the Ohio River are suspended during concreting from timber girders spanning the length of one foundation monolith to avoid the alternatives of stopping the work of concreting in order to place them or of using timber supports which would have to be embedded in the concrete. The 4-ft. wide wickets of these dams seat on oak sills which are anchored to vertical I-beams embedded in the concrete. To the upper end of these beams on the downstream side are bolted the cast-iron horse boxes about which the wickets hinge. Anchor beams and horse boxes are assembled in the form and bolted to the sill, from which they hang during concreting. The hurters are flat, rectangular cast-iron tracks in which the props that support the wickets slide when the latter are raised or lowered. These castings weigh about 900 lb. each, and as there is one for every wicket, they are spaced on 4-ft. centers. The problem of supporting to accurate line and grade the sill and hurters for a 30-ft. monolith during continuous concreting is a difficult one, which has usually been solved by building solid timber supports for the purpose and leaving them embedded in the concrete.



At dam 24 the sill is supported by a 6 x 20-in. by 36-ft. timber placed directly above it and resting either on bents outside the form or on the sill of a completed monolith on either side. Steel rods, threaded at both ends and passing through 1 x 2-in. plates, support the sill with its attached anchor beams every 4 ft. The sleeve nuts shown on the bottom of the rods in the accompanying sketch remain embedded in the concrete after the rods are removed. The hurters, as may be seen in the photograph, are suspended from two timber girders, each made of two 3½ x 19-in. plank 40 ft. long, bolted together with 1-in. fillers between. These girders are placed 7 ft. apart and each hurter rests on a pair of 1 x 3-in. oak seats 2 ft. long hung from the girders by ¾-in. rods passing through the space provided by the 1-in. fillers and secured at the top by a nut and plate washer. As the concrete is brought up to the top of the castings, the oak seats, which with the sleeve nuts below them remain embedded, are out of sight. The sill and hurters are hung before concreting is started, but are accurately placed and leveled just before the concrete reaches them.

TIMBER GIRDERS SUPPORT CASTINGS TO ACCURATE LINE AND GRADE DURING CONCRETING

The dam is being built by the Sheridan-Kirk Contract Company for the United States Government under the direction of Major T. H. Jackson, Corps of Engineers, U. S. Army.

New Type of Cantilever Form Saves Erection Time

THE SEMI-CANTILEVER type of form being used in building the Yadkin River dam, described on page 610 of this issue, is stated to have greatly reduced the time required for handling and setting forms on this work. Differing from the forms used for heavy work of this character on the Panama Canal and on the Welland Ship Canal, these forms have no cantilever members outside the horizontal waling pieces. The bottom of each form is held by cleats between the waling piece at the top of the form below and the outside edges of the vertical studs. The lower ends of the studding in the top form bear against these blocks and transmit through them to the waling piece the pressure from the concrete. This waling piece in turn is held by tie rods embedded in the previous lift of concrete. It is thus unnecessary to secure the upper set of forms to the lower one in any way, and the tie rods to the waling piece of each form at the top constitute the only connection to be broken before the form can be lifted out of place by the derrick.

However, cantilever action is not relied on to support the top edge of the form, as with the other types referred to. The tie rods which are passed through the top waling piece of the upper form are anchored to the plumb stones placed in the previous lift instead of being left free until embedded in the new lift of concrete. Although the forms are only 6 ft. in height, it is considered cheaper on this work to anchor the tie rods to dogs in holes drilled for the purpose than to embed them at the time the previous lift is poured. Holes are drilled about a foot deep in the stones selected, or in the old concrete, with a small air hammer. The tie rods have several inches of thread on one end and an eye on the other into which is forged the eye of a short rod about 1 ft. long. The latter is driven into the hole drilled for it after the threaded end of the tie rod has been put through the hole bored for it to the outside of the wale. The rod is drawn tight by screwing up the nut on the outside. It is easy to judge accurately the location of the holes in the plum stones, any slight inaccuracy being taken up by wood washers outside the form.

RIGID CONSTRUCTION, ONLY ONE WALE TO A FORM AND NO CONNECTIONS EXCEPT TIE RODS

The dam is being built for the Tallassee Power Company, a subsidiary of the

Aluminum Company of America, by the Hardaway Contracting Company, Inc., for which S. S. Scott is superintendent. J. E. S. Thorpe is resident engineer for the power company, of which Edwin S. Fickes is chief engineer.

Shallow Form as Aid in Coating Roof Trusses with Cement Mortar

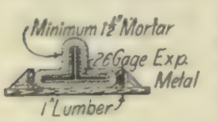
By R. C. HARDMAN
Balboa Heights, Canal Zone

IN COATING individual members of the roof trusses, longitudinal trusses and monitors of some large reinforced-concrete and steel pier sheds recently completed in the Canal Zone, shallow forms were used to pour the mortar around the lower flange of the members, which consisted of angles back to back, and the vertical legs of the angles were plastered and finished with a screed. The coating of 1½ in. of cement mortar, held in place by a wrapping of No. 26 gage expanded metal, was applied as a protection against fire and rust.

The main trusses were 80 ft. center to center of building columns, the lower chord being approximately 25 ft. above the deck of the pier. There were two bracing trusses between main trusses in each bay. All members of the trusses and monitors were coated except the upper chords, which were incorporated in the roof slab. The work was carried on from light wooden trestles supporting a working platform directly under the lower chord. These trestles were in units, mounted upon wheels for easy moving, long enough to reach from end to end of main trusses, and about 6 ft. in width. As the trusses were but 17 ft. center to center, these platforms were connected by plank walkways for easy intercommunication and for coating the longitudinal trusses.

A cement gun was first tried for the work, but without satisfactory results, due to the large waste of material caused by the smallness of the sections. After discarding the cement gun method a wooden form built up to the exact shape desired was tried. This also proved unsatisfactory, as the space of 1½ in. between steel and form was too small to permit the mortar to thoroughly cover the bottom faces. The mixture used was also too wet for good construction.

The method finally adopted was to use a light, shallow trough blocked in position under the member. This trough, shown in the accompanying section, was then filled with a comparatively dry mixture and the upstanding legs of the angle members were coated and formed by means of a combination trowel and screed similar to the one described by the writer in the Engineering Record of March 25, 1916, page 429. The trough forms for the lower chord were blocked up directly from the traveling platform and those for the inclined members were blocked from the lower chord. The vertical members were covered by troweling alone. The truss members, which were of angles back to back, were first thoroughly cleaned by means of wire brushes and then tightly wrapped with expanded metal wired in place. The trough form was then placed and filled sufficiently to give the horizontal portion of the member its proper cover. The upstanding legs were then covered and formed by the trowel-screed. Joints between members were formed by a trowel.



The work was carried along by three gangs of about ten West Indians each, the three gangs being under one American foreman. One gang erected, wrecked and re-erected forms, the second did the pouring and shaping, while the third was the plaster gang putting on the finishing touches. All concrete was mixed by two Smith hand-mixers and hoisted by rope and pulley in galvanized-iron buckets. The large gusset plates forming kneebraces at the ends of the trusses were coated by pouring into a solid form enclosing the entire plate.

The 84 main trusses, 84 monitors and 168 longitudinal trusses covered required about 12,000 sq. yd. of expanded metal, which cost about 8 cents per square yard to place. The main trusses required 414 and the longitudinal trusses 150 cu. yd. of mortar. This mortar was placed at a cost of $18.33 per cubic yard, with cement at $1.17 a barrel, sand at 86 cents a yard and common labor at 13 cents an hour. After the preliminary experimenting the work was carried along at the average rate of a bay per day—one main truss, one monitor and two longitudinal trusses. The cost of doing the work decreased steadily as the gangs became more accustomed to the work, the unit costs for the first few trusses being quite high.

Move Vitrified Duct Line with Screw Jacks

By W. M. STIEVE
Washington, D. C.

BY MEANS of screw jacks 2000 ft. of vitrified duct line belonging to the Brooklyn Rapid Transit Company on Gravesend Avenue, South Brooklyn, was recently moved horizontally in sections between manholes averaging 300 ft. in length. The line was moved a total distance of 30 in., sliding on plank skids. The line had to be moved to make room for the column footings of the new elevated railroad at that point, which were located over the existing duct line. The conduit was so near the surface that it could not be spanned by the footings. The method adopted saved building an entire new line before putting the old line out of service, the only new work required being the construction of additional manholes.

DUCT LINE MOVED WITH JACKS

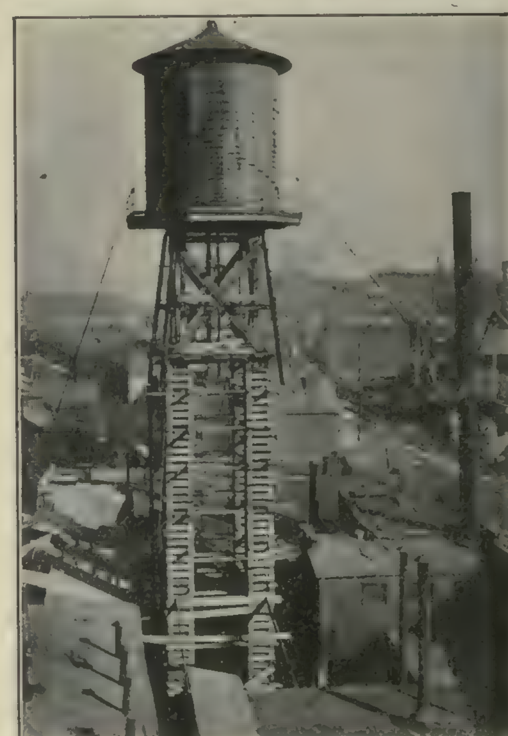
The line consisted of two four-way ducts, 30 in. long, enveloped in 3 in. of concrete. It was uncovered and a trench 30 in. wide on one side and 18 in. wide on the other excavated to the bottom of the concrete envelope. One-inch planks were then set underneath the line as indicated in the accompanying sketch, and a large number of screw jacks were placed against blocking on the narrow side of the trench. A man stationed at each jack took a half turn at a signal from the foreman, and each continued to turn his jack in response to signals till the move was complete. In this way a nearly equal pressure was kept up along the whole length of the section being moved. To make sure that the line was moving evenly and was not overstressed at any point, graduated sticks driven horizontally into the back at intervals were watched carefully. The current was shut off only a few hours each day while the actual moving of a section was in progress. This interruption was possible without inconvenience because of the nature of the service for which the conductors were used.

The entire 2000 ft. was moved without any damage to the electrical conductors. A few cracks developed in the concrete envelope, which were readily repaired with cement mortar, and a few of the tile ducts were broken and had to be replaced by split ducts.

Raise Tank 50 Feet on Cribbing Tied Together with Plank

By JOHN P. EICHLEAY
Pittsburgh, Pa.

GUYED WITH wire rope and steamboat ratchets, the 16 x 20-ft. tank shown in the photograph has just been raised an additional height of 50 ft. with screw jacks and blocking. As the photograph shows, the neighborhood of the tank foundation was pretty well crowded, and there was no room to make the blocking any larger than the size of the original tower, which had supported the tank 32 ft. above the ground. The tank was therefore raised on four towers of timber cribwork tied together every 12 courses with 3 x 12-in. plank in both directions. These planks also provided a convenient support for working platforms. Screw jacks were used, and the tank was caught up before raising began on timber bents erected inside the old steel tower.



TANK RAISED ON ACCURATELY BUILT CRIBWORK

The tank, which is one of those at the plant of the United States Glass Company in Pittsburgh, has been raised by the John Eichleay, Jr., Company.

Wisconsin Builds More Than 1000 Miles of Road This Year

During the present year 1158 miles of state-aid roads have been built in Wisconsin at an average cost of $3,140 per mile.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Railway Committee Reports on "Daylight Saving"

Committee of American Railway Association Thinks Roads Should Not Agree to Time Change Until Adopted Generally

The American Railway Association, at its semi-annual meeting in New York City, Nov. 15, considered a report on the "daylight saving" movement from its committee on standard time. The document, signed by the committee headed by E. B. Thomas, president of the Lehigh Valley Railroad, reads as follows:

"Last May several of the countries involved in the European conflict advanced the hands of the clock an hour during the summer months. Following this emergency action, more or less agitation developed in various sections to make a similar change in this country.

Railroads' Attitude Summarized

"The committee on standard time is of the opinion that the correct stand for the railways to maintain on this subject is as follows:

"First—That the present subdivision, or zone system, of dividing time is scientifically correct.

"Second—That any change in such subdivisions of time would result in endless confusion, and would be disastrous to the railroads.

"Third—That in the event of a nation-wide movement to change the hands of the clock in order to readjust the hours of day-light to the hours of labor, the railroads should not antagonize the movement. It is the feeling of the committee that the railroads will not suffer any very serious inconvenience nor disarrangement of schedules by the change, as proposed, although such a change from a scientific standpoint is not warranted nor is the committee in sympathy with the movement.

"The committee feels that the railroads should not agree to the 'daylight-saving' project until it has been previously adopted by the principal business and municipal centers, together with the state and local authorities. Unless a change of the character proposed can be made on the same date throughout the country it will lead to great confusion and difficulty."

Railroads Sue to Test Eight-Hour Law

Suits to test the so-called eight-hour railroad law have been filed by the Atchison, Topeka & Santa Fe, the Chicago, Rock Island & Pacific, the Chicago & Eastern Illinois and the Union Pacific railroads. The Chicago, Great Western, Missouri Pacific and the Chicago, Burlington & Quincy roads have also joined in similar action. Reports state that every railroad in the country is considering filing suits attacking the Adamson measure.

The bill of complaint filed by the Union Pacific alleges that the act is unconstitutional because it is not a proper regulation of interstate commerce; because it violates the guarantees of the fifth amendment to the Constitution, and because it is unworkable as applied to existing conditions under which the trainmen are operating.

Open Engineering Department Library

The general engineering department of Union College, Schenectady, is establishing a library and reference room. Bulletins, catalogs and other publications are wanted from state engineering departments, manufacturers and other institutions.

Bridge Under Construction Near Seattle Fails

Falsework of Steel Truss Undermined by Snoqualmie River Flood—Piers Undamaged—Eight Tons Recoverable

A partly completed steel bridge over the Snoqualmie River, near Tolt, Wash., collapsed Nov. 9, when a flood undermined the falsework. The piers are undamaged, but of the 53 tons of materials in the wreck only about 15 per cent can be recovered. The wreckage will be removed and the work resumed next summer.

Through Pratt Truss

The structure was a steel, pin-connected through Pratt truss of 209-ft. span, with a 20-ft. roadway. At the time of the accident, water in the Snoqualmie River was 10 ft. deep, and the span was 30 ft. above the water surface. A freshet caused by warm winds melting the snow in the Cascade Mountains undermined the falsework. Anchor bolts which had been placed at one end, but not grouted, were pulled out by the falling span. The total weight was 106 tons.

The bridge was being built for King County by the Weymouth Construction Company, contractor, of Seattle. As the structure is part of a new line not yet open to the public, no interference with traffic will result from the accident. The contract price was $18,000.

Western Cement Companies Charged with Forming Trust

Indictments, which have been returned by the federal grand jury, charge sixteen cement men on the Pacific Coast with combination in restraint of trade in the organization and operation of a cement trust. The indictment, which was returned Oct. 27, was kept secret until Nov. 8. It charges that prices were fixed, territory assigned, and that the agreement has been in effect since August, 1914.

The firms whose officers are reported to be involved are the Oregon, Cowell, Pacific, Riverside, Santa Cruz, Standard, Superior, Washington and the Olympic Portland cement companies.

California's $15,000,000 Highway Bond Issue Carried November 7

At the general election, Nov. 7, the measure in California which provided for an appropriation of $15,000,000 for State road work was approved by a large majority. As outlined in the Engineering Record of Oct. 28, page 536, the new appropriation includes $12,000,000 for completing the system now under way and $3,000,000 for a county and co-operative plan under which eight additional extensions will be undertaken. The present highway organization will be continued, and the new work is to be started at once. Several counties in California have also voted independent bond issues. Among them are Sacramento County, with an issue of $1,700,000, and Stanislaus County, with a $1,500,000 issue.

Want Uniform Law to Prevent Strikes

The formation of a committee to make suggestions to Congress and state legislatures for the perfection of laws providing amicable settlements of labor disputes was announced last Monday by V. E. Macy, president of the National Civic Federation. Every phase of the country's life will be represented in the committee.

Recommend $7,000,000 Water Terminal at Bayonne

New Jersey Harbor Board Submits Plans and Estimates by B. F. Cresson, Jr., and F. Van Z. Lane to Develop 420 Acres

General plans for the development of a water and industrial terminal at Bayonne, N. J., that, if constructed, will rival the Bush Terminal in South Brooklyn were filed this week with the Board of Commissioners of that city by the New Jersey State Board of Commerce and Navigation, of which J. Spencer Smith is president. The plans were prepared under the immediate direction of B. F. Cresson, Jr., chief engineer of the commission, and F. Van Z. Lane, engineer of the Bayonne Chamber of Commerce. Five schemes were presented. The fifth, designated as Primary Installation 5, is an outgrowth of the other four, and is the one recommended by the engineers.

Location

The site chosen for the development is on the Upper New York Bay frontage of Bayonne, extending from a point between East Thirty-fifth and East Thirty-sixth Streets to East Forty-sixth Street, and from the National Docks Railroad to the pierhead line; it embraces 420 acres, of which approximately 400 acres are under water. The tract is entirely undeveloped. The scheme recommended provides dockage for thirty modern freight ships, a 1000-car railroad yard, with facilities for classifying and assembling freight, a ferry terminal for Bayonne-Manhattan service, 4 miles of bulkhead platform, 1,350,000 sq. ft. of one-story bulkhead sheds, 7,770,000 cu. ft. of second and third-story bulkhead sheds, and more than 200 acres of land for industrial buildings. There would be highway and trolley connections, and along one side would run a railroad having direct connection with practically every railroad reaching New York from the New Jersey side.

The total estimated cost of the installation is $7,235,000, of which $2,122,000 is for dredging, bulkheading, and reclamation, and $5,113,000 for the other facilities. The plan is to provide for a 35-ft. depth of water.

The report is the result of legislation passed a year ago, and a series of conferences early this year between the Bayonne Chamber of Commerce, the City Commissioners of Bayonne, the State Board of Commerce and Navigation, and Irving T. Bush, president of the Bush Terminal Company, looking to the development of the industrial possibilities of Bayonne.

Experts Wanted to Investigate Foreign Markets

To obtain men to act as trade commissioners and special agents for the Bureau of Foreign and Domestic Commerce, examinations will be held Dec. 6 by the U. S. Civil Service Commission. The duties of the appointees will be to present data which will enable American manufacturers to plan campaigns for the sale of their goods abroad.

Men are wanted to undertake the following investigations: Motor vehicles in Russia and the far East; investment opportunities in Russia; metal-working machinery and prime movers in Russia and in Brazil; hardware in Africa, the near East, and India; ports and transportation facilities in Russia and the far East; mineral resources in the far East.

Applicants should ask for form 275, stating the position desired.

Must Raise About $2,000,000 to Complete New Jersey Sewer

The Passaic Valley Sewerage Commission finds that the trunk sewer cannot be built for $11,250,000 subscribed by the fifteen New Jersey municipalities now in the agreement. The cost will probably be at least $13,000,000. Work on the uncompleted tunnel under Bayonne and New York Bay, the most difficult and essential part of the improvements, cannot be resumed until additional money is raised. The legal difficulty will have to be met by application to the legislature for another time extension.

Short Course in Highway Engineering at University of Illinois

The civil engineering department of the University of Illinois announces that in cooperation with the state highway department the fourth annual short course in highway engineering will be held at the University Jan. 8 to 19, 1917. The program, now in course of preparation, is planned to interest those engaged in the development of country roads, the administration of municipal affairs and contracting. Each subject will be handled by a specialist.

While it is intended that the course shall be a continuation of the work of last year for those who have attended previously, courses will also be arranged for those attending for the first time. Special attention will be given matters relating to bond issues and the development of county-road systems. No fee is charged.

Cleveland Company Wins Suit Over Concrete Dock Patent

The Cleveland (Ohio) Dock Engineering Company obtained a favorable decision in an appeal recently brought against it by the Detroit Iron & Steel Company disputing patent 1,089,405 covering concrete pier construction. The Cleveland company, in 1910, designed and built, for the Detroit firm, a concrete dock. In 1913 the latter company attempted to duplicate the dock without recognizing the validity of the patent in question. The Cleveland engineers brought suit and won. The case was appealed, resulting in another victory for the Cleveland Dock Engineering Company.

Propose Texas Highway Commission

A bill has been prepared for presentation to the next legislature creating a state highway department for Texas. The tentative document provides for three commissioners to be appointed by the governor, one of whom shall devote his entire time to the commission at a salary of $4,000. Funds will be raised by an automobile tax of 25 cents per horsepower, the minimum taxation being $7.50 a year and the maximum, $15. It is estimated that this will insure an annual income of $2,000,000. One third of the money is to be returned to the counties in which the machines are registered; two thirds is to be used in the construction of state roads. The bill will be presented next January.

Steamer Breaks Through Canal Lock

Two foot-gates in Lock No. 7 of the Welland Canal were smashed Nov. 5 when a steamer, traveling at too high speed, crashed through the gates and dived into the lock below. Adjacent farms and gardens were flooded. The damage is estimated at $12,000.

Winter Training for New York Engineers in Reserve Corps

Plans are on foot to provide military drill and instruction in military engineering for the members of the Engineer Officers' Reserve Corps in New York City. The organization formed under the name of the Civilian Engineers' Training Battalion, which provided instruction last winter and spring for some 500 of those who attended the military engineering lectures, will be taken into this organization, many of its members having applied for commissions in the Reserve Corps, and a considerable additional number being expected to do so in the near future. The entire training organization will be in immediate charge of Captain Robins, Corps of Engineers, under the direction of the Eastern Department of the United States Army, and it is hoped that exceptionally good facilities for instruction in military engineering can be arranged for with the assistance of the state military authorities.

Open New Tech Dormitories

The new dormitories of the Massachusetts Institute of Technology, which were opened Nov. 6, are the outgrowth of a spirit of cooperation and offer greater opportunities for the students in different courses to become acquainted. The cream-colored brick structures are situated below the educational buildings on the Riverway and are one of the first examples in Boston of the Florentine style of architecture. Student government will be the policy in the new dormitories.

Engineering Society Activities

Engineers' Club of Trenton, N. J., will, at its Nov. 22 meeting, entertain as its guest Harrington Emerson, of the Emerson Company, of New York City. He will speak on efficiency.

Engineers' Club of Philadelphia will hold a meeting Nov. 27 for junior members. Telephone engineering will be the subject of lectures by A. P. Godsho, A. L. Gracy and J. H. Mahan. A prize of $50 will be awarded, at the end of the club fiscal year, for the best paper by a junior member describing an engineering work with which the writer has been connected, or recording investigations contributing to engineering knowledge.

Colorado Association of members of the American Society of Civil Engineers was addressed Nov. 11 by M. H. Aylsworth and Fred J. Rankin, chairman and engineer respectively of the Colorado Public Utilities Commission. "State Control of Public Utilities" and "Regulation from a Engineering Standpoint" were their topics.

The Associated Engineering Societies of St. Louis heard Capt. Offnere Hope, Coast Artillery Corps, U. S. A., speak Nov. 15, on "Our Coast Defenses." The meeting was held under the auspices of the local section of the American Institute of Electrical Engineers. At a future meeting L. C. Nordmeyer will give personal experiences and observations on China.

Cleveland Engineering Society will meet Nov. 21. F. H. Newell and Isham Randolph will speak on "A Practical Plan of Co-operation" and "What the Established Technical Man Owes to the Beginner." Hunter McDonald will outline to the meeting reasons why a government nitrate plant should be located at Muscle Shoals. The subcommittee on plan, of which Mr. Newell is chairman, will also meet Nov. 21 in the Cleveland society rooms to draft a plan for submission to the third conference of the committee on co-operation to be called in Chicago early in 1917.

Harvard Engineering Society of New York will hold its tenth annual dinner at the Harvard Club, Dec. 7. President A. Lawrence Lowell and W. S. Kies, vice-president, American International Corporation, are among the speakers.

Municipal Engineers of the City of New York, at their Nov. 22 meeting, will hear Edward M. Blaw, assistant engineer, Board of Estimate and Apportionment, New York City, tell of the preparation of the building district maps of the city. Special entertainment will be provided Nov. 25, instead of the customary program.

What Engineers and Contractors Are Doing

FRANCIS C. SHENEHON, of the University of Minnesota, who has been engaged on hydraulic investigations in Illinois since last June, has been retained as an expert in the settlement of the terms of a lease for water power between the Marseilles Land & Water Power Company and the Northern Illinois Light & Traction Company. The water power company has a dam across the Illinois River at Marseilles and sells power to the traction company under a lease covering a period of 180 years, five of which have passed. The document is so contradictory that a court of equity has been called upon to determine its real meaning. In addition to Dean Shenehon, Thomas W. Orbison and Isham Randolph, consulting engineers, of Appleton, Wis., and Chicago, respectively, have been engaged as engineering experts to look after the interests of the water power company.

J. R. SHERMAN has resigned as assistant engineer, U. S. Reclamation Service at Meadow Creek, Wash., to go to South America. He will have charge of construction of a large tailings dam near Rancagua, Chile, for the Braden Copper Company.

WILLIAM A. DUFF, whose appointment as assistant chief engineer of the Canadian Government Railways was announced in these columns, has been in the employ of that road since 1913. After graduating from the University of Toronto in 1901 he joined the engineering staff of the Vancouver, Victoria & Eastern Railway. The following year he went to the Grand Trunk Railway and in 1903 entered the employ of the Kenwood Bridge Company at Chicago. That was followed by his appointment in 1905 to a position with the Canadian Bridge Company. During 1907 and 1908 Mr. Duff was chief draftsman in the bridge department of the Transcontinental Railway and from then until 1913, assistant bridge engineer. He resigned in 1913 to go to the Canadian Government Railways.

WILLIAM L. BOWMAN, civil engineer and lawyer, of New York City, has removed his office to the Equitable Building.

E. W. KIBBEY has resigned as county engineer of Koochiching County, Minnesota, and as city engineer of International Falls to take active charge of the Kibbey Engineering Service Company, with offices in the Plymouth Building, Minneapolis. The firm will specialize in service to bonding companies and contractors. G. S. Kibbey and E. W. Kibbey have also organized the Minnesota Construction Company for general contracting, specializing in tile drainage work.

WILLIAM H. VANCE, formerly engineer maintenance of way of the Louisiana & Arkansas Railway, has been made chief engineer. The position he formerly held has been abolished. Mr. Vance has been in the employ of the Louisiana & Arkansas since 1906 and in railway service since 1902.

M. F. CLEMENTS has been promoted from assistant engineer to engineer of bridges for the Northern Pacific Railway, succeeding H. E. Stevens, promoted. Mr. Clements is a graduate of the University of Iowa, class of 1899, and has been with the Northern Pacific since 1907. After graduation he entered the service of the Burlington, Cedar Rapids & Northern Railway, remaining with that road until 1902, when he was appointed chief draftsman for the maintenance of way department of the Chicago, Rock Island and Pacific Railway. A year with the Clinton Bridge Company preceded his appointment with the Northern Pacific in 1907 as draftsman on bridge design. Mr. Clements' advancement was steady and at the time of his recent promotion he was in charge of track elevation at Spokane

EDWIN G. FOSTER, formerly assistant engineer for the Buffalo, Rochester & Pittsburgh Railway, has been made valuation engineer, with office at Rochester, N. Y.

GEORGE W. CORRIGAN has been promoted from roadmaster to division engineer of the Stockton division of the Southern Pacific System. Since graduation from the University of Missouri in 1900 he has been actively engaged in railroad engineering work in the West.

K. A. SINCLAIR has resigned as acting county engineer of Douglas County, Oregon, and returned to Portland.

JEFFERSON D. DAVIS recently returned to New York City from Idaho, where he was superintendent in charge of construction of the Bear Lake pumping station. Mr. Davis is now in Halifax, N. S., serving as expert witness on the failure of a dock, owned by Furness Withey & Company, which collapsed two years ago when a valuable cargo was unloaded thereon.

GEORGE W. TOWNSEND, who recently resigned from the Baltimore Sewerage Commission, is now engineer in charge of the safety department of the Barrett Company at Frankford, Pa.

J. H. FARGO has resigned from the employ of Renhart & Donovan, contractors, of Oklahoma City, to become superintendent for Vandenberg & Pawley, general contractors, of Wichita, Kan.

T. B. HUDSON, for the last 6½ years chief civil engineer of the Indiana Steel Company, is now engineer in charge of construction at the Maryland plant of the Bethlehem Steel Company. Mr. Hudson was with the Indiana firm for nine years.

CLYDE POTTS, consulting engineer, of New York City, has been engaged by Stratford, Conn., to design 60 miles of sewers and a sewage-disposal plant. The project will cost $450,000.

FRANK J. PHILLIPS, who has been with the Miami Conservancy District since graduation from the University of Iowa in 1915, is now in the sales department of the General Fireproofing Company at Youngstown.

JACOB L. BAUER has been reappointed county engineer of Union County, New Jersey. His office is at Elizabeth.

E. A. LINDBERG has left the employ of the Aluminum Company of America to take a position with the Utah Copper Company. He was graduated from the University of Nebraska in 1912 and was with the Aluminum company two years.

H. F. MCGREGOR, formerly superintendent of streets and bridges of Tacoma, Wash., has been appointed superintendent of the water department.

COLIN D. MURDOCK, chief computer of local improvement districts in the city engineering department of Tacoma Wash., for the past seven years, will succeed H. F. McGregor as superintendent of streets and bridges.

BERT SCHNEIDER, who was with the engineering forces of H. L. Cooper on the Keokuk power development, is now employed in the engineering department of the Sparrows Point plant of the Bethlehem Steel Company.

W. E. BELCHER, of the Stone & Webster Engineering Corporation, has been assigned to work in Akron, Ohio, as engineer representing the structural division. Construction is in progress on four large buildings for the B. F. Goodrich Company.

RICHARD C. S. WATSON, formerly engineer on surface and mine surveys for the St. Joseph Lead Company of Bonne Terre, Mo., is now mine engineer for the Donk Brothers Coal & Coke Company at Collinsville, Ill. After being educated at the Castle Hills and Saint Paul schools, London, England, Mr. Watson went to South America, where, for fourteen years, he was engaged on railroad construction, land and mine surveys, and smelter construction. He returned to the United States in 1911. Previous to his employment by the St. Joseph Lead Company, Mr. Watson was with the St. Louis Smelting & Refining Company.

A. S. CLARSON has been appointed city engineer of Verdun, Quebec. He was for some time on the staff of the Montreal Electrical Commission and has also been associated with engineering projects in England.

O. T. REECE, consulting engineer, of Oxford, Kan., has been retained by the commissioners of Comanche County to design and build several concrete bridges. His headquarters will be at Coldwater, Kan., temporarily.

C. E. PAINTER has resigned from the employ of Black & Veatch, consulting engineers, of Kansas City, Mo., to become associated with the J. P. Sprague Company of that city. Mr. Painter will be engaged on estimates and designs of reinforced-concrete buildings. Mr. Painter's first engineering work was with Calcasieu Parish, Louisiana. That was followed by his appointment as assistant city engineer of Newton, Kan., from which position he resigned to join the staff of Black & Veatch.

LITTELL SNIVELY has taken a position in the engineering department of the Cananea Consolidated Copper Company at Cananea, Mexico. After graduation from the Colorado State College in 1906 Mr. Snively went to the Philippines in the service of the U. S. government. Since his return to the United States, three years later, he has been in charge of several irrigation projects. He was resident engineer on the Halligan dam at Fort Collins, Col., and also connected with the North Platte (Wyo.) Valley Irrigation Company. He has also been a member of the engineering department of the state of South Dakota.

HOWARD CORLEY has resigned from the construction staff of the Babcock & Wilcox Company to become erecting engineer for the William B. Scaif & Sons Company. His headquarters are at Pittsburgh.

PETER JENNY, formerly with the Robert Grace Contracting Company, is now with the J. F. Casey Company. He is employed on sewerage work in Milwaukee.

SANFORD E. THOMPSON, consulting engineer, of Boston, has opened new offices and laboratory in the Federal Street Building. These replace the Newton Highlands and Milk Street offices. The laboratory equipment, which includes a concrete saw and a 125-ton compressing machine, permits handling work of a special nature.

A. E. FOREMAN has resigned as chief assistant to the city engineer of Victoria, B. C. He had been in the employ of the city for a number of years and assistant city engineer since 1912.

W. C. PEARCE, formerly supervisor of track of the Chesapeake & Ohio Railway, has been appointed division engineer with headquarters at Richmond, Va. F. D. Beale is made acting division engineer, with headquarters at Clifton Forge, Va., and H. A. Bertram becomes acting division engineer of the Chesapeake & Ohio Railway of Indiana, with headquarters at Peru.

J. N. GEORGE & SONS, contractors, of Shreveport, La., have completed their 30-mile road contract at Baton Rouge and are now starting work on a contract in De Soto Parish calling for 25 miles of road building.

H. N. LEGREID has resigned as county engineer of Humboldt County, Iowa, and as engineer for several drainage districts in that vicinity, to become associated with Arthur L. Webster, consulting engineer, of Wheaton, Ill. Mr. Legreid will have charge of the recently opened office at Harvard, Ill. After graduation from the University of Wisconsin in 1907, he was engaged on farm and district engineering and contracting. Five years later he was made assistant office engineer for C. G. Elliott, of Washington, D. C., and in 1914 went to Iowa as assistant county engineer of Humboldt County under J. L. Parsons. He was made county engineer the next year.

J. W. WALTER, formerly of the Plains division of the Atchison, Topeka & Santa Fe Railway, has been made assistant engineer in charge of construction of an 80-mile branch line in Oklahoma and Texas.

BLACK & VEATCH, of Kansas City, have been officially appointed consulting engineers to the superintendents of the water and light plants who are members of the Kansas League of Municipalities.

JAMES H. REDING, civil engineer with R. Winthrop Pratt, of Cleveland, Ohio, is on the Mexican border, at El Paso, as first lieutenant in the first battalion of Ohio engineers. He has just completed a detail as adjutant of both the first battalion and the provisional regiment of the engineers, the latter having been recently organized from the militia engineers stationed at El Paso.

C. P. COLLINS, whose resignation as sanitary engineer of Johnstown, Pa., was noted in the Nov. 4 issue, has re-entered the service of the city and will continue to direct the sanitary work.

S. R. OLDAKER has been appointed city engineer of Hermiston, Ore.

R. E. SHUCK has been transferred to Spokane to succeed M. F. Clements as assistant engineer on grade separation for the Northern Pacific Railway.

FRED R. HESSER, for four years assistant engineer of the Kansas health and highway departments, has joined the sales force of the General Fireproofing Company at Youngstown, Ohio. Mr. Hesser also served in the bridge department of the Kansas City Terminal Railroad Company.

WILLIAM OSBORNE SELL, of the Ferro Concrete Construction Company, Cincinnati, is in Rochester, N. Y., engaged in designing an addition to the Kodak Park plant of the Eastman Kodak Company.

Obituary Notes

GEORGE W. CHAMBERS, contractor, of Rochester, N. Y., died recently at the age of 71. Mr. Chambers was associated with the late James D. Casey in contracting work under the firm name of Chambers & Casey. After the death of Mr. Casey Mr. Chambers conducted the business alone. He engaged extensively in railroad building and had contracts for work on the New York Barge Canal.

LEONARD COLE RITTENHOUSE, junior member of the firm of James H. Rittenhouse & Son, civil and mining engineers, of Scranton, Pa., died Nov. 10. Mr. Rittenhouse was a graduate of Pennsylvania State College, and only thirty-two years of age. One of his undertakings that elicited considerable comment was the connection of a 47-deg. slope with a 950-ft. vertical shaft in a zinc mine at Franklin Furnace, N. J.

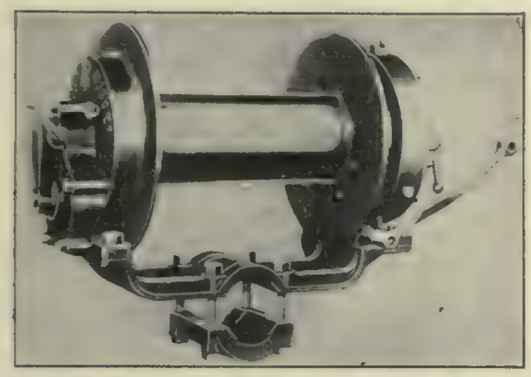
Civil Service Examinations

Massachusetts.—Examinations will be held Dec. 11 in Boston for civil and sanitary engineers. Residents in the state during the last year are eligible.

New York.—Examinations for state, county and village service will be held Dec. 2 in cities throughout the state. Among the positions open are junior assistant engineer, salary $901 to $1,200; junior electrical engineer, salary $901 to $1,200; supervisor of dredging plant, salary $175 per month.

New Model Hoist Is Designed for Light Lifting and Hauling

For those who prefer manila to wire rope for light hoisting and hauling, the Ingersoll-Rand Company, New York City, has brought out a new model "Little Tugger" hoist. The square piston, reversible driving engine, automatic lubricating, inclosed gearing, drum-release clutch and worm-operated band brake are essentially the same as in the No. 1 model. The principal differences are in the diameter



NEW HOIST OPERATED BY STEAM OR COMPRESSED AIR—WEIGHS 358 POUNDS

and length of the drum, width of flanges and the main frame and overall dimensions.

Although designed primarily for underground work, it is recommended by the manufacturer for all-around hoisting, hauling and handling in mines, tunnels, quarries and industrial plants.

Tool Company Opens New Factory

The new plant of the Van Dorn Electric Tool Company, Cleveland, which was recently opened, will about double the company's production. The building is made of steel, brick and concrete with maximum lighting surface. The greatest possible effort seems to have been made to secure efficient factory operation. Among the points to be emphasized is that all inspectors report directly to the chief engineer. This, according to officials of the Van Dorn company, is necessary, as if these men reported to the production department there might be a tendency to "get out the work by overlooking slightly defective parts."

Jack Used to Straighten Poles

A jack which has proved an efficient means of straightening or pulling poles is a product of Templeton, Kenley & Company, Limited, of Chicago. The device, as shown, is operated by one man and works when inclined at an angle of 45 deg. In the instance illustrated sixteen strokes of the lever pushed the pole into a vertical position. The I-beam base prevented ground slippage and the cap of the rack bar formed a dependable truss. Jacking, sighting and tamping can all be done by one man. The manufacturers suggest the use of their jack to avoid the danger of internal strains, which might cripple the men when such a device is not used.

SIXTEEN STROKES MADE POLE VERTICAL

Pine Export Company to Investigate European Markets

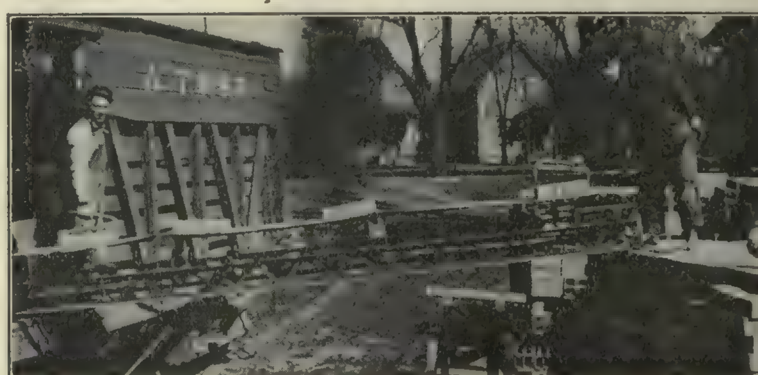
The Yellow Pine Export Lumber Company was recently organized at New Orleans for the purpose of extending American lumber markets in Europe and South America. The company will have a large capital and through co-operation of all of the mills of the company a lumber order of any size will be handled by the mills as a collective group. It is the intention of the new company to send special agents to South America, and to Europe following the declaration of peace.

Portable Conveyor Reduces Cost of Unloading Material

A portable conveyor designed for use by coal dealers will probably interest contractors who handle much material. The machine illustrated is said to have reduced the cost of unloading by almost 50 per cent. Aside from this saving, the large gondola cars and increasing distance required between the cars and the unloading point have made it nearly impossible for one man to shovel from the car to the farthest point of the dumping ground.

The device is manufactured by the Stephen-

CONVEYOR UNLOADS 1465 BRICK IN AN HOUR AND LOADS 648 SACKS OF CEMENT IN LESS THAN TWO HOURS



Adamson Manufacturing Company of Aurora, Ill. It has an 18-in. belt conveyor, which measures 16 ft. from center to center. A 2-hp. covered motor supplies the power, and a pair of trucks permit easy moving. One user states that two men moved 1465 brick in an hour with the machine. A car was loaded with 648 sacks of cement in 1 hour 56 minutes.

John Scott Medals Awarded

Acting on the recommendation of the Franklin Institute, the city of Philadelphia, recently awarded John Scott legacy medals and premiums to John V. N. Dorr, president of the Dorr Cyanide Machinery Company, of New York City, and to Carl E. Akeley, sculptor, naturalist and African explorer, who is connected with the American Museum of Natural History.

The basis of the award to Mr. Dorr was the invention of the Dorr classifier—for separating quick from slow-settling materials when both are suspended in a liquid, the Dorr thickener, for dewatering slimy material, when suspended in a liquid, and the Dorr agitator, for maintaining slimy material in suspension.

The award was made to Mr. Akeley for the invention of the Cement Gun, manufactured by the Cement Gun Company, of New York City.

Patents Issued on Colloidal Bitumens

United States patents have been issued to Clifford Richardson on an improved "bituminous substance" and on the process of manufacture. Similar patents have also been granted in Canada, Great Britain, France and Italy. It is believed that these are the first covering a product and process involving the introduction of colloidal matter into bitumens of all types. The process consists of the introduction of clay in the form of a colloidal aqueous paste and combines this paste with the bitumen in such a way that after the water is driven off, the bitumen forms the continuous phase of the colloidal material.

Outline for Study of Bitumens

The Barber Asphalt Paving Company has published an "Outline for the Study of Bitumens," arranged in convenient question and answer form with space for additional memoranda. While the whole subject of bitumens is covered, the outline has been prepared with especial reference to the asphaltic materials used in highway construction. The booklet contains references to most of the standard text books on highway engineering and is a convenient reference.

Business Notes

B. A. Brennan, formerly contract manager of the Westinghouse Machine Company and later sales manager of the power department of the Bethlehem Steel Company, has resigned as vice-president of the Mercantile Trust Company of St. Louis to accept the presidency of the Citizens Company, Incorporated, of Baltimore.

A. Leschen & Sons Rope Company, of St. Louis, is constructing a $100,000 administration building adjoining its factory. The new structure will be 75 x 115 ft. with three stories and basement. The top floor will be devoted to a restaurant; recreation rooms and shower baths will occupy the basement.

Parsons Company of Newton, Iowa, has removed its New York office to 18 West Thirty-fourth Street.

Troy Wagon Works Company has just established a connection with R. P. Carroll of Cleveland, Ohio, who will act as local district manager and will handle an entire line of Troy motor truck trailers.

A. M. Anderson, Chicago sales representative of the Oshkosh Manufacturing Company, has removed to 605 South Dearborn Street.

F. Raniville Company of Grand Rapids, Mich., has opened a New York office at 6 Church Street, in charge of George S. Baker. A complete stock of the company's goods will be maintained at the new branch.

Badger Meter Manufacturing Company of Milwaukee recently sold 2500 water meters to Kansas City, Mo.

Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio, has three additional licensees. They are the Streator Clay Manufacturing Company, Streator, Ill., which has a daily capacity of 60,000 paving block, the Martinsville Brick Company, of Martinsville, Ind., with a daily productive capacity of 30,000, and the Cleveland Brick Clay Company.

Robert C. Clifford, who for the last four years has been district sales manager for the United States Cast Iron Pipe & Foundry Company, is now associated with the Walter A. Zelnicker Supply Company, St. Louis, in charge of the rail department.

Engineering Record

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A Weekly Journal Devoted to Civil Engineering and Contracting

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Railroad Matters

ALREADY there are indications that the prediction in the Engineering Record last week that the railroad investigation would be momentous are to be realized. But the congressional investigation, apparently, will not be allowed to absorb all of the time that the public can give to railroad matters. The carriers have instituted numerous actions to test the constitutionality of the eight-hour law, while the brotherhoods have made affiliations with certain of the unions of railroad employees, so that instead of 400,000 standing for the so-called eight-hour day, there will be 700,000. There is no need of counsel to follow railroad matters closely in the next few months. The newspaper reading public will not be able to escape from their consideration. As never before, railroad management, railroad regulation, railroad ownership have become national questions.

Exercising One's Influence

ELSEWHERE in these pages will be found an editorial on appropriations for the Bureau of Standards. Those in sympathy with the views there expressed should write to their congressmen expressing the same views or sending a copy of the editorial together with a letter indorsing the position taken. With few exceptions, the members of Congress have little knowledge on scientific subjects and unless their constituents advise them as to their position they have no means of judging of the importance of matters before them other than the statements of the officials requesting the appropriation. If every engineer and manufacturer who is benefited by the bureau's work would put his ideas before his congressman or before the appropriate congressional subcommittee, the bureau could get anything, within reason, that it desired. Besides writing to one's own representative, it would be well if communications were also addressed to John J. Fitzgerald, chairman of the House Appropriations Committee, and to Joseph W. Byrns, chairman of the subcommittee which passes upon the requests of the Bureau of Standards. Additional copies of the Engineering Record will be sent to those who desire to cut out the editorial referred to and send it to Washington.

An Accomplishment

IF permanent construction had been a prerequisite of the West Okanogan irrigation project the system would never have been built. That, in brief, indicates the policy of the financiers of that irrigation district. They wanted to have an irrigation system. They wanted to prevent land speculation. They wanted action. They succeeded in each of these objects. The project, which is the subject of the leading article in this issue, was laid out and completed within a year. The funds available were known. Six hundred thousand dollars was the limit of construction cost. But limiting the expenditure did not cause the details to be slighted. On the contrary, the best efforts of the engineers were directed toward conservation of head and minimum leakage and toward permanent construction where it would have been wasteful to adopt any other kind. The landowner's interests were safeguarded, speculation was prevented and a healthy if slow growth assured.

New Influence Line Methods

EXTENDING in range and detail the field of the newer graphic methods of drawing influence lines and solving indeterminate structures, D. B. Steinman in this issue, page 648, contributes a most interesting series of examples of the use of deflection diagrams as influence lines. In fact, the idea of the identity between influence lines and deflection diagrams will undoubtedly tend to simplify the construction of influence lines, particularly for engineering students. The applications given by Mr. Steinman to illustrate the feasibility and advantages of the method are quite striking. Influence lines for reactions, shears and bending moments in simple beams, for stresses in the members of a simple truss, for cantilever spans, for a two-hinged portal frame and for continuous and fixed-end beams are presented. Both practising engineers and teachers will find his discussion illuminating.

The Writing Season

DURING the spring and summer months, when the season's work is being laid out and executed, engineers and contractors have little time for anything except the immediate business in hand. Even during the winter months, of course, there is work to be done, but seldom is it as pressing as the tasks that fill the spring and the summer days. This, then, is the season that is most likely to afford opportunity for putting on paper the experiences gained during the past eight or nine months. If not reduced to writing now, when they are in mind, they are likely never to find a permanent record and both engineering and contracting will thereby suffer a permanent loss. It is strange that those who, week by week, follow technical developments through the pages of engineering and construction magazines often are averse to recording their own experience through the same mediums. They do not remember that if everyone took the same attitude as they do, technical journals would be impossible and the world's progress would be much slower. This is the writing season. If you have had interesting experiences during the season now closing, make your record now. Engineers and contractors will be your debtors.

Hiding Their Light

THE PRECEDING PARAGRAPH, suggesting that this is the writing season, brings to mind recent correspondence with an engineer having a large practice among small municipalities and in private projects of moderate size. He protested that there was little in his experience that would be of interest to other engineers, remarking that "he seldom did monumental work." Engineers, by and large, however, are not looking for descriptions of monumental work so keenly as they are for ideas which can be applied in their own work. The small commonplace thing is done a hundred times where the spectacular or monumental job is done once. Judged by the ratio of use, therefore, the small item, the "kink," is a hundred times more serviceable to the readers of engineering journals than is a striking feature of the Catskill Aqueduct or the Panama Canal. We do not mean to decry the importance of the major work, but merely to remind engineers who deal habitually with smaller installations that their ideas, by repetition, have an importance far beyond the measuring stick of the cost on a single installation. Here and there about the country are hundreds upon hundreds good ideas that would aggregate large savings, if only those who are responsible for the ideas would realize their news value. The material appearing in the "Hints for the Contractor" section of the Engineering Record is proof that even on the smallest job there are features that merit discussion. May we suggest that each reader engaged on small work look at his job from this angle and say whether or not there are departures from customary practice? If the answer is in the affirmative, put the experience on paper, and "do it now."

Utility Development

THAT the public is the finally responsible party in utility development was admirably set forth by Mayor James M. Curley of Boston at a recent hearing upon the revenue requirements of the Boston Elevated Railway. The chief executive of the Massachusetts capital delivered a cour-

ageous address to the effect that if the company demonstrates that it is being economically managed relief should be recommended to the incoming Legislature, preferably along the lines of reduced taxation rather than of fare increase. In some quarters the idea is held that if a public utility cannot afford to embark upon a further extension of facilities of costly character at a given period, the public should be expected to await more prosperous times before such facilities are undertaken. This viewpoint, the mayor demonstrated, is mistaken. In the last analysis it must be the public and the public alone which meets the cost of any given service, including all charges connected therewith, and therefore the public is the rightful decider as to what supernormal extensions shall be undertaken, with the single proviso that the public must always stand ready to meet the fair cost of such facilities. This is a very important truth. Possibly it may appear self-evident to some people, but in view of Mr. Curley's straightforward utterance in the Boston Elevated investigation, it deserves emphasis at this time. If the general public desires a service and is willing to pay its cost, then the economic justification for these facilities becomes a purely academic question. The utility management has done its duty when it has acquainted the public with the cost of the proposed facilities.

Industrial Conference Board

ANNOUNCEMENT was made in New York last week that there has been formed for the consideration of labor problems the National Industrial Conference Board, representing twelve of the large associations of manufacturers. Unfortunately, the newspaper publicity which followed the announcement gave a very misleading impression of the purpose of the board. It was represented to be a movement to fight labor. This is farthest from the minds of those who are responsible for the movement. They realize keenly that warlike methods in dealing with labor are not only obsolete but are attended by grave dangers. Their proposal is to lay before the country the true facts regarding labor difficulties and also to bring about the adoption of fundamentally sound labor policies in the industries represented in the several associations having affiliations with the board. In other words, the constructive activities are to be given major emphasis, while the other line of action will be to lay before the public the true facts when controversies actually arise. The Engineering Record believes that the management of the board is in the hands of those who will face conditions as they find them and who will not hesitate to suggest remedies that are correct even though counter to the wishes of those manufacturers whose indifference and lack of true insight into the nature of our labor problems have brought us to the present condition. It will need courage to take such a stand, but only such a stand can result in a real solution.

Grade-Crossing Protection

RECOMMENDATIONS looking to a standardization of grade-crossing signs and other protection throughout the United States were presented at the annual convention in Washington last week of the National Association of Railway Commissioners. These include a standard warning sign at least 300 ft. from the crossing in each direction, the use by day by crossing flagmen of a white disk with the word "Stop" standing out prominently, instead of the varicolored flags now in use, and the use by night of a red lantern. They also call for the painting of crossing gates in one certain way, the removal as far as possible of obstructions to a clear view of coming trains and the grading of approaches so that free passage of vehicles will not be impeded.

These suggestions, highly commendable in the main, are not all new. Several railroads, recognizing the inadequacy of the old protective devices against fast-going automobiles, have been working along similar lines. If the recommendations of the commissioners are to be carried out the constituted authorities must take it upon themselves to provide the sites for the signs, to help grade the approaches and to induce adjacent property owners to remove unnecessary obstructions to vision. And all this will work toward that co-operation in the expense of grade-crossing protection that seems to this journal as desirable as co-operation in the expense of grade-crossing elimination.

But the public and the railroad should not relieve the autoist of all responsibility. We are said to be a nation of gamblers, and so long as it is a fair wager that there is no train coming, or that we can beat the train to the crossing if it is coming, many of us will continue to take the chance in spite of disks, bells and gates. Therefore on out-of-town highways, where speeding prevails, the approaches, instead of being graded to permit unimpeded passage across the tracks, should be graded to impede such passage, by steep bumpers or ridges across the roadway, as proposed by T. G. Dabney in the Engineering Record of Nov. 11, page 600. Failure to slow down at such a bumper would mean disaster, and only the veriest speed maniac would bet on a sure loser.

The Channel Tunnel

THE history of the project for a tunnel under the English Channel, outlined on page 645 of this issue, affords an example of traditional British conservatism. It has been up time and again, but for one reason or another—and generally on account of military considerations—has been allowed to lapse.

European geologists and engineering experts tell us that the actual construction of this project would be simple compared to the difficult problems entailed by enormous earth pressures, tilted and faulted strata and great flows of water met in driving the Simplon and other Alpine tunnels. Indeed it is probable that the first attempt at the construction of a tunnel under the channel, begun more than forty years ago, could have succeeded even with the limited means and experience then available. Not construction difficulties but the obstinacy of the British public halted the first effort to drive the tunnel.

The task of the promoters has thus been without parallel in the history of great enterprises. Instead of having to convince the nations concerned that the project was feasible, profitable in itself and of great economic advantage to both parties—points conceded from the outset—the promoters have been faced with the more serious difficulty of combating an unfounded prejudice. The idea that such a tunnel would destroy England's insular position and lay her open to easy invasion took such deep root in the British mind that this project of international importance has stood checkmated since 1882. It has taken a European catastrophe to uproot this prejudice and bring England to the point of seriously considering a great public work which would not only be of economic benefit but might be of inestimable military value. The threat of the submarine to England's sea power, and the object lesson of Germany, far better able to live within herself than Britain, yet seriously hampered in the present conflict by blockade, are believed to have won for the proposed tunnel a consideration which was denied to better arguments.

There is no doubt that this project, which, large as it is, would cost less than the sum spent in a few days by England alone to carry on the war, could be financed at the present time. Were the money not available in England, it is safe to say that American bankers would require no further demonstration of the practicability of the project, and would welcome the opportunity to furnish funds for a profitable commercial enterprise of this character, in view of the far greater sums they have already loaned for more destructive purposes.

It is to be hoped that this time British objectors will be convinced or silenced, and that the project will realize the success its merits should have won for it long ago.

Dr. Douglas' Gift and Its Significance

THE GIFT by Dr. James Douglas of $100,000 as the beginning of an endowment fund for the library of the United Engineering Society is an indication of the great accomplishments made possible by the union of headquarters of the national engineering bodies. The officials of the library hope that the endowment will reach $1,000,000, and they are already making plans for expansion which will make this library unique, not only in its collection of technical books and periodicals, but also in the service it will be prepared to render the members of the profession. The library, through its efforts in forming committees to classify engineering knowledge, its index of tech-

nical periodicals available in various libraries of the New York metropolitan district and its information service on current engineering literature, has demonstrated its virility and its determination to leave nothing undone which will make its resources more readily available to those seeking information on engineering subjects.

The plans for the future cannot all be made public at this, their formative, stage. Announcement has already been made, however, of the plan to place on the library shelves every engineering periodical published in the world, no matter in what language. Already the library receives regularly 1000 technical periodicals. There are some 250 more not on the mailing list at present. It is proposed that these shall be added, and that the library will then, through its information service, be able to tell anyone seeking a particular class of information when data on that subject have appeared.

It can be expected that if this ideal—of securing all that is available throughout the civilized world—controls the plan for the periodical division, a scope equally broad will control the policy of the library with reference to the acquisition of engineering books. Those familiar with library resources claim that the consolidation of the library of the American Society of Civil Engineers with that of the societies already on Thirty-ninth Street has made the united collection the greatest reservoir of technical information. With the plans in hand, the position of the library will be strengthened, while at the same time its resources will be made more readily available.

Moreover, the needs of the enlarged library have been constantly in the minds of those who are planning the addition to the building. The space available for the library will be greatly enlarged, while the facilities are being so planned as to conduce to the utmost serviceability of the library resources. Among the additions will be a number of small study rooms which can be allotted to individual investigators who expect to spend much time in the library.

Reverting to the larger possibilities suggested by Dr. Douglas' gift, one cannot help feeling that the predictions made by those who urged that the civil engineers vote favorably on the proposal to move to Thirty-ninth Street have been vindicated. An idea of broad compass is always more stimulating than a narrower one, and no matter what the standing of the great engineering societies as individual bodies, their appeal to the imaginations of engineers must be far less than that of a single united profession. It was this thought of a closer union between engineers of every persuasion that stimulated Dr. Douglas to make his gift. The same thought was controlling, too, in the mind of Ambrose Swasey when he endowed the Engineering Foundation, even though the consolidation of headquarters had not then been proposed. Mr. Swasey stipulated that the civil engineers should have a part in the management of the foundation.

The great idea—professional unity—which has stimulated Dr. Douglas and Mr. Swasey will undoubtedly stimulate other leaders of the profession who are well endowed with this world's goods. Undoubtedly, we are but at the beginning.

The engineering societies are amply able to keep up the present work for their memberships and to expand that work with the years. Large endowments, however, will enable the work to go along much faster and to realize plans which otherwise must be kept in abeyance for a long time.

Truly the determination of the civil engineers to move to the Engineering Societies Building was a momentous one.

Leadership Through Industrial Research

CONGRESS will shortly convene and among the subjects which will come up for discussion will be the appropriations for the Bureau of Standards. In normal times it is natural for engineers and industrial leaders to be interested in the bureau's appropriation. Now the interest should be redoubled. Both here and abroad a new light has broken as to the bearing of research on the national welfare. Germany and England in this respect form a striking contrast. The former owed her tremendous growth in foreign trade to her thorough and extensive scientific investigation. England, on the contrary, was blind to its benefits, and its commercial power, relative to Germany's, shrank. In other words, Germany's commercial progress has been predicated on discoveries made in the laboratories of her engineers and chemists.

We have occupied a middle ground. We have not developed the research perfection of Germany; neither have we neglected this agency as has England. Our electrical industry, notably, has been brought to its present great strength and its world leadership through research work, while other branches of manufacturing, though on a smaller scale, have been strengthening themselves by making sure of the scientific foundation on which they stand.

The colleges, too, in this respect, are farther ahead than those of England. Notable engineering researches have been carried on, particularly in the experiment stations of some of the institutions of the Middle West, while the scientific laboratories in a great number of schools have produced stimulating discoveries which, even if not directly, have nevertheless indirectly had a commercial bearing.

Furthermore, the government has not stood still. In structural, metallurgical and electrical lines, the Bureau of Standards has rendered signal service. It has made a marked impress upon industrial fields and has assumed an undisputed leadership in many lines of research work.

It must not be thought, however, that we can be satisfied with what has been accomplished. Striking evidence that there is still much to do is afforded by the recent organization of the National Research Council. Engineers, chemists and scientists generally have joined hands in order that the scientific brains of the country may be mobilized and every agency put to the work for which it is best adapted. And the keynote of the council's work is patriotic—the welfare of our whole country. Industrial preparedness is essential if the United States is to make progress in foreign markets. Unless our processes are continually improved, unless all the experience that this country produces is brought to bear on our industrial problems, we shall not be able to compete with European manufacturers backed by thoroughgoing scientific research.

Certainly in a matter so vital to the welfare of the nation, the government itself should not be backward. No matter how great its appropriations for the Bureau of Standards, the industries and the universities will nevertheless redouble their research study. President Butler of Columbia University, for example, has recommended an endowment of $6,000,000 for a great research laboratory.

There will always be broad problems, however, which particular industries and smaller laboratories either have no incentive to handle or are unable to take up because of limited means. These general, these broad problems are essentially the kind that the government should attack. Even within the realm of problems applicable to a limited field, government work is desirable in order that there may be some public check and light on the results that are obtained by private laboratories.

Though the bureau's budget for the year 1917-18, which will shortly be before Congress, are not known, it is safe to say that the requests denied last year will be repeated. Among these was an additional $50,000 for investigations of structural materials, $50,000 for the site of an engineering laboratory, to house the work now being done in War Department buildings at Pittsburgh; and authorizations for a suitable engineering laboratory building and an immense, and much needed, transverse testing machine to take full-size, built-up members. The laboratory building would cost $250,000 and the testing machine an equal sum, though only $25,000 was asked for the current year under each heading as an initial appropriation.

Appropriations for other lines of work, of equal importance in their respective fields, were asked for last year and denied. These, too, we presume, will be again requested.

Industrial research is so important to our national welfare, and the time so propitious—considering the awakening to the importance of research—that engineers and industrial leaders should not fail to impress upon their representatives in Congress the importance of large appropriations for the bureau. Exclusive of building appropriations, the amount allotted for the current year is about $750,000. An increase of this appropriation to a million or a million and a quarter is hardly an unreasonable request, considering the vital character of the work that the bureau should do.

$600,000 Washington Irrigation Project, Financed by Landowners, Completed in a Year

West Okanogan System First to Be Built Under Washington Law—Land Speculation Prevented—Transition from Circular to Rectangular Section Without Loss of Head

By J. C. STEVENS
Hydraulic Engineer, Portland, Oregon

THE WEST OKANOGAN valley irrigation project, probably the only one financed and built during the present war period, was surveyed, designed and constructed in less than one year. It will water 10,000 acres of land in the Okanogan River valley, Washington, extending for 30 miles south of the Canadian boundary line. The main-line construction involved 36 miles of earth ditch, 27 miles of wood and steel flume and 4.4 miles of wooden pipe—a total of 67.4 miles of conduit. The sum the district could afford to spend was determined. The best system for that money was then designed and built.

This project is the first of its kind built under the irrigation district law of the State of Washington. Under the provisions of that statute the landowners organized an irrigation district and voted $600,000 in 20-year 6 per cent bonds to cover the cost of construction. Through the efforts of that great empire builder, James J. Hill, the bonds were duly subscribed for and bids invited on the construction work.

System Completed in a Year

A contract for the construction of the irrigation system was signed between A. Guthrie & Company of St. Paul and the board of directors of the West Okanogan Valley Irrigation District July 7, 1915. Just one year later—July 7, 1916—the completed project was formally accepted by unanimous vote of the directors, and the works were taken over by them for operation and maintenance. The contract price was $511,650.

The project lies in the most favored fruit section of Washington. It is doubtful if there exists a condition of soil and climate more favorable to growing apples and other orchard products. The lands, however, are not being devoted exclusively to the growing of fruit, but also to diversified farming. On the hills bordering the valley are extensive cattle ranges, and the raising of alfalfa and other forage crops will be combined with fruit culture.

The water supply is taken from the Similkameen River, 11 miles above the town of Oroville. As the minimum summer flow of this river is three times the maximum diversion for irrigation, an abundant supply of water is assured. The main canal, consisting of 5 miles of earth ditch and 6 miles of wooden flume, has a capacity at the head of 150 sec.-ft. At Oroville the water is divided three ways. The main portion—104 sec.-ft.—crosses the Similkameen River in a 46-in. wood-stave pipe 2913 ft. long and continues southward on the west side of the Okanogan valley. Twenty-seven second-feet are carried across the Okanogan River just above Oroville in a 30-in. wood-stave pipe 7635 ft. long to the east side of the valley. There it divides north and south. The third portion—9 sec.-ft.—continues north on the west side to the Canadian boundary line. Ten miles below Oroville a wood-stave pipe 34 in. in diameter and 4588 ft. long carries 45 sec.-ft. from the west to the east side of the valley, where it divides north and south.

The map gives the layout and general features of the project. The general character of the Similkameen River cañon and surrounding country is shown in one of the pictures.

Work was practically suspended during the winter. No grading could be done on account of frost, and an unusual snow made work on the flumes very trying. Wooden pipe was, however, laid whenever possible throughout the winter season. The curve shows the progress during each month for the year.

Conduits Tested Before Acceptance

The contractor was obliged to test out all conduits to 60 per cent of their maximum carrying capacity before acceptance by the district. This rigorous requirement for new canals and flumes was met without serious mishap. Water was turned into the main canal at the head early in March, and gradually increased day by day until the 60 per cent was being carried as far as the first spillway. During that period a crew of men patroled the line. Stretches of earth ditch that showed excess seepage were puddled; leaks in flumes were stopped by throwing in a small amount of soil or, where necessary, by calking with oakum. As soon as the next stretch of canal was ready, water was let into it gradually until the required amount was being carried. In this manner all portions of the systems were primed as near to the required amount as was possible with the available spillway facilities.

THE SIMILKAMEEN SIPHON, WINDING OVER THE COUNTRY, MIGHT BE LIKENED TO A MAMMOTH SNAKE

The official tests and measurements were made July 1 and 2 by the board of directors of the district, the engineer in charge, the superintendent for the contractor and the irrigation manager. At this time it was found that all lines were carrying from 60 to 90 per cent of their respective capacities. During the tests there were no breaks, no settlement and no damage or signs of weakness in any of the lines or structures.

No Leaks After Priming

Minor breaks in the earth ditches at critical points during the period of priming were repaired quickly. Flumes showed a tendency to settle, particularly on steep earth or clay slopes. In such cases the leakage that inevitably occurs between the time water is turned in and until the boards have had time to swell tight will often cause settlement. At such points the joints were generally calked with oakum in advance to minimize the danger as much as possible.

After the "priming" was completed the flumes and pipes became remarkably tight. For thousands of feet along some of the flumes not a drop of escaping water could be seen. It seems almost incredible that flumes made of so many pieces of rough lumber could be made to hold water so effectively.

Portions of the earth canals were excavated in very gravelly and sandy soils. Excessive seepage occurred at some of these sections when water was first turned in—enough in some instances to cause sloughing of hillsides and seriously to menace cultivated lands below the canals. At these places patient work of puddling was always rewarded by a gradual reduction in losses, until all visible seepage was finally stopped.

Land Speculation Prevented

All lands under the system are in private ownership except 1400 acres allotted to Indians. Holdings vary from 20 to 320 acres. Before contracts for construction were signed about one-third of the lands for sale in the district were listed under contract to sell for stipulated prices. This was done to forestall land speculation and to insure land being sold at reasonable prices to those who would actually reside on and cultivate it. About 4000 acres are now under irrigation. Sales have been moderate, but there has been little or no land speculation—a condition indicative of steady, healthy growth which promises ultimate success.

During the last session of Congress sufficient money was appropriated to enable the U. S. Indian Service to purchase water rights for all Indian allotments under the system. When the negotiations are completed bonds to an amount corresponding to

the value of these water rights will be retired.

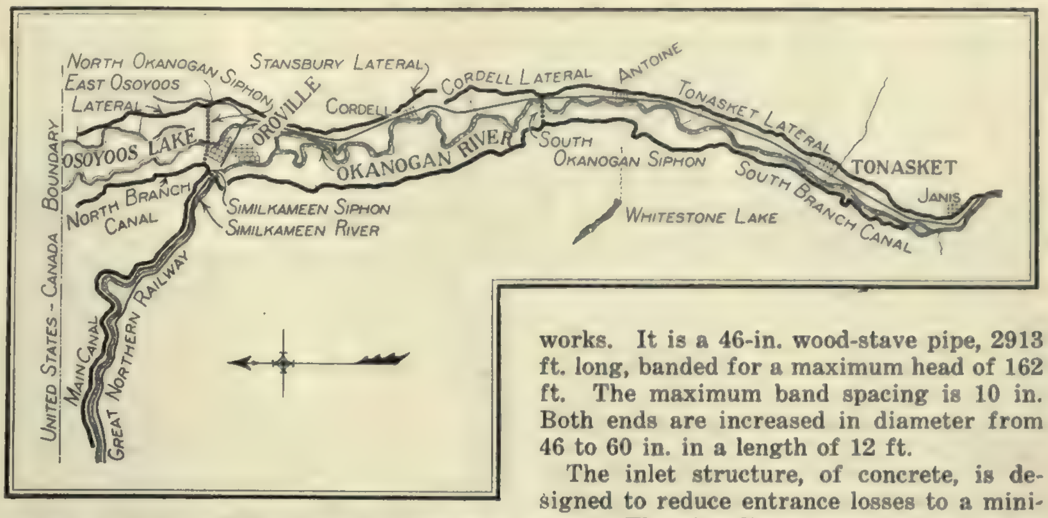
If a strictly permanent type of construction had been a prerequisite of the West Okanogan irrigation project the system could not have been constructed. It was therefore necessary to build the best possible system with the funds available. Wooden flumes having an estimated life of 10 years were adopted and provision was made for a replacement fund to rebuild them during the life of the bonds. On steep hillsides, where the line went through treacherous clay, and where even slight leakage would be destructive, steel flumes were used. The life of the wooden pipe was estimated at twenty years—the same as that of the bonds. Where inlets or outlets of important pipe lines were in earth ditch, concrete structures were built and special preservative measures adopted for the pipes themselves.

INTAKE OF MAIN CANAL

The intake of the main canal is of concrete, with steel gates, and is so arranged that accumulation of débris is prevented. In all structures the hydraulic functions were designed to minimize losses of head and to insure their operation with the least possible outlay for maintenance. That this has been done is evidenced by the fact that the first season's operation has been accomplished with practically no interruption in the flow of water to the irrigators. The single exception is a few days in July, when a minor break in the main canal was caused by an unprecedented cloudburst. No unusual expenses have been incurred and all lands have had an abundant supply of water.

The headworks, the plan of which is shown, diverts the water without raising the level of that in the river or obstructing its flow. The river at that point is about 300 ft. wide with an average depth, at low water, of 2½ ft. The gates are formed of 18-in. channels to close the 14-in. openings under the curtain walls. They have skeleton extensions of light angles to prevent binding in the guides. The gate sills are at the level of the river bed at the shore, and at low water the maximum required for the canal is secured even if the depth of flow over the sills is not more than 0.7 ft.

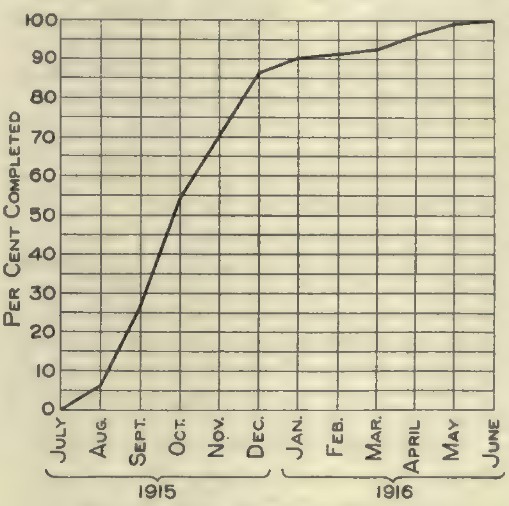
The gate structure is placed practically in line with the shore. The ends of the piers are faced with H-bars to form guides for flashboards. Steel rails were bolted on the front face of these H-bars, parallel with the river, to deflect driftwood. Except at extreme low water, it is expected that one or two 8-in. flashboards will be left on the bottom of the guides to prevent gravel from



GENERAL MAP OF WEST OKANOGAN IRRIGATION SYSTEM

being carried over the gate sills and into the canal.

A sluiceway on the downstream end of the gate structure can be closed by flashboards to raise the level a few inches at extreme low water if necessary. When the sluiceway is open, it, with the diversion



CURVE SHOWS PROGRESS OF WORK

dike, produces a scouring action in front of the gates which prevents accumulation of sand and gravel.

The diversion dike is very low and extends diagonally upstream about one-third the width of the river. As it is made of loose boulders, water flows over and through it at all stages of the river. The dike deflects the flow toward the gates.

SIMILKAMEEN SIPHON

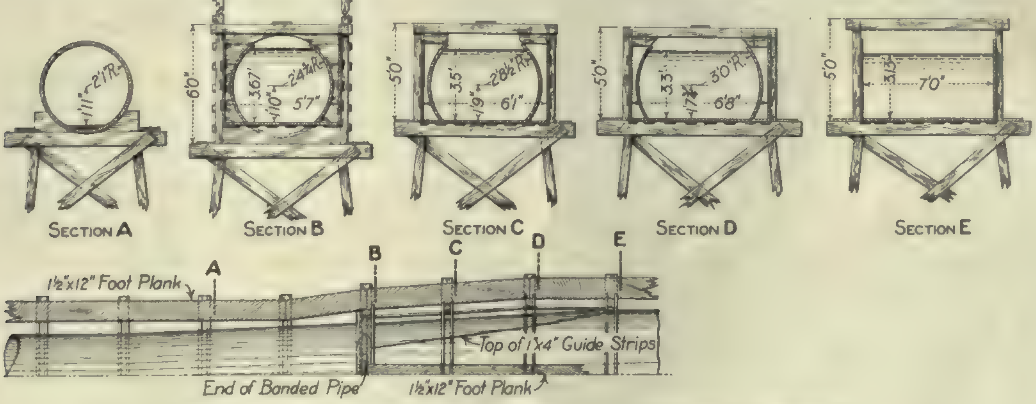
The Similkameen siphon carries a maximum of 104 sec.-ft. across Similkameen River at a point 11 miles below the headworks. It is a 46-in. wood-stave pipe, 2913 ft. long, banded for a maximum head of 162 ft. The maximum band spacing is 10 in. Both ends are increased in diameter from 46 to 60 in. in a length of 12 ft.

The inlet structure, of concrete, is designed to reduce entrance losses to a minimum. The pipe diverts practically at right angles to the main canal on a steep hillside. A curved diversion wing extending upstream into the main canal is intended to divide the water in two portions, 104 sec.-ft. going into the pipe and 36 sec.-ft. continuing in the north-branch ditch. Complete control of either line is secured by one set of flashboards in the concrete structure. For less than maximum flows, flashboards are inserted until the desired depth is secured in the north branch, the water to the pipe spilling over the top of the flashboards. This method of control was not costly. It also has been found to be very elastic.

SECTION CHANGES FROM ROUND TO SQUARE

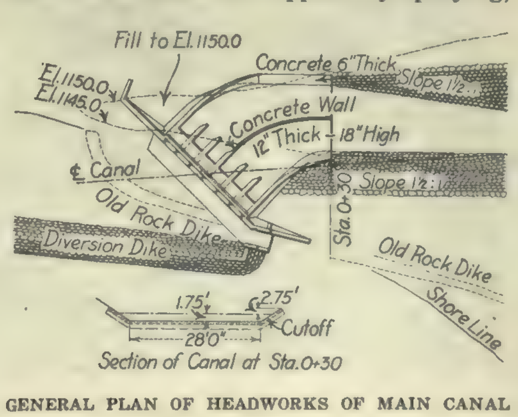
In passing from the main canal to the pipe the velocity of the water is increased from 2.24 to 9.10 ft. per second. This increase is effected in a length of 42 ft. with gradually decreasing areas and gradual transition of form. As the pipe connects with a wooden flume the outlet structure is built of wood. In that structure the velocity undergoes a reduction from 9.10 to 2.30 ft. per second, which would have meant a loss of 1.2 ft. if proper means had not been adopted. The areas were gradually increased and conversion from round to square section was effected as shown in one of the drawings. It is expected that nearly all of the velocity head will be recovered by this manner of transition.

At both ends of the pipe, where the static head is less than 20 ft., the fir staves were given a shop treatment of immersion for 10 minutes in a bath of hot "firoleum," a product of the distillation of fir wood which resembles creosote but is somewhat cheaper. After construction the inside of the bell ends was given two coats of hot creosote. The whole pipe was then painted with one coat of water gas tar and one application of coal gas tar. Those parts that were buried in the ground received an additional coat of coal-gas tar. The preservatives were heated and applied by spraying,

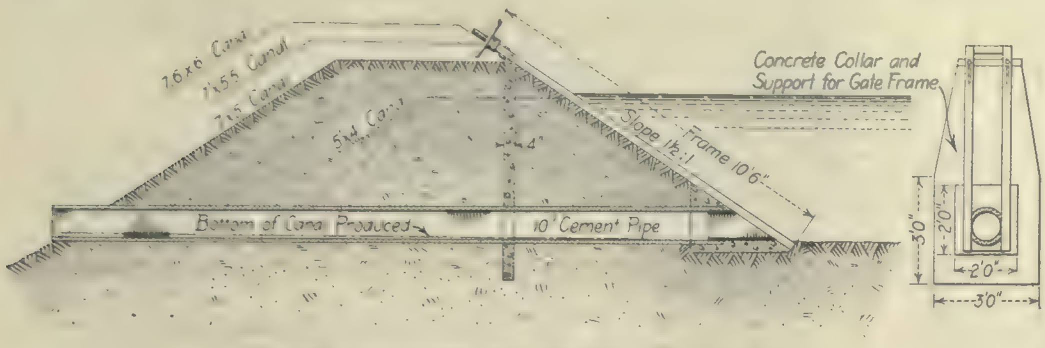


STEPS IN TRANSITION FROM CIRCULAR TO RECTANGULAR SECTION

Between sections B and E standard flume construction was used, with 1 x 4-in. guide strips nailed to radial collars at bents



GENERAL PLAN OF HEADWORKS OF MAIN CANAL



LATERAL HEADGATES FOR DIFFERENT SIZE CANALS

using compressed air from a portable gas-engine outfit.

The pipe was laid above ground wherever possible, but in crossing cultivated lands it was sometimes necessary to bury it. A wooden bridge composed of two 120-ft. Howe truss spans, with pile-bent approaches, carries the line over the Similkameen River.

North Okanogan Siphon

The North Okanogan siphon crosses the Okanogan River just above Oroville and carries 27 sec.-ft. to the east side of the valley. The pipe is 30 in. in diameter. To the Y, where it branches north and south to supply laterals, is 7635 ft. The north branch is made up of 438 ft. of 18-in. and 376 ft. of 20-in. machine-banded pipe. The south branch is an 18-in. pipe 552 ft. long. The intake to the 30-in. pipe and the outlets of both branches are of concrete. The same plan of applying preservatives and paints was used on this as on the Similkameen siphon.

From each branch there is a compound pipe of 10 and 12-in. sizes with a gate valve, leading to a common concrete surge box. Each of these waste pipes is so designed that when the valve is open for maximum flow the friction and velocity heads in it are equal to the static and friction heads in the main pipe beyond the point where the waste pipe joins. In the extreme end of each branch pipe a simple butterfly gate was installed. This was made of 1¼-in. lumber mounted on a 1-in. iron shaft. and so designed that the gate may be held in any position. By manipulation of this butterfly gate with the gate valves in the waste pipes complete regulation is secured.

South Okanogan Siphon

This pipe line crosses the Okanogan River at a point 10 miles below Oroville. It carries 45.6 sec.-ft. from the west to the east side of the valley. There 36.2 sec.-ft. flows southward into the Tonasket lateral and 9.4 sec.-ft. flows north into the Cordell lateral. The pipe is 34 in. in diameter and 4588 ft. long. Both ends are belled to a 40-in. diameter in a length of 12 ft. The inlet structure is of wood and designed to reduce entrance losses to a minimum. At the outlet no special attempt was made to recover velocity head. The pipe ends in a concrete well which discharges into a large wooden box with weirs and flashboards for controlling the division of the water to the two branches.

The Tonasket siphon carries 16 sec.-ft. through Tonasket and across Bonaparte Creek. It is 3718 ft. long, made of continuous wood staves and is 26 in. in diameter. Through the town the pipe is buried in the streets and alleys. On account of the low heads the buried portions were given three coats of coal-gas tar instead of two as was the case with the other pipes.

The Siwash siphon, 593 ft. of 26-in. continuous wood-stave pipe; the Whitestone siphon, 641 ft. of 28-in. pipe; the Ninemile and Cache Creek siphons, of 488 and 498 ft. respectively of 18-in. machine banded pipe, and the Peterson Creek siphon, 275 ft. of 16-in. machine-banded pipe, were built in addition to those before mentioned.

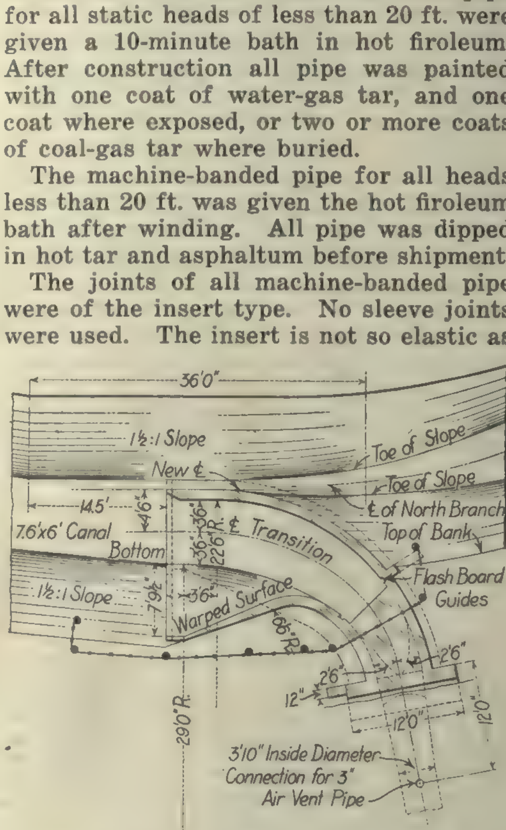
MAIN LINE FLUME ON HILLSIDE UNDER CONSTRUCTION

Preservative Treatment

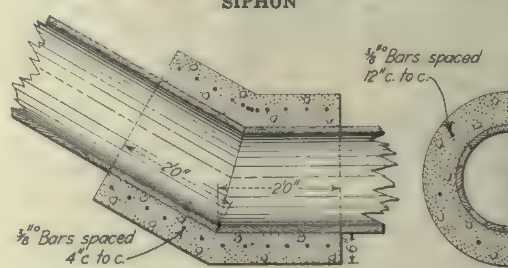
The staves of all continuous stave pipe for all static heads of less than 20 ft. were given a 10-minute bath in hot firoleum. After construction all pipe was painted with one coat of water-gas tar, and one coat where exposed, or two or more coats of coal-gas tar where buried.

The machine-banded pipe for all heads less than 20 ft. was given the hot firoleum bath after winding. All pipe was dipped in hot tar and asphaltum before shipment.

The joints of all machine-banded pipe were of the insert type. No sleeve joints were used. The insert is not so elastic as the sleeve joint, since with the former a deflection of ½ in. at each joint is about the limit. Sharp curves were made by the use of reinforced-concrete elbows, as shown. The portion of the pipe embedded in the concrete was thoroughly cleaned of all tar by first scraping and then scrubbing with caustic soda. The results were very satisfactory and no leaks have been detected in any of them.



PLAN OF UPPER TRANSITION SIMILKAMEEN SIPHON



CONCRETE ELBOW FOR WOOD PIPE

Distribution System

The distributing laterals were designed to deliver water for irrigation under the rotation plan. As the lands are somewhat rolling, a minimum of 2 sec.-ft. was allowed in all distributing ditches, flumes and pipe lines.

All laterals and deliveries were designed with trapezoidal weirs in earth sections and suppressed weirs in flumes. The system was constructed to carry water to each 40-acre tract or fractional lot. Water is delivered to the high point in each tract or, where impracticable, to the margin of the tract, at sufficient elevation to reach the high point.

Headings from the larger canals are of steel and concrete. The steel headgates were especially constructed for a 34-deg. slope by the Columbia Engineering Works of Portland. The top is supported on an extension of the cutoff wall, which makes a simple and effective installation.

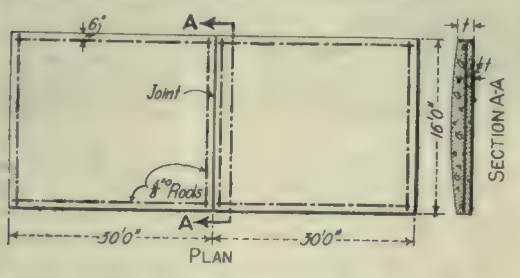
The cement pipe used on the distribution system was made on the shore of Lake Osooyos and hauled to place. Plain pipe with male and female joints was used. In laying the pipe in the trench the male end was touched up with mortar before joining, and a wrap of mortar was made by rolling in a piece of cheesecloth long enough to reach around the pipe. By wrapping this roll of mortar around the outside of the joint and patting it with the hand a practically watertight joint was secured.

The affairs of the district are administered by a board of three directors elected from among the landowners. H. K. Bowen of Tonasket is president. Erwin Truax and George I. Cole of Oroville constitute the board of directors; E. Riste of Oroville is secretary, and J. Criswell, irrigation manager.

During construction, D. C. Henny of Portland was consulting engineer, R. F. Hoffmark was superintendent for A. Guthrie & Company, the contractors, and the writer was engineer in charge. All wood pipe was furnished by the Portland Wood Pipe Company of Portland.

Simple Reinforcement Suggested to Stop Concrete-Road Cracks

A CAREFUL study recently made by engineers of the U. S. Office of Public Roads and Rural Engineering of the cracks which have developed in the Ohio Post Road, which is 24 miles in length and surfaced with plain Portland cement concrete, indicates that the cracks are gradually becoming wider, not only because of the spalling of the edges, but also because of separation between the different parts of the cracked slabs. The separation is generally more noticeable near the joints or at the outside edges of the slabs, depending on whether the cracks are longitudinal or



HOW SINGLE-ROD REINFORCEMENT SHOULD BE PLACED IN CONCRETE SLAB

transverse, and it has also been observed that fresh cracks usually begin at the edges of the slabs or at the joints.

These facts have suggested to Messrs. Moorefield and Voshell, senior highway engineers, that the formation and widening of cracks may be prevented in great measure by employing a simple method of reinforcing. The method of reinforcing which they propose would consist in placing a single rod in the concrete about 6 in. from each of the four edges of the slabs, as shown by the sketch. It is estimated that for a 16-ft. pavement with joints spaced 30 ft. apart, ⅝-in. round rods, spaced as indicated, would probably provide a reasonable safeguard against the formation and widening of cracks.

If this method of reinforcing should prove efficient, the amount of steel required would be very much less than is necessary with any other method which has so far been tried.

Periods of Filter Service Increased 250 Per Cent

Modified Methods of Operation Effect Marked Economies at Cincinnati Water-Purification Plant, According to J. W. Ellms and S. J. Hauser

INCREASES as high as 250 per cent in the periods of service of the mechanical filters of the Cincinnati water-purification plant have been realized by a modified method of operation, involving merely the closing of the effluent valve and the admission of a small amount of wash water—without wasting any water to the sewer. These measures proved particularly effective when the normal periods of service of the filter units were shortened by quantities of micro-organisms which clogged the sand beds, resulting in a high loss of head and the introduction of entrained air into the filtering medium. How these striking economies in filter operation were accomplished was explained at the annual convention of the American Chemical Society (sanitary engineering section) in a paper by Joseph W. Ellms, superintendent of filtration, and Stephen J. Hauser, chemist, of the Cincinnati Waterworks. The paper, in condensed form, is given below.

Micro-Organisms Clog Filters

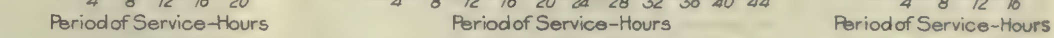
With rapid sand filters the usual method of relieving clogging due to micro-organisms is to wash the filter. This may mean under the worst conditions an increase in the amount of wash water from 8 to 10 times the quantity normally used. A reduction in the output of a plant from 10 to 15 per cent, on account of the added volume of wash water needed and the increased power and labor required to keep the plant in operation, imposes a burden on the plant that few operators fully realize unless they have passed through the experience.

The troubles produced by micro-organisms in the operation of the rapid sand filter plant at Cincinnati have been entirely those caused by shortened periods of service.

The character of the organic matter during the summer and fall months is such that it forms a rather heavy colloidal coating on the sand grains that is particularly effective as a filtering medium. In consequence it becomes possible to operate filters to a comparatively high loss of head and still produce an effluent of high quality. From 10 to 11 ft. loss of head can usually be obtained, while a rate of filtration equivalent to about 125,000,000 gal. per acre per day is maintained. The period of service at this rate may range from 3 to 70 hours.

When filters are operated to a high loss of head air is usually liberated from the water and becomes entrained in the sand bed. The escape of some of this air takes place, of course, when the effluent valve of the filter is closed, and filtration ceases. More air escapes upon the application of wash water. It was noted in the operation of the Cincinnati filters that by merely closing the effluent valve, with the consequent escape of some entrained air, and then reopening this valve, the loss of head decreased, and a further period of service could be obtained. Accordingly, systematic experiments were commenced during a period of shortened filter runs to determine what influence disturbance of the sand surface by various methods had on the period of service of the filter and on the quality of the filtered water.

Diagram 1 shows the effect of closing the effluent valve for 10 minutes at a loss



RESULTS OF THREE EXPERIMENTS BASED ON MANIPULATION OF VALVES

1—Effect of closing effluent valve for 10 minutes, thereby liberating entrained air. 2—Service period lengthened by closing effluent valve and opening wash-water valve during high loss of head. 3—Effect of closing effluent valve and opening wash-water valve during low loss of head.

ACTUAL RESULTS OF USUAL AND MODIFIED METHODS OF OPERATION OF THE CINCINNATI FILTERS WHEN APPLIED WATER WAS INFESTED WITH MICRO-ORGANISMS

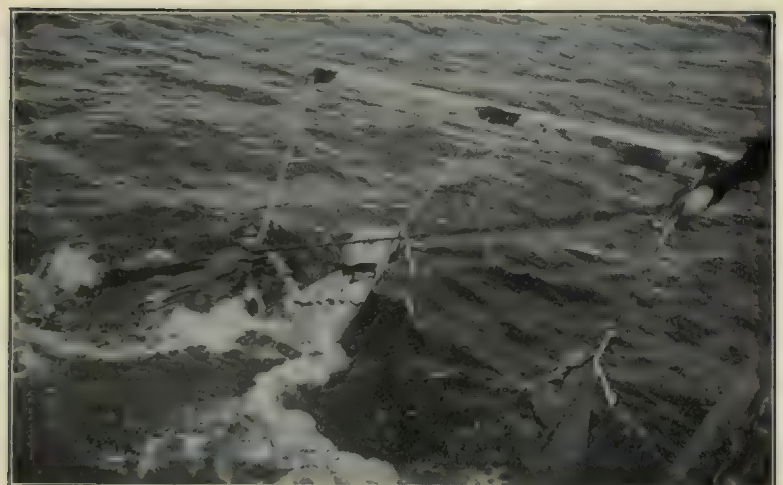
Date	Period of service, hours: Normal	Period of service, hours: Including extended periods	Bacteria per c. c. filtered water: Effluent from filters	Bacteria per c. c. filtered water: Outlet filtered-water reservoir	Total water filtered, gal.	Wash water used, gal.	Wash water saved, gal.
Aug. 27	23.21	....	7	16	48,403,000	744,000	....
Aug. 28	22.66	....	11	27	62,653,000	1,023,000	....
Aug. 29	18.52	....	14	37	60,513,000	1,176,000	....
Aug. 30	12.16	....	12	38	55,987,000	1,658,000	....
Aug. 31	9.61	....	12	26	63,042,000	2,364,000	....
Sept. 1	7.33	....	12	34	59,612,000	2,928,000	....
Sept. 2	5.81	....	9	36	60,875,000	3,768,000	....
Sept. 3	*4.42	17.69	6	32	49,000,000	996,000	2,994,000
Sept. 4	*3.31	13.25	10	33	54,653,000	1,482,000	4,464,000
Sept. 5	*2.80	11.19	9	44	59,805,000	1,924,000	5,762,000
Sept. 6†	*2.25	8.98	9	‡23	70,083,000	2,808,000	8,406,000
Sept. 7	*2.59	10.36	160	‡12	52,292,000	1,812,000	5,454,000
Sept. 8	*2.50	10.00	470	‡20	69,583,000	2,505,000	7,515,000
Sept. 9	*2.93	11.72	460	‡13	59,945,000	1,842,000	5,520,000
Sept. 10	*3.42	13.67	430	‡10	47,138,000	1,242,000	3,720,000
Sept. 11	*3.94	15.76	260	‡6	59,472,000	1,362,000	4,074,000
Sept 12	*3.60	14.38	130	‡12	67,458,000	1,688,000	5,056,000
Sept. 13	*3.74	14.97	85	‡23	59,972,000	1,440,000	4,332,000
Sept. 14	*4.12	16.49	85	‡9	60,055,000	1,308,000	3,940,000
Sept. 15	*4.04	16.17	80	‡32	59,722,000	1,326,000	3,996,000
Sept. 16	*4.23	16.93	55	60	52,222,000	1,104,000	3,540,000

*Estimated hours of service for the first period.
†0.48 p.p.m. of copper sulphate applied to the settled water and 1.2 p.p.m. to the applied water.
‡0.15 p.p.m. of chlorine applied to the filtered water from Sept. 6 to Sept. 15.
Average volume of wash water used per wash, 60,000 gal.

of head of 10 ft. or over, and the consequent escape of some of the entrained air. On an average it will be seen that at each closing of the effluent valve an increase of about 10 per cent of the normal period of service was produced. In other words, without any washing or agitation of the filter bed, other than that produced by the escape of entrained air, the filter run was lengthened about 30 per cent. The bacterial efficiency of the filter was not affected.

DIAGRAM 2

Diagram 2 shows the result of opening the wash-water valve for 1 minute (rate of application being 5000 gal. per minute) and of forcing filtered water up through the sand bed after the effluent valve had been closed. Two effects are here combined—the disturbance of the sand bed produced by the escape of all of the entrained air and by the movement of a small quantity of filtered water up through the sand bed.



HOOKING IN AN EMPTY BAG, AT SAME TIME LOOSENING UP THE ROPE

This method, entailing no loss of water, increased the period of service over 250 per cent, as compared with 30 per cent by merely closing the effluent valve as shown in diagram 1. The bacterial count is not affected by this method of agitating the bed.

In order to eliminate the effect on the sand bed of the escape of entrained air an experiment was made in which the effluent valve was closed when the loss of head was sufficiently low to prevent the liberation of air from the water. The results given in diagram 3 illustrate the effect of closing the effluent valve without liberation of air, followed by the effect of water agitation. The water was applied in the same way as in the previous experiments. The mere closing of the effluent valve has some slight effect in reducing the loss of head. The marked effect, however, is that produced by the opening of the wash-water valve, and shows that there can be effected an increase of practically 100 per cent in the length of the period of service for the same loss of head.

PRACTICAL BENEFITS

In order to show the practical benefit to be derived from this modified method of operating filters infested with micro-organisms the combined data of the operation results of the Cincinnati filters between Aug. 27, 1916, and Sept. 16, 1916, both inclusive, are given in the table. From Aug. 27 to Sept. 3 a progressive reduction in the period of service of the filters may be seen. On the latter date the modified method of operating was commenced. This method consisted of closing the effluent valve when the loss of head reached about 10 ft. and opening the wash-water valve so that filtered water passed upward through the sand bed for about 1 minute and at a rate of about 5000 gal. per minute. No water was wasted to the sewer. Ten minutes after the effluent valve was closed it was reopened, the opening of the wash-water valve having taken place during this period. The loss of head usually fell back to less than 2 ft., and the period of service was increased thereby nearly 100 per cent. This operation was repeated twice thereafter, or three times in all.

Up to Sept. 6 it will be seen that the bacteria in the filtered water remained low and that the number was fairly uniform. In order to learn the effect on the filters of applying copper sulphate to the settled and applied water 0.48 p.p.m. was introduced into the settled water and 1.2 p.p.m. into the applied water on Sept. 6. The amounts used were known to be insufficient to effect complete removal of the diatoms; and since the Ohio River was the source of the supply of organisms only temporary reduction in the number in the settled water could be hoped for. Some reduction was produced.

The anticipated result following the application of copper sulphate to the settled and applied water, namely, a tremendous increase in the bacterial content of the water, took place on Sept. 7. To counteract this increased bacterial load on the filters, chlorine was applied to the filtered water, beginning Sept. 6, and was discontinued on Sept. 15. The bacterial content of the chlorinated filtered water was uniformly low.

WASH WATER SAVED

Referring again to the table, the practical value of the modified method of operating filters is clearly proved by the great saving effected in the wash water used. During the period between Sept. 3 and Sept. 16 the volume of wash water estimated to have been saved amounted to 68,773,000 gal. The actual percentage of wash water used was 2.78. The percentage of wash water that would have been required if this modified method of operation had not been used is 11.16.

BOAT WITH OUTRIGGER CARRIES 1500 POUNDS OF COPPER SULPHATE

Outriggers and Pulleys Facilitate Copper-Sulphate Treatment

MOST of the hot weather in Denver passed before it was necessary to treat the water supply at Marston Lake with copper sulphate for algæ. The rise of anabæna to 500 standard units occurred late in August at the same time as synedra increased to 1500. One part of copper sulphate in 8,000,000 exterminated the offenders. Anabæna died at once, but the synedra required about a week, and after two weeks started to grow again, though not in sufficient numbers to cause trouble. Stephanodiscus started to multiply Oct. 1, reaching 4000 standard units, and then decreased rapidly, giving no trouble. Just previous to that time cheesecloth was placed on the revolving screens at the north outlet (see Engineering Record of Sept. 4, 1915, page 291). It caught all the crustaceans and nearly all the other organisms.

A new way of securing the bags to the outrigger on the launch, although merely a detail, eliminated past difficulties and expedited the work. Small sash pulleys for 3/8-in. sash cord were placed on the 3 x 6-in. by 20 ft. outrigger in recesses 2½ ft. apart, beveled so that the rope did not bind or rub. Six sacks with 50 lb. of the chemical were put out at a time. The salt dissolves in 20 to 30 minutes, so that changes have to be made often. The ends of the rope are secured to metal cleats on the outrigger just inside the boat. When a bag needs filling, one man with an iron hook pulls it into the boat, loosening the rope at the same time. With this outfit 4500 lb. was distributed over this 6,000,000,000-gal. 600-acre lake under the general direction of D. G. Thomas, chief engineer of the Denver Union Water Company.

Highway Department Gives Equipment Depreciations

Upon completion of road-construction projects in Arizona depreciation per year on equipment used by the State Highway Department, according to the latest report, is as follows: Engines, gas and steam, 20 per cent; fresnos, 100 per cent; graders, 20 per cent; mixers, concrete, 20 per cent; mules, 10 per cent; pile drivers, 20 per cent; plows, 20 per cent; rock crushers, 20 per cent; steam shovels, 10 per cent; tents, 75 per cent; wagons and harness, 20 per cent; wheelbarrows and concrete carts, 50 per cent; trucks on daily rate on basis of life of three years, and all small equipment, such as picks, axes, shovels, etc., on the value at time of transfer to new project.

Driving of Tunnel Beneath English Channel Awaits British Parliament's Consent

French and English Companies, in Existence More Than Forty Years, Ready to Resume Work on Twin-Tube Rock Tunnel Discontinued in 1882

BRITISH DISTRUST of any physical connection with the continent, the obstacle that has barred since 1882 the construction of a double-track railway tunnel linking London with Paris under the English Channel, seems to have been overcome by the object lessons of the war. So far from rendering the British Isles more difficult to defend, French engineers have pointed out that such a connection might be England's only salvation were her control of the seas lost and her coast effectively blockaded. The construction of such a tunnel, suggested at the beginning of the nineteenth century and brought to the very point of actual accomplishment after the close of the Franco-Prussian War, would probably, because of favoring geological conditions, be attended with less difficulty and danger than the work of completing the far shorter Astoria gas tunnel under the East River in New York City. The proposed tubes would be excavated wholly in a thick bed of argillaceous chalk, highly impervious, soft enough to be readily excavated with tunneling machines and strong enough to stand up safely under a pressure of 210 to 280 lb. per square inch. The lowest points in the tunnel, near mid-channel, would be tapped by drainage galleries, which would be used, with the help of cross-drifts, to start work on the main tubes simultaneously at a number of points. Preliminary tunnels have been driven more than a mile beyond the shore line on either side in this stratum. They are still pumped out and carefully maintained, and experience with them is held to have demonstrated the practicability of the plan. Electric traction would be used to operate the 37 miles of double-track line, and both British and French estimates indicate that commercially the venture should prove exceedingly profitable. The entire project, including the present plans, which Mr. Asquith, the British Premier, has stated would be taken up by the Cabinet at an early date, is reviewed by A. Dumas, in *Le Génie Civil* of Oct. 21 last, from which article the facts here presented have been taken.

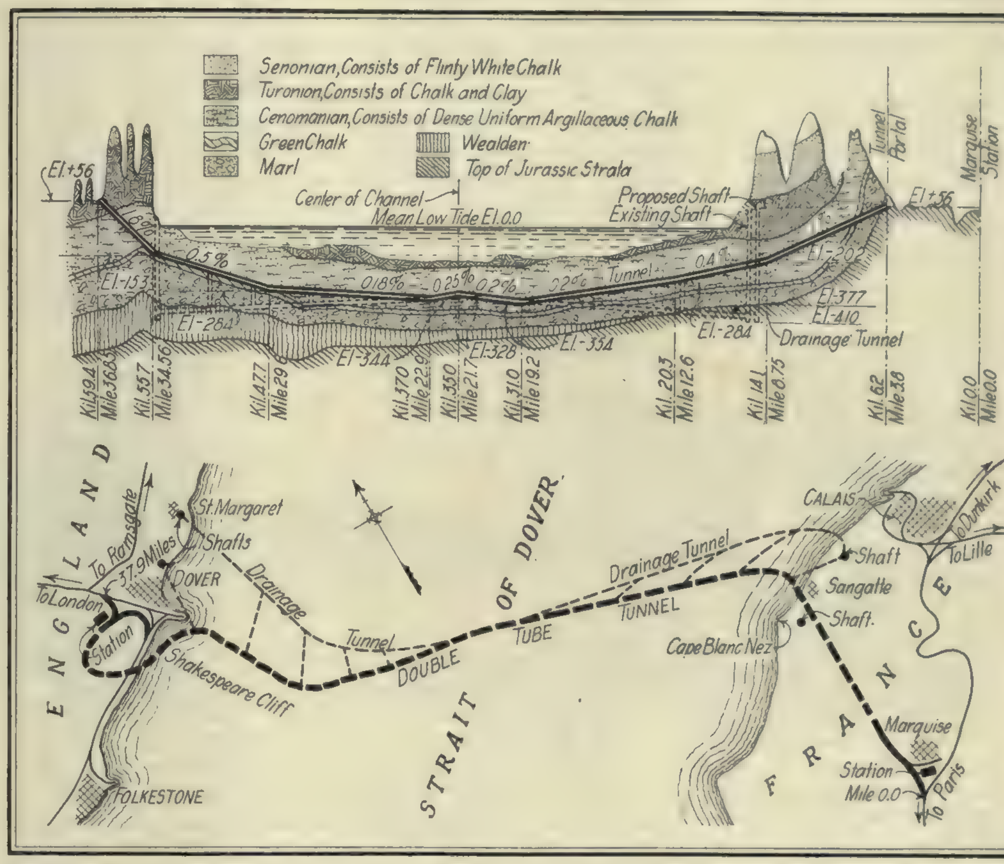
Scheme Long Delayed by British Opposition

The scheme for establishing a physical connection between England and France across the Straits of Dover is an old one, a French engineer having suggested it to Napoleon as early as 1802. Serious proposals for a feasible project, however, began with the French engineer, Thomé de Gamond. Passing over Gamond's early proposals, which date back to 1834 and include a sheet-iron tube sunk on the bottom, an $80,000,000 bridge, two 5-mile riprap jetties between the ends of which a ferryboat would operate, a riprap causeway with three drawbridges, and his first tunnel scheme proposed in 1856, the first plan which formed the basis of definite action was proposed by him in 1866. This plan resembles the present one, except that it included a construction shaft and permanent station on an island to be made at the site of the Varne shoal in mid-channel. An Anglo-French committee of six was constituted in 1869 to carry out this plan, and although most of its original members are dead the committee is still in existence with full authority. After the war of 1870 the plans were modified by omitting the island station, which was considered too vulnerable to an enemy fleet.

Boring machines tried out at that time were expected to complete this tunnel in four or five years at a cost of $40,000,000, and the net annual revenue from freight and passenger traffic was expected to reach $10,000. It was the intention to operate trains with compressed-air locomotives, and Gamond had worked out a scheme for compressing the air required by using the rise and fall of the tides. A French company was created by an act of Aug. 2, 1875, with a ninety-nine-year franchise to construct the French half of the tunnel and co-operate with a similar British company in carrying out the plans to be finally adopted by the commission above referred to. This company raised and spent more than $400,000 on shafts, soundings and borings. It constructed a trial tunnel 7 ft. in diameter, 6033 ft. long from the French shore. Its construction plant and underground workings have been maintained in good condition and the company is ready to go ahead with the completion of the project.

The British meanwhile had organized in 1872 the Channel Tunnel Company, which was merged by an act of July 16, 1874, into the Southeastern Railway Company. This company co-operated with the French company and spent $200,000 on exploration. It was succeeded within a short time by the Submarine Railway Company, which excavated two headings from the English shore, one 2641 ft. and the other 6075 ft. long. The shafts from which these tunnels were driven were sunk in the Shakespeare Cliff near Dover. This company was later merged into the Channel Tunnel Company, Ltd., which has maintained the early construction work and plant. Its tunnels have been pumped for a long period, and have shown a remarkably small quantity of seepage.

In 1875 Gamond died, believing that his project was to be put into immediate execution. However, popular outcry, led by London newspapers, definitely put a stop to continuation of the work in 1882. The conservative party succeeded in defeating motions made to resume construction in 1883, 1887 and 1906. It is interesting to note that at the last-mentioned date the French proposed, as a concession to England, to build a long section of the tunnel approach as an elevated railroad along the French coast, so that the British fleet could readily destroy it on occasion. As Dumas points out, this plan at present would scarcely appeal to the British mind. Were such a line in operation to-day, raids by enemy destroyers, submarines or sea planes would perhaps be able to keep it out of commission a good part of the time.



PLAN AND PROFILE LOCATED TO KEEP LINE WITHIN SINGLE THICK IMPERVIOUS STRATUM

Cenomanian stratum dips to northeast, so that drainage tunnels also come within it, though apparently below it on profile.

In spite of the opposition across the channel the project has never been lost sight of in France, and the plans have been revised and kept up to date until the present project, in many of its essential details, is practically a new one. Albert Sartiaux, chief engineer of the Compagnie du Chemin de Fer du Nord, and for some time a director of the French construction company, the Société Française du Chemin de Fer Sous-Marin, has been in charge of the engineering work and is responsible for the present plans.

Geological surveys of the channel, confirmed by the explorations already made,

indicate that the proposed tunnel will meet nothing resembling the tilted and faulted strata which caused such great difficulty in the construction of the Simplon tunnel and which resulted in the temporary loss of an entire heading while the Astoria gas tunnel under the East River in New York City was being built. The theory commonly accepted among geologists is that an isthmus connected France and England during the Miocene period and that subsequent settlement has caused the formation of a shallow strait. The indications are that this settlement was very gradual, and was not attended by any faulting or folding. The strata found on both sides of the channel correspond very closely in thickness, position and material. At the top is the well-known white chalk in which flint occurs, underlain by a stratum of chalk and clay. Beneath this in turn is a bed 200 ft. thick of compact argillaceous chalk which is very uniform and dense. It is extensively quarried for the manufacture of cement, and corresponds to the gray chalk found at Rouen in France. This material, while it does not require timbering, is rather easy to excavate and is nearly watertight. Soundings indicate that it maintains a uniform thickness for the entire distance under the channel, and lies approximately between the elevations indicated on the profile. The latest plans contemplate a thorough exploration of this bed from the drainage drifts, which will be constructed first, and a vertical alignment of the tunnel which will not require leaving this stratum except at the ends. The outcrop of this bed on both shores has determined the location of the line and of the junction stations shown on the plan.

Twin Tunnels to Be Built

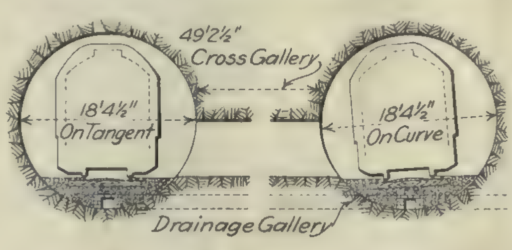
The present plans call for the construction of twin single-track tunnels 18 ft. 4½ in. in diameter and 67 ft. 7 in. center to center. The total length of the line from the junction with the Paris-Calais road to that with the railroad from London to Dover will be a little more than 37 miles of double track, about 32 miles of which will be in tunnel. The location on the French side, which is more definitely settled than that on the British, contemplates a maximum grade of 1 per cent, while a grade of 1.8 per cent is shown on the present plans at the British end. A short hump about 4 miles in length is planned at the middle of the channel, from each end of which water will be taken through drainage tunnels to pumping stations at shafts sunk on shore on either side. The two drainage tunnels will be connected with the main tunnels by cross-drifts dividing the latter into excavation sections 4 or 5 miles in length, which can be constructed independently of each other.

From experience with the trial drifts constructed, the seepage in the main tunnels is not expected to exceed 8 gal. per minute per 100 lin. ft. of single-track tunnel, or 26,500 gal. per minute for the entire length of both tubes, which is well below the quantity of water pumped in many of the deep mines of Europe.

Tunnel to Be Built in Sections

The French half of the work is naturally divided into two sections, the first of which includes the station and approach and the first 4½ miles of tunnel, which can be drained through the existing shaft. The construction plans contemplate building the remainder of the French section by first driving the drainage tunnel, from which three cross-tunnels will be excavated to the line of the main tunnels. From the end of each of these cross-drifts and from the end of the drainage tunnel at mid-channel the excavation of the main tunnels will be started upgrade, all of the spoil being taken out through the drainage tunnel and the main shaft. During the construction of the drainage tunnel and cross-drifts it is proposed to drill test holes up and down at intervals of 500 ft., to define exactly the limits of the stratum in which the tunnel will be constructed. This exploration work may result in modifying the proposed profile shown herewith.

Tunneling machines modeled on that invented by Colonel Beaumont and thoroughly tried out on the British side of the strait will be used to drive both the main tunnels and the 10-ft. drainage tunnels. It is expected from the past performance of this machine that a progress of 3.7 miles per year can be made for each machine in use, provided the muck can be disposed of. With all the headings working, this would require the transportation of 4400 tons of material daily through the section of drain-



TWIN-TUBE SECTION ADOPTED

age tunnel next the shaft. The French engineers expect to accomplish this with an electric railroad of 2-ft. gage (presumably double-track), over which 100 train movements a day in each direction will be necessary. This estimate also allows for transporting in and out 1200 workmen daily. A very large shaft will be necessary to accommodate hoisting equipment capable of raising material to the surface at this rate. Experience indicates that the shaft on the French side will be difficult to sink, and it is expected that the pneumatic process, grouting or freezing, or perhaps a combination of all three, will be required.

Based on this estimate of progress in the headings it would take three years to drive the drainage gallery to the center of the strait. In the meantime work would have started, at some of the four points of attack provided for, on the main tunnels. It is expected that by this method the entire work can be completed in 4½ or 5 years. The work on the British half of the tubes will be carried out along much the same lines, although the construction scheme for this half of the work has not yet been gone into so thoroughly as that for the French side.

Electric Operation Decided On

As was to be expected, the contemplated use of compressed-air locomotives has been abandoned for electric operation. Numerous breaks in grade will not constitute a disadvantage with electric traction, and consequently it is planned to change the profile of the tunnels, as may be required, to insure keeping them well within the impervious stratum. It has been estimated that the train movements would be sufficient to ventilate the tunnel, but the plans provide in addition for two 300-hp. ventilators, each capable of changing the air in the tunnel once in three days without assistance from train movements.

Venture Likely to Prove Profitable

Although it is estimated that the project would cost in excess of $2,000,000 per mile, a figure not approached by any other railroad tunnel in Europe, it is believed that the operating revenue to be derived from the enterprise would make it a profitable one from the outset. It would be possible, if terminal facilities could be provided to load them, to move 144 troop trains a day in one direction. If 1600-ton freight trains (representing about a 50-car train in American practice) were hauled, a possible volume of 225,000 tons of freight a day could be handled on the same basis. As the most recent estimate of Sir Douglas Fox places the cost of the English half of the tunnel at $31,655,000, and as Albert Sartiaux estimates that the French half can be built for $34,740,000, the net annual revenue from such maximum traffic at prevailing rates would represent a large fraction of this estimate for the entire cost of the project.

Estimated Construction Cost $77,000,000

To be on the safe side M. Sartiaux has supposed that the entire construction cost will amount to $77,000,000, and has made a conservative estimate of the proportion of the present freight and passenger traffic across the channel which would be diverted to the new line. On this basis 440 to 550-ton trains (corresponding to a 15 to 20-car American freight train) would be the standard for freight traffic, and fifteen freight and passenger trains would be operated each day in each direction. The net revenue on this traffic would yield 5 to 7 per cent on the sum invested. A similar estimate published by Baron Emil d'Erlanger in the *Evening Standard* also places the net annual earnings of the road at $5,400,000, which represents about 7 per cent on the maximum expenditure contemplated.

The tunnel, if constructed, will have a far-reaching effect in cementing French and English commercial relations. The line would bring Paris and London almost as close together as New York and Boston, and would reduce by 5½ hours the best running time that can be made at present. It would make it as easy for a London agent to visit points in northern France as for a New York salesman to reach the cities of Massachusetts. The most important saving, however, would probably prove to be the elimination of the double transfer from rail to water and back to rail, which is necessary at present, and a saving in the time required for the transit of freight shipments probably much greater than the saving in passenger time.

Number of Native Engineers Increases

The total number of engineers employed by the Bureau of Public Works of the Philippine Islands June 30, 1911, was 153, according to the annual report of the director. That number had been reduced to 98 by the end of 1915. In 1911 the number of engineers not natives of the islands was 143; in December, 1915, it had shrunk to 63. The total number of native engineers has increased from 10 to 35 in the same four years.

Bascule Bridge for Highway Service in California

Leaves Connected at Center Only by Bar to Equalize Shear, All Stress Being Carried by Cantilever Action

SACRAMENTO COUNTY in central California recently authorized the construction of a highway bridge across the Sacramento River between Walnut Grove and Grand Island. As the river is navigable at this point, it was necessary to maintain an unobstructed channel, and after a study of conditions it was decided to use a Strauss heel-trunnion type bascule bridge with two 113-ft. leaves. The leaves are designed to act as independent cantilevers, both live and dead load being balanced by a counterweight. No connection for transferring stress is provided at the junction of the leaves except a bottom-chord lock for equalizing shear.

SUBSTRUCTURE OF STEEL CAISSONS

The river bed at the selected site consists largely of sand and silt, and provision against scour was required. At high water the average depth is 38 ft. and at low water about 20 ft. The piers supporting the movable leaves were built by sinking steel caissons, 9 ft. in diameter, 49 ft. below extreme high water, sealed at the bottom with a concrete mixture 25 per cent richer in cement than the 1:3:5 mix used in the piers proper. Two such caissons were provided for each pier. Previous to the sinking of the caissons a cluster of timber piles had been driven for the piers and cut off above the concrete seal at the bottom of the caisson after it had been sealed and pumped dry. Wood forms were used for the upper portions of the piers, which at the top are 26 ft. long by 5 ft. wide.

Creosoted timber fenders spaced 13 ft. from the center line of bascule piers mark the limits of the 200-ft. clear channel and serve to protect the piers. Each fender is made up of four pile clusters with a row of piling between, faced with waling strips. The total weight of the superstructure steel in the bridge is about 260 tons, the weight of the machinery is about 26 tons, and the counterweights are about 210 tons each.

The bridge provides a roadway 6½ ft. above extreme high water and 18 ft. wide between curbs. The floor surface has a 3-in. creosoted wood-block paving laid on two layers of single-ply felt, well coated with asphaltic filler and laid on 1⅜ x 6-in. creosoted planking placed diagonally and supported on 4 x 6 in. transverse subplanking spaced 16 in. on centers and bolted to the steel stringers.

DESIGN AND OPERATION

The leaves are designed as Pratt trusses acting as cantilevers and have no connection at the center other than a lock bar below the floor system for equalizing shear. The operating strut shown in the photograph serves also as a live-load anchor arm. Its location in relation to the leaf and tower naturally lends itself to this purpose, and it only remained to design this member so as to carry the tension stress induced by the maximum live load on the leaf and to devise a satisfactory detail to anchor it to the tower when the leaf is closed.

This detail is an 8-in. turned pin secured to the operating strut by means of two collars with flanges riveted to each web of the strut. This pin projects beyond the webs far enough to carry irregular hexagonal nuts, any side of which can bear against the rear surface of the joint at the apex of the tower, which is made normal to the center line of the strut. Each side of the hexagonal nuts has a different radius, and as these range, by ⅛-in. variations, from 7¾ to 8⅜ in., the length of the strut can be varied within the range of ⅝ in., until an exact adjustment between the leaves and struts is effected. After adjustment the nuts are secured in position with a setscrew keying the collars to the pin which carries the nuts.

The leaves are operated by electric motors. In case the usual source of power fails, electric power can be supplied by a 40-hp. gasoline engine driving a 30-kw. generator set installed in the operator's house. For starting this gas engine compressed air is available at all times. Both leaves are operated simultaneously by means of a submarine cable interlocking all control apparatus.

LEAVES LATCHED AT CENTER

When the leaves are closed the locking together is effected by a 5½ x 2-in. forged-steel latch bar driven by a 5-hp. motor, and the leaves are properly aligned against unequal expansion or contraction by metal-lined oak guides bolted to the ends of the chords. The electrical brake-control system developed for slowly stopping the closure of the leaves consists of a magnetic brake which automatically puts a drag on the mechanism after the current is shut off and thus compensates for the lack of exact speed regulation which the alternating-current motor does not permit. The control of the main lifting motors is interconnected electrically so that they cannot be started until the locks have been opened; and when closing the leaves the locking cannot be completed until the leaves have been fully closed.

The concrete counterweight which balances the movable leaves is mounted on steel trusses supported on trunnions at the apex of the triangular framing of the tower span. Each leaf is moved by means of a pair of rack-toothed operating struts, one end pin-connected to the leaf at the hip of the trusses, the other engaged by operating pinions located on the portal of the tower span. The pinion and rack are held in mesh by a triangular guide equipped with rollers bearing against the flanges of the strut and free to turn on the operating pinion shaft, supported by bearings secured to the two tower legs. The operating pinions are actuated, through a train of reduction gears, by one 15-hp. 220-volt 850-r.p.m. motor for each leaf. With this motor the leaf is raised to full height in two minutes.

In order not to interfere with navigation the bridge was erected in the open position, and when lowered for the first time the leaves met within ¼ in. of perfect alignment and within ⅜ in. of the same elevation. By adjusting anchor arms by means of the hexagonal nuts referred to in the foregoing the leaves were brought into exact alignment.

The bridge was designed by the Strauss Bascule Bridge Company of Chicago. Jenkins & Wells of Sacramento were general contractors for the work; the steel and machinery were fabricated by the American Bridge Company, the electrical equipment was installed by the Butte Engineering & Electric Company of San Francisco, and the entire work was supervised by Drury Butler, county engineer.

BASCULE HIGHWAY BRIDGE OVER SACRAMENTO RIVER HAS 113-FOOT LEAVES

Rapid Progress on Twin Peaks Tunnel

The Twin Peaks tunnel work in San Francisco is progressing at a rapid rate, according to a recent report of City Engineer M. M. O'Shaughnessy, and will be completed in May, 1917. Only 3400 ft., or less than one-third of the total length of the tunnel, remains to be excavated, and practically all stations and other accessory construction have been finished. Several hundred workmen are employed at both ends in day and night shifts, and the progress of the completed bore is about 12 to 15 ft. per day from each end. About 3750 ft. have been excavated from the east portal and 4750 ft. from the west portal. The concrete gang follows the excavating crew closely, and sides, arch and invert are completed as fast as the heading advances. Pneumatic placing machines are used to expedite progress of the concreting. The two ventilating shafts from the tunnel to the surface above have been completed, and one of these is used for pumping out the seepage water, which is coming into the tunnel at the rate of 300,000 gal. per day.

Influence Lines as Deflection Diagrams

A New Method for Treating This Subject Is Developed and Its Application to Simple and Indeterminate Structures Illustrated

By D. B. STEINMAN
Special Assistant to Gustav Lindenthal, Consulting Engineer, New York City

THERE have appeared in the Engineering Record during the last two years a number of articles developing and applying the newer graphic methods of designing indeterminate structures (see Engineering Record of Aug. 28, 1915, page 258; Sept. 11, 1915, page 324; Dec. 18, 1915, page 762; Aug. 19, 1916, page 234). All of these methods may be reduced to a single fundamental principle which should form part of the working apparatus of every structural engineer. This principle is simply the identity between influence lines and deflection diagrams. This idea, once grasped, will be found an invaluable aid not only as a starting point for the solution of indeterminate structures but also in providing a new and helpful point of view for many of the more elementary problems of simple structures.

Applications of this concept to the construction of influence lines for reactions, shears and bending moments in simple beams, for stresses in a truss, and for the graphic solution of statically indeterminate structures are here illustrated and described.

Influence Lines Are Deflection Diagrams

Every influence line is a deflection diagram. For a proof of this relation the reader is referred to an article by the writer in the Engineering Record of May 20, 1916, page 680. The principle there established may be generalized as follows:

The influence line for any reaction, shear, bending moment or stress is identical with the deflection diagram produced by a unit displacement at the point of application and in the direction of the desired reaction, shear, bending moment or stress.

Application to Reactions

To illustrate the application of the foregoing principle, consider first the simplest problems in influence lines. Thus, to find the reaction at the end of any simple span, assume the end raised a unit distance while the other end remains on its support; the resulting deflection diagram, Fig. 1, is the familiar influence line for beam reactions. Similarly, to find the reaction at an intermediate pier between two simple spans or to find a floorbeam reaction, raise the middle support a unit distance with the adjoining supports unchanged to obtain a triangle for the usual influence diagram.

Fig. 2 represents a cantilever bridge with a central anchor span. To obtain the influence line for one of the pier reactions, R, the corresponding support is raised a unit distance and the resulting deformation diagram is the desired influence line.

Application to Shears

To obtain the influence line for shears at any section of a beam, assume a unit shearing displacement at the section. As there is no rotation, the two segments of the beam must remain parallel. The resulting deflection diagram is given by ASTB, Fig. 3. Since the ends, A and B, resting on supports, must have zero deflections, they are joined by a closing line AB to complete the diagram.

Fig. 4 represents a beam with overhanging ends. To obtain the influence line for the shear at the support S, a unit shearing displacement is assumed at that section, the two segments of the beam remaining parallel. The resulting displacement diagram, ASTB, is the desired influence line.

Application to Bending Moments

To obtain the influence line for bending moments at any point M of a simple span, assume a unit bending or angle change at the section, as in Fig. 5. Drawing the closing line AB, the desired influence diagram is obtained. Fig. 6 shows how the construction of the moment influence line in the span AB may be modified to keep the closing line horizontal, at the same time extending the application of the construction to the case of a cantilever bridge.

Application to Stresses in a Truss

The foregoing examples indicate how the principle here discussed may be utilized to endow the simplest influence lines with an added meaning. A more novel extension of the principle is in the construction of influence lines for the stresses in a truss. For this purpose the principle may be restated as follows:

The influence line for the stress in any member of a truss is identical with the deflection diagram produced by a unit elongation of that member.

This relation was established in the article by the writer previously cited. In application it is advisable to assume a unit shortening of the given member, instead of a unit lengthening, thereby inverting the resulting diagram, in order to provide for the fact that positive influence ordinates are measured upward, while positive deflections are measured downward.

To apply this principle to any truss member, proceed as follows: Assign to the given member a unit contraction, while all the other members remain unstrained. Find the resulting deflections by means of a simple Williot diagram and project them to the panel points of the truss to obtain the desired influence line.

Examples of Method Applied to a Truss

Fig. 7 shows the application of the above-mentioned method to a truss with subdivided panels, the influence lines for four different members being constructed. In each case the entire truss to the right of the member is first assumed fixed and is therefore represented by a single point (5, 6, 7, 8, 9, 10) in the Williot diagram. The contraction of the given member is represented by a heavy line of unit length, and the remaining points are found by drawing light lines perpendicular to the directions of the members in the usual manner. Projecting the points thus found to verticals below the panel points of the truss, the deflection diagram 0-3-4-5-10 is obtained. A closing line is drawn through the end points (0, 10), since the ends of the span have zero deflections. The resulting figure is the influence diagram for the member, the areas above and below the closing line giving + and — areas respectively.

As seen in the foregoing examples, the Williot diagram will generally be a simple figure on account of the zero deformations in all but one member of the truss. To further simplify the construction, if there are several panels to the left of the one containing the given member, they may be replaced by two straight lines connecting that panel with the end of the truss.

It may be noted, in passing, that the closing line introduced in the foregoing examples is another short cut; it takes the place of the rotation correction which is ordinarily made in the Williot procedure by means of an auxiliary truss diagram. It will be found instructive to apply the foregoing construction to various members of trusses with K-system or triangular bracing and to trusses with multiple systems of web members.

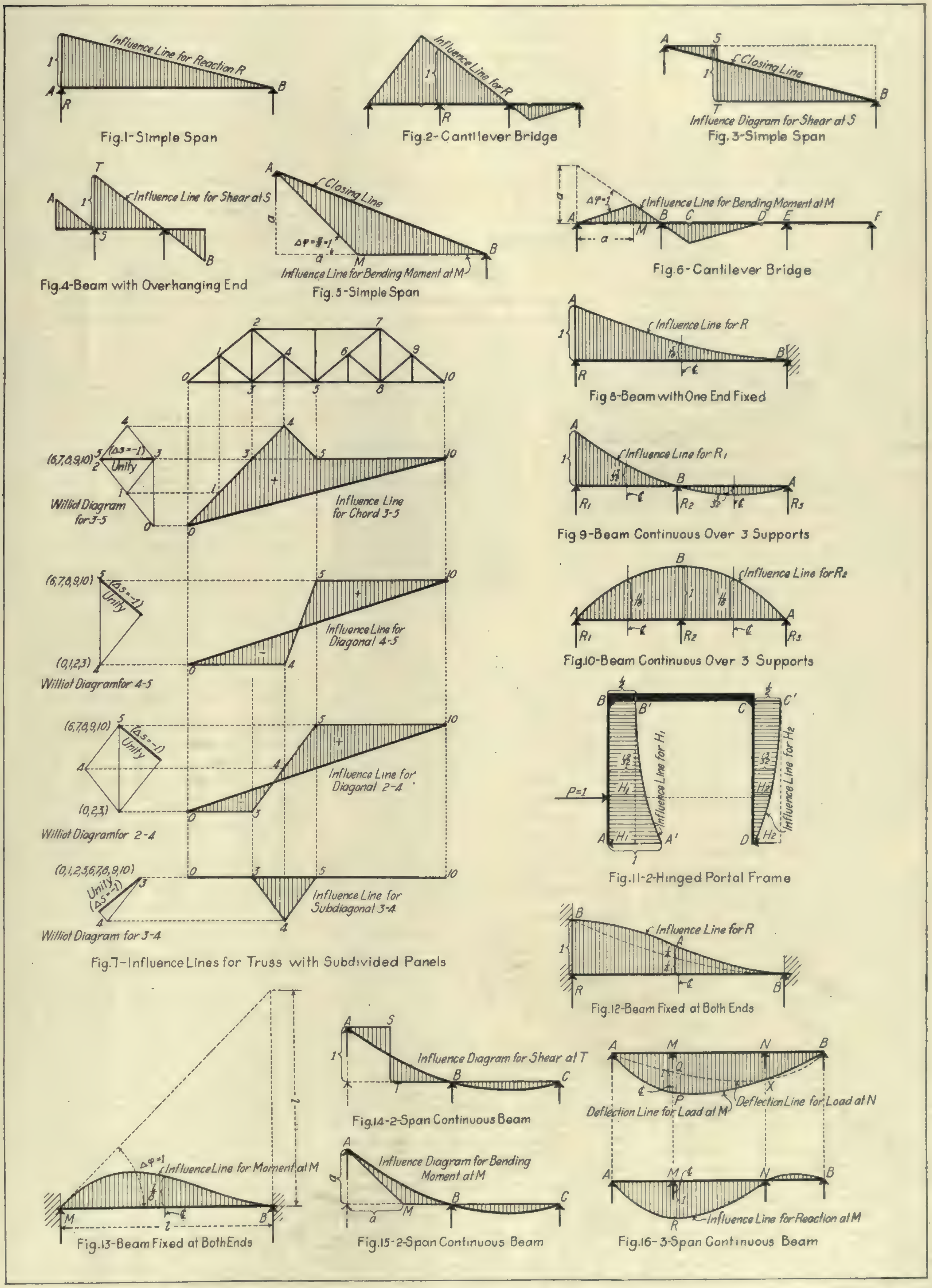
Advantages of the Method Applied to a Truss

The above-cited method of constructing influence lines for trusses, although not intended to replace the older methods, possesses certain advantages over them. In the first place, it is completely graphic—instead of merely representing moments or shears from which the stresses must be figured analytically, it gives those stresses directly, making automatic correction for such factors as lever arms and secants of inclination. In the second place, it is absolutely general, dispensing with the necessity of remembering different rules for constructing different influence lines. It gives the influence lines for new or uncommon truss systems or combinations of members without requiring first an analysis of their stress relations. In this last advantage the method probably finds its chief usefulness, inasmuch as it furnishes an additional tool for the attack of unfamiliar truss problems.

Application to Indeterminate Structures

This same principle, furthermore, forms the basis for the graphic solution of all statically indeterminate structures. It constitutes a bridge to pass from the study of simple influence lines to the subject of indeterminate systems. For example, if the beam in Fig. 1 is restrained at one end, a unit displacement of the other end will strain the beam into the familiar elastic curve of a cantilever beam, as represented in Fig. 8. This curve is the influence line for the reaction R at the free end of the beam, thus replacing the straight line of Fig. 1.

In a beam continuous over three supports a unit displacement of one end produces the elastic curve shown in Fig. 9, and a unit displacement at the middle support produces the elastic curve shown in Fig. 10. These deflection curves are the influence lines for the respective reactions. Each half of the curve in Fig. 9 or Fig. 10, referred to the tangent at B, is identical in form with the basic elastic curve shown in Fig. 8 and may be plotted with its ordinates. In general, the influence line for the reaction at any support of a continuous bridge is simply the elastic curve produced by removing the support and applying a load to give the point a unit vertical displacement. The application of this principle to the design of the Sciotoville Bridge was presented by the writer in the Engi-



INFLUENCE LINES APPLIED TO THE SOLUTION OF VARIOUS PROBLEMS, INCLUDING STATICALLY INDETERMINATE CASES

neering Record of Aug. 28, 1915, page 258.

In the case of arches, the influence line for *H*, *V* or *M* at one end is obtained as the deflection diagram produced by giving the end a unit horizontal, vertical or rotational displacement respectively. This principle was applied in the Engineering Record of Sept. 11, 1915, page 324.

In the case of a suspension bridge, the influence line for *H* is the deflection diagram of the stiffening truss produced by a unit shortening of the cable between anchorages. This principle was applied in the Engineering Record of Aug. 19, 1916, page 234.

An interesting illustration of the principle here discussed is afforded by the problem of a portal or rectangular frame, ABCD, Fig. 11, subjected to horizontal loads. Neglecting bending or compression in the top member, a unit horizontal displacement of A will make the frame assume the form A'B'C'D. Here the curves A'B' and C'D are identical with the elastic curve of Fig. 8, and constitute the influence lines for the horizontal reactions at A and D. Thus, for a unit load applied at *P*, the horizontal intercepts H_1 and H_2 give the respective horizontal reactions.

COMBINATIONS OF DEFLECTION DIAGRAMS

In a beam fixed at both ends, a unit vertical displacement at one end, without rotation, produces the deflection curve BAB, Fig. 12, as the influence line for the end reaction. Each half, BA, of this curve is identical with the basic elastic curve BA of Fig. 8. In the same beam a unit rotation at one end, without translation, yields the deflection curve Fig. 13 as the influence line for end moments. The ordinates of this curve may be obtained as the intercepts between the parabola shown dotted and the elastic curve BAB in Fig. 12. The former represents the deflections of a cantilever beam subjected to a bending moment applied at the free end; the latter represents the deformation of the beam required to restore the free end to its initial position. The differences between the respective ordinates therefore represent the resultant displacements of the beam and are plotted in Fig. 13 to enlarged scale.

SYNTHESIS OF DIAGRAMS

In many cases, as in the foregoing example, the influence line or deflection diagram is best obtained by the synthesis of simpler deflection diagrams.

Another illustration is shown in Fig. 14, representing the influence line for shear at a section S in a two-span beam or girder. The broken line ASTC represents a unit shearing displacement; to bring the point A back to its support, an end reaction is evolved at A which produces deflections represented by ABC. These must be subtracted from the first set of deflections to obtain the resultant displacements or influence ordinates. In a similar manner a combination of the deflection diagrams of Figs. 5 and 8 yields the influence line for bending moments shown in Fig. 15.

The device of synthesis of deflection diagrams is particularly useful in the case of structures indeterminate to the second degree or higher. Thus, let it be required to construct the influence line for intermediate reactions in a three-span beam or girder, AMNB, Fig. 16. First consider both supports M and N removed and a unit load applied at M; the resulting elastic curve is APXB. Next, to restore X to its original position, a reaction is evolved at N. A force at this point would produce an elastic curve AQXB, shown in dotted lines. The differences between the ordinates of the two curves give the ordinates of the desired influence line ARNB. Although this deflection curve, like that in Fig. 13, could be roughly sketched at sight, the procedure just outlined is a simple method for accurately obtaining the ordinates for the desired line.

Whether structures are designed by the method of least work or by the principle of virtual velocities, two methods which are essentially the same in actual procedure and differ only in appearance or interpretation, the graphic design ultimately resolves itself into the problem of constructing influence lines. For this purpose the simplest and most direct method of attack, one which will help to visualize the problem instead of obscuring the immediate issue by the use of mysterious looking formulas is provided by the concept here developed—namely, that every influence line is a deflection diagram.

"Panama Canal Slides Will Be Overcome for All Time"—General Goethals

In His Latest Annual Report the Governor of the Canal Reviews History of Slides and Answers Criticisms of Work at the Isthmus

"AS predicted at the time the great Culebra movements occurred, the slides will be overcome finally and for all time, notwithstanding the calamity howlers and in spite of the disastrous predictions of the 'know-it-alls.'"

With these words Major-Gen. George W. Goethals, governor of the Panama Canal, in his annual report for the year ended June 30, 1916, concludes a discussion of the slide situation at the isthmus. Although this question has been dealt with in previous reports and official documents, General Goethals believes that misconception regarding the slides is so general, due to the publication of erroneous information from various sources, that he is justified in reporting upon the matter again, even at the expense of repetition. He takes a fling at several of the Panama Canal's critics, among them Prof. Benjamin Le Roy Miller, of Lehigh University, and ex-United States Senator Thomas Kearns, who believes "that the whole trouble is caused by subterranean gases formed in the earth, which, when permitted to escape through certain channels or breaks in the earth, carry with them eruptive material, sometimes for a long distance, to the place of least resistance."

HISTORY OF SLIDES REVIEWED

General Goethals enters rather fully into the history of the Panama slides, much of this ground having been covered in his official statement published in the Engineering Record of Nov. 27, 1915, page 652. Gaillard Cut, he explains, extends from Pedro Miguel to Gamboa, a distance of 8.75 miles. The canal prism through this section averages 300 ft. bottom width, and has a depth of 45 ft. Every foot of the existing channel was excavated through rock, all of which, though of various kinds and densities, had to be drilled and blasted in order to remove it. It is possible that the water may have softened some of the material, yet it is known that the softer varieties of rock encountered in the excavation were protected from disintegration by contact with water. The bog theory is a myth. The cut has been stable with the exception of the portions in the vicinity of Culebra and at Cucaracha. The slides at Culebra are on both sides of the waterway, occupying a length of 2800 ft., while the channel affected by the Cucaracha slide is less than 2000 ft. long, so that out of a total length of 8.75 miles only 0.88 mile is affected.

A misconception that exists relates to the character of the slides. They have not been, except in part at Cucaracha, a slipping down of portions of a bank in order to reach the slope at which the material will stand. Slides of this character have occurred, but they were small in extent and easily handled. Those at Culebra are breaks resulting from deformation or crushing of underlying strata which, under changed conditions, could not bear the weight of the superimposed mass, and caused a vertical settlement or drop of the overlying material, which subsequently moved into the prism. Final rest will be secured when all the material that is in motion has ben removed. As is shown by experience with smaller breaks that have occurred from the same cause, when the end is reached the final surface will be concave, or bowl shaped.

SCIENTISTS' COMMITTEE INVESTIGATES

General Goethals takes issue with Professor Miller, who is quoted in a press item as having said: "For many years to come the rainy season is almost certain to cause such slides as to close the canal for weeks or even months." Speaking of the investigating committee from the National Academy of Sciences appointed late last year by President Wilson, General Goethals says: "It was anticipated that the committee from the National Academy of Sciences would make a more thorough examination than Professor Miller had done, and it was hoped that, as a result, the statements of Prof. Benjamin Le Roy Miller, Ph.D., would be found to be what we considered them—erroneous, unwarranted and unfair, and help restore the confidence that he had helped to destroy.

"The preliminary report by the committee of the National Academy of Sciences was submitted to the President in January, 1916. At that time they expected that their final report would be completed in April, but up to date it has not been received. It will be noted that the statement made by Professor Miller, that practically all Gold Hill and much of Zion Hill must be removed, is not concurred in; and in this connection it should be remembered that a committee of this character expresses its opinions guardedly, for whatever happens they must be found on the right side. They advocated, as a matter of scientific interest, the making of an accurate triangulation of the hills in question—Gold, Contractors, Culebra, and Zion—which has been done. By checks made at frequent intervals the slightest movement on the part of any of the four hills would be disclosed at once. No movement of any kind has taken place."

The committee expressed the belief that every available and practicable device for controlling the water, both on the surface and underground, should be employed, and to this end advocated covering the slopes with vegetation to prevent surface wash, closing peripheral cracks, draining undisturbed and threatened areas, and draining by tunnels.

MEASURES TO PREVENT SLIDES

General Goethals reviews the measures taken to prevent slides, including the covering of slopes with vegetation, the closing of peripheral cracks in rock with sluiced earth, the installation of drains, and other expedients that have been proposed by the various investigators.

It is admitted, says General Goethals, that if the water could be entirely excluded the earth movements would cease, but unfortunately this is impossible. With the heavy tropical downpours the best that can be done is by drainage, to carry away what falls as rapidly as possible, but ground water cannot be eliminated. So far as concerns ground water, the construction of the canal has created entirely new conditions. The old tributaries of the Chagres River and those of the Rio Grande, which formerly were natural drains, are now well above the water surface of the canal, and the canal has become the drainage channel for the country for miles on either side. Even assuming that it were possible to devise a system for getting rid of ground water, it must still exist below the surface of the water in the canal itself. The slides in question affect the banks for a considerable distance down, probably below the bottom of the canal, and if ground water be primarily the cause, then it cannot be removed from the strata at which the trouble starts.

DRAINS IMPRACTICABLE

So long as the slides are active and the configurations of their surfaces change as rapidly as they now do, it is impracticable to open and maintain the permanent drains recommended in the moving areas. When equilibrium is restored, and as a means of promoting permanent stability, the drains of a permanent character should be constructed and maintained.

On the subject of proposed drainage tunnels Donald F. McDonald, geologist, reported as follows: "While the sliding rocks have a high percentage of pore space, the pores are mostly of capillary size and are filled with water which obeys the laws of capillarity and which cannot therefore be drained off. These experiments definitely established that all cures by drainage which had been offered to and urged on the canal authorities were absolutely futile, and the money which might have been wasted in worthless tunnels, wells and acres of asphalt covering was saved for the only remedy that could bring permanent cure under the circumstances—dredging."

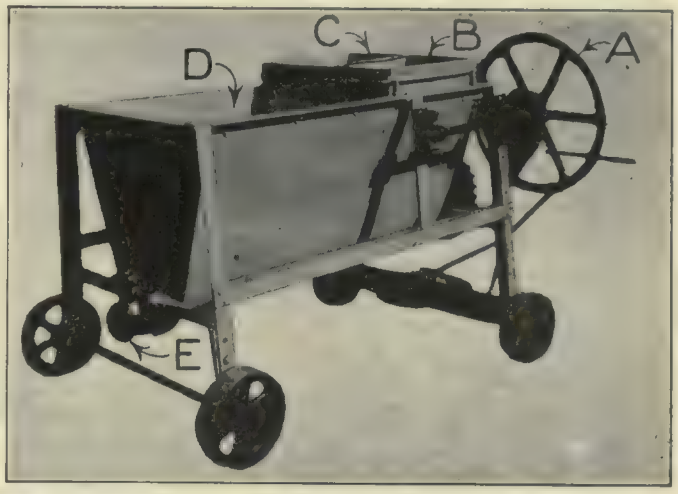
General Goethals concludes his report by commenting upon some of the extravagant theories which have been advanced to account for the slides. One is that a huge reservoir of water exists within the earth and that the pressure therefrom produces the slides. The mutual attraction of the large masses on either side of the cut is assigned as the cause for bringing down the material, while one critic believes that the trouble is due to the fact that "a huge magnet that previously existed has been cut in two."

City Engineer Designs Paving-Grout Mixer

Apparatus on Wheels Is Equipped with Paddle for Agitating Materials and Securing Uniform Mix

THE accompanying illustrations show the main features of a paving-grout mixer which has been designed by A. W. Hall, city engineer, of Jackson, Mich. It is claimed to produce a more satisfactory product than is obtainable by hand-mixing methods. A feature of the device is a paddle wheel which may be revolved through a chain drive by the hand wheel *A*, thus agitating the grout mixture and insuring its homogeneity. Cement is placed in the hopper *B* and sand in the hopper *C*. Each of these compartments has a capacity of 1 cu. ft. The ingredients fall by gravity into the mixing tank *D*, where water is added by a hose. The outlet *E* for the mixed grout is controlled by a hand-operated valve.

This equipment, it is said, has effected a substantial reduction in the cost of mixing and placing grout for the brick pavements of Jackson.



PORTABLE GROUT MACHINE IS EQUIPPED WITH HAND-OPERATED STIRRING PADDLE

San Diego, California, Makes Repairs to Its Wood Pipe and Tunnels

Repair of the San Diego (Cal.) water system includes retimbering the four tunnels and rebanding the wood-stave pipe which runs through them. The work is being finished at a cost of $16,700. The 22-mile wood-stave line varies in size from 40 in. at its intake to 24 in. where it discharges into the University Heights reservoir in San Diego. As it is the main line connecting the impounding and the distributing systems its upkeep is of vital importance. Nothing had been done to the pipe or tunnels since they were built eight years ago. Two of the tunnels were found to be higher at both ends than in the middle. All have now been graded so that the drainage is excellent, and with the new timbering just placed it is almost impossible for them to become clogged. Everything has been done with a view to keeping the tunnels dry and carrying away any water which may leak from the main. The aggregate length of the four tunnels is 6733 ft. That length of 36-in. pipe had to be rebanded and in some places new staves put in. For the rebanding of the pipe the city purchased 18,000 new bands at a cost of $4,660. The entire job will be finished this year. This information was furnished by A. C. Francis, of the operating department of San Diego.

Stress Distributed Unequally to Rivets of a Joint

Theoretical Analysis and Results of Tests Made by Professor Batho Show That First and Last Rivets Get Higher Stress

THAT the first and last rivets in a riveted connection take by far the greatest proportion of the total load is indicated by the theoretical analysis and checked by results of a short series of tests (five rivets on each side of the joint) presened by Cyril Batho, assistant professor of applied mechanics, McGill University, Montreal, in a 50-page paper in the *Journal* of the Franklin Institute for November. While admitting that further experimentation is necessary, particularly to determine general laws for a variable *K* entering the equations and to find whether the joint acts by friction between the plates or by shear on the rivets, Professor Batho shows that close agreement between his analysis and the test results now available seems to prove the soundness of his theory, which is based upon the principle of least work. The practical importance of his conclusions is evident in view of the universal assumption in design that all rivets carry equal loads. These conclusions are as follows:

SUMMARY AND CONCLUSIONS

"1. It is shown that a riveted joint may be considered as a statically indeterminate structure, and that a series of equations may be obtained for any joint by means of the principle of least work, giving the loads carried by each of the rivets in terms of a quantity *K*, which depends upon the manner in which work is stored in, or by the action of, the rivets.

"2. This theory is applied to various types of joints, and the modifying effects of non-uniform distribution of stress in the plates, unequal partition of the load between the two cover plates, and a difference in the modulus of elasticity of the middle plate and the cover plates are also considered.

"3. It is shown experimentally that extensometer measurements on the outer surfaces of the cover plates of a riveted joint are sufficient for the determination of the mean stresses in the plates, and that the partition of the load among the rivets may be determined from such measurements. It is also shown that, at any rate after the first few loadings, the distribution of strain in the plates of a joint is not altered by repeated loadings.

"4. It appears from 3 that if there is any frictional hold between the plates, it acts

only over those portions in the immediate neighborhood of the rivets. All the experiments tend to show that friction does not play an important part, but further experiments are necessary on this point.

"5. Experiments made on a number of specimens having a single line of rivets and loaded in tension give results in close agreement with the theoretical considerations. They also show that the longitudinal stresses in a portion of the cover plate between two consecutive rivets are a minimum along the line of rivets, rising to a maximum at the edges of the plates.

"6. The experiments show that the value of *K* for a joint having a given ratio of width of cover plate to rivet pitch and a given number of rivets varies approximately directly as the load and inversely as the area of the rivets. An empirical rule is given for its value in joints similar to the experimental specimens, but a more general rule cannot be given until further experiments have been made. A theoretical estimate is made of the value of *K* for a rivet acting in shear, and the result is shown to be within the range of the experimental values.

"7. Both the experimental results and the theoretical deductions show that: (a) In a double-cover butt joint having a single line of rivets, the two end rivets and the two rivets on each side of the junction of the middle plates take by far the greater part of the load at all loads within that causing permanent deformation of the plates or rivets, the actual proportion decreasing slowly as the load increases; (b) if, in such joints, the total area of cross-section of the cover plates is equal to that of the middle plates, these four rivets take equal loads, but if it is greater the end rivets take greater loads than the others, the difference increasing as the area of the cross-section of the cover plates increases; (c) if two plates of uniform width and equal thickness are connected by a single line of rivets to opposite sides of a gusset plate of uniform width, the first and last rivets take the greater part of the load, but if the gusset plate increases in width from the first to the last rivets, the partition of load is more uniform."

Resident Engineers Study Moot Drainage Problems

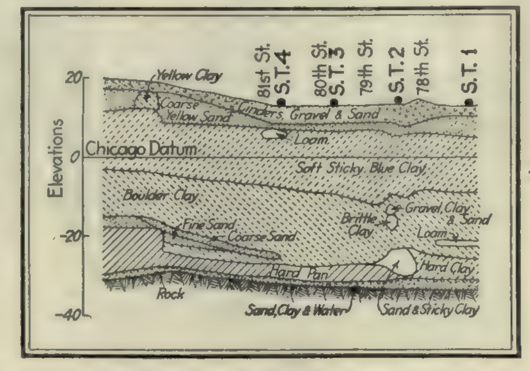
Staff meetings of the large engineer corps of the Little River Drainage District of Missouri are held bimonthly to discuss questions on which there are few or no printed data with reference to certain changes that occur in canals after construction, such as sloughing, breaking of banks, caving and shoal formation. The extent of the works of the district is so large that it affords an admirable opportunity to study the various conditions which are conducive to the changes noted. To make definite the field of research for each man, the chief engineer, William A. O'Brien, appointed resident engineers to report progress and make a study in the field of the following subjects: E. S. Blaine, deterioration of ditches; H. V. Newcomb, spoil areas required and clearing; V. H. Henderson, proper openings under large spoil banks; L. D. Sheppard, excess excavation, and Blair Boyle, protection of banks. The study of these topics will continue during the construction period or until all information that it is believed can be obtained has been secured and carefully tabulated.

Soil-Bearing Tests Determined Loading on Chicago Track-Elevation Work

Investigation Deemed to Justify Loads of 3900 Pounds Per Square Foot on Clay or Sand—Such Loads Have Caused Little Settlement

By R. H. FORD
Engineer of Track Elevation, Chicago, Rock Island & Pacific Railway, Chicago

ON ACCOUNT of the great weight of the concrete retaining walls necessary to support the elevated grade of the Chicago, Rock Island & Pacific Railway, caused by the separation of grades between the Rock Island and the Chicago & Western Indiana Railroad at Seventy-ninth Street, Chicago, a special study was made of the bearing power of the soil, as preliminary calculations showed that the soil would be loaded approximately ten times greater than is ordinarily the case with track elevation. As a result of the test, loads of 3900 lb. per square foot were allowed on clay or sand, and in the two years that the walls have been standing no appreciable settlement or cracks have been noted.



RELATIVE THICKNESS OF STRATA

Preliminary tests were made by borings during September and October, 1912, a soil auger being used, so arranged as to decrease in size from 4 in. to 1 in. These borings showed six different strata. Rock is overlain with hardpan and this in turn is overlain by a sheet of thin blue clay; above the clay is a stratum of glacial drift, which is characteristic in this territory; and above the drift comes soft, sticky clay with a covering of coarse yellow sand, while the surface layer is composed of various materials which have been used from time to time for roadbed filling.

Owing to the uncertainty of the bearing power of the mixed deposit above described, the series of soil-bearing tests was also made. For this purpose test pits were dug large enough to get a level bearing on the bottom of the pit of sufficient size for the bearing plate of a specially constructed loading frame designed as shown in the accompanying photograph. The bearing plate was 2 ft. square, made of ordinary 3-in. lumber and surmounted by four vertical 6 x 8-in. bridge ties. A horizontal loading platform 6 x 6 ft., of 3-in. lumber, was then placed on top of these posts, and the entire structure was thoroughly bolted to secure rigidity. At the ground level a frame or curbing was set so as to prevent overturning in case of unequal settlement, and an allowance of ¼ in. was left to prevent binding with the posts. This curbing was secured in position by stakes driven at the end of the 3 x 8-in. planks, 16 ft. long, of which it was constructed. Pig iron was used on the loading platform, each piece being weighed separately and the weight being painted thereon.

The amount and rate of settlement were determined with a Y-level and an 11-ft. rod, the foot of the rod being placed on the bearing plate and extending up through the loading platform. Before the tests were begun a bench was located a short distance from the apparatus.

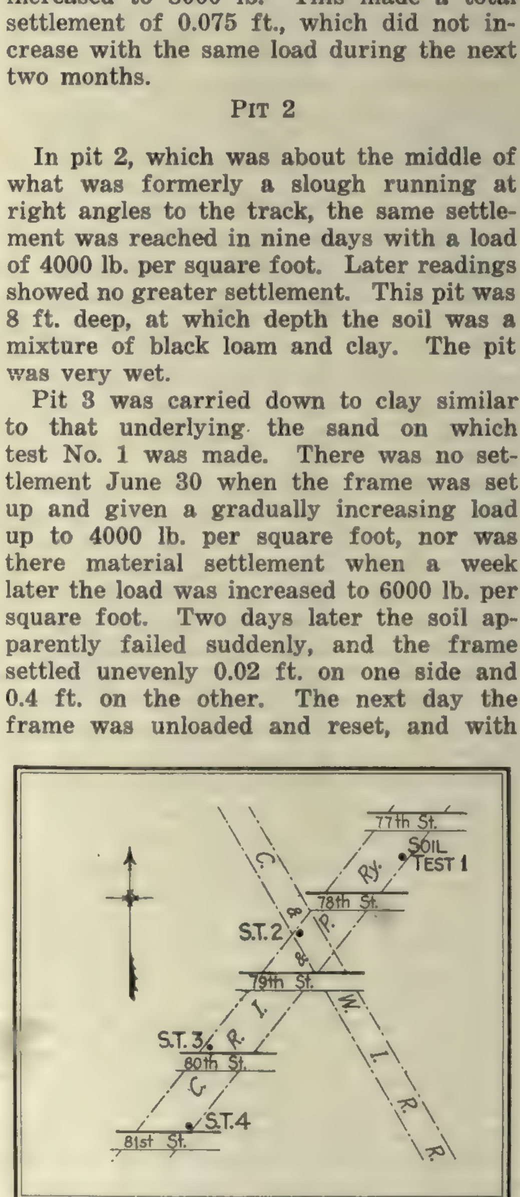
The accompanying drawings show the location of the boring and test pits, and also the soil strata. Four test pits were used, the tests beginning in April, 1913, and the last one being terminated in July of the same year.

The first pit was 6 ft. deep. At the bottom was 2 ft. of fine yellow sand, overlying clay. The water in the pit was 6 in. deep. There was an initial settlement of 0.007 ft. with a load of 500 lb. per square foot, a further settlement of 0.019 ft. two days later when the load was increased to 3000 lb. per square foot, a settlement of 0.025 ft. two days later when the load was increased to 5000 lb., a settlement of 0.01 twelve days later when the load was raised to 6000 lb., and a settlement of 0.015 ft. three days later after the load had been increased to 8000 lb. This made a total settlement of 0.075 ft., which did not increase with the same load during the next two months.

PIT 2

In pit 2, which was about the middle of what was formerly a slough running at right angles to the track, the same settlement was reached in nine days with a load of 4000 lb. per square foot. Later readings showed no greater settlement. This pit was 8 ft. deep, at which depth the soil was a mixture of black loam and clay. The pit was very wet.

Pit 3 was carried down to clay similar to that underlying the sand on which test No. 1 was made. There was no settlement June 30 when the frame was set up and given a gradually increasing load up to 4000 lb. per square foot, nor was there material settlement when a week later the load was increased to 6000 lb. per square foot. Two days later the soil apparently failed suddenly, and the frame settled unevenly 0.02 ft. on one side and 0.4 ft. on the other. The next day the frame was unloaded and reset, and with



LOCATION OF TEST PITS

4000 lb. there was no settlement. On the following day, however, before 6000 lb. per square foot was reached, the frame leaned badly, and it was necessary to prop it to prevent overturning. The vertical settlement was 0.42 ft., all of which took place in a few minutes.

The clay at the bottom of pit 4 was similar to that at the bottom of pit 3, but did not contain so much sand. It was very wet at the time the test was made, as there was 5 ft. of water in the hole during the whole time. After two weeks there had been a settlement of 0.43 ft. with a load of 4000 lb. per square foot.

The tests indicated safe loads as shown in Table 1.

Standing water from surface and seepage water was at all times in the pits. Observations during the tests indicated

PIG IRON TO THE DESIRED WEIGHT WAS PILED ON A 6 X 6-FOOT PLATFORM

that the area of the bearing plate was too small, and the soil squeezed out from under the plate, which was a condition not met with in the wall construction. The foundations on which the wall would rest would consist of clay in all cases. Taking these things into consideration, combining them

TABLE 1—SAFE LOADS INDICATED BY TESTS

Material	Loads, lb. per sq. ft.
Loam mixed with clay	1000
Clay when wet (as in pit 4)	1000
Clay when moist as ordinarily found (pit 3)	2000
Clay confined	2000

with the data secured from the borings with the soil tests, and comparing this information with the weight of the soil of structures in the vicinity, especially the buildings of the International Harvester Company, the loading of which is approximately 4800 lb. per square foot, the loads in Table 2 were finally determined upon.

TABLE 2—LOADINGS ALLOWED

Material	Loads, lb. per sq. ft.
Clay, when wet or dry	3900
Sand	3900
Loam mixed with clay Foundation to be lowered to clay	

On the basis of the loading in Table 2, 1700 ft. of walls, varying in height from 5 to 20 ft., were constructed, and the results carefully studied in the light of these tests, and no appreciable settlement or cracks have been noted. A study of the bearing power and soil conditions during the succeeding two years indicates that the safe loads adopted were warranted. It is believed that where the ground remains continuously wet, as in the case of large amounts of rain after foundation excavations have been prepared, causing soft clay to remain wet for a considerable time previous to construction, the liability of initial settlement is materially lessened by the use of crushed stone or gravel of a sufficient depth to overcome the softening due to standing water. Investigation shows that usually from 2 to 4 in. is soft due to these causes, irrespective of the depth to which the excavation has been made preparatory to construction.

Road-Building Methods of New York State Criticised; Deputy Commissioners Reply

D. T. Pierce Bases Comment Upon Inspection of 2200 Miles of Road—H. E. Breed and F. W. Sarr Take Issue with Some of His Statements

THE Engineering Record has received the following comment on the condition of New York State highways. Copies were sent to the first and second deputy state highway commissioners, whose replies are given below.

Notes on New York Road Conditions

By DANIEL T. PIERCE
Executive Assistant, Barber Asphalt Paving Company, Philadelphia

A recent survey of 2200 miles of New York state roads suggests some comments which may be of use to road builders elsewhere.

At many points throughout the state there are encountered gangs of men cutting out sections of recently improved roads for the purpose of putting in drainage and telford support, the necessity for which had become painfully evident. Practically all of this work should have been done before the improved road was built. To wait until weak spots develop in a road before providing adequate drainage or support is very much like waiting until the wall of a house sags or cracks and then strengthening the foundations.

It is hardly conceivable that 3 or 4 miles of road will have the same sub-base conditions and can safely be built on the same foundation throughout. Yet this is apparently what has been done and is being done. A few dollars in "extras" for taking care, during construction, of spots where weakness in the support of a road surface is likely to develop will evidently save heavy expense in correcting such weakness after a road is completed.

SURFACE TREATMENT FAULTY

Insufficiently and improperly covered surface treatments are to be observed all over the state. As to bitumens employed, light hot oil appears to have the preference this year in place of the tar that was liberally employed in 1915. In many places what is called "sand" is used for covering both oil and tar. This upon examination is found in some cases to contain varying quantities of clay and loam. The results obtained, even when the sand is clean, are such as to confirm the well-known fact that only very coarse sand is suitable for covering surface applications. Where stone chips are used the quantity is insufficient. The state calls for 50 tons of stone chips per mile of 16-ft. road. This is not enough to permit integration or bonding. The spectacle of a ½-in. stone chip in lonesome isolation surrounded by 2 or 3 in. of uncovered oil is a spectacle that produces, according to temperament, either amusement or grief.

From careful observation of results the conclusion must be drawn that quite different surface treatments should be applied to plain macadam and asphalt penetration roads. The surfacing of plain macadam with light oil appears to give very good results. The same treatment of penetration roads in many cases results in unduly softening the original road and consequent mushing and rutting. As an example of this condition may be cited the Ballston road (No. 5062), part of which is in the village of Ballston. The latter portion has not been oiled and is in far better condition that the 2½ miles of the road outside the village that have been oiled. Although built in 1910 by the penetration method, the section in the village of Ballston is in almost perfect condition, while so much cannot be said of the section outside of the village where the traffic is lighter.

A similar condition is encountered on the Craryville-State Line road (No. 762), another penetration highway built in 1911. It is evident that resurfacing with light oil has resulted in mushing up the surface of this road, notwithstanding which a contract for reoiling with a light cold oil has been let. Where resurfacing or seal coating has been carried out with heavy asphalt cements in place of the light oils usually employed, the results are uniformly much better than those obtained with the lighter materials.

FLAT ROADS THE BEST

Although high crowns on bituminous roads have generally been abandoned, it may be of interest to road builders to note that New York's experience strikingly confirms the wisdom of building bituminous roads with almost flat surfaces. Judging by the condition of some twenty-five roads, the ideal section is one with not more slope toward the crown than is absolutely necessary for surface drainage; and, as is well known, with a smooth and impervious surface only a very slight crown is necessary for this purpose.

A considerable number of roads built prior to 1912 were originally designed to be waterbound macadam. They were changed to bituminous construction without alteration being made at the same time in the cross-section. In other words, they were built with the same crown that they would have had if constructed of plain macadam. The bituminous highways in the neighborhood of Elizabethtown afford an excellent opportunity to observe the comparative wearing qualities of high crown and flat roads. The flat roads are uniformly in much better condition than the others, one notable example of the better wearing qualities of the flat road being highway No. 5117, 6 miles of penetration consisting of a 3-in. top on but 3 in. of broken-stone

base. This was built in 1912 at a cost of 87.2 cents per square yard, and is in almost perfect condition now. Not only does the high-crown road encourage driving in one track and consequent rutting, it also seems to be more susceptible to other forms of disintegration, the relation of which to the shape of the road is more or less a mystery.

Second-Class Concrete

It will occasion no surprise, nor need it give concrete-road advocates any particular concern, to know that the so-called second-class concrete roads built in New York from 1912 to 1914 have gone all to pieces. These roads were built with a 1:3:6 mix. If proof is needed that such a mixture is foredoomed to failure it may be found in the present condition of the concrete road (No. 5179) built in 1912 between Schroon Lake and North Hudson; in 6 miles of road between Upper Jay and Keene (No. 5236), which was apparently built without expansion joints; and in the condition of the 1912 road near Java (No. 976), hardly enough of which remains to show that the road was built of concrete. The latter road was abandoned by the contractor prior to its completion and never accepted by the state. These roads are only interesting as danger signals and as additional evidence that good concrete roads cannot be built with lean concrete mixtures.

The desirability, if not the absolute necessity, for side support for bituminous roads has long been known. This is shown in the breaking down of the edges of curbless roads and has necessitated extensive repairs on many roads which, otherwise, have required no maintenance. A concrete header has many advocates, but is objectionable to the extent that it makes a sharp line of division between the road surface and the softer shoulder. Earth shoulders usually drop 2 in. or more below the surface of the header within a very short time after they are built. A better practice, which appears to be the rule in the Borough of Queens, New York City, is to use old stone for building out the shoulders a distance of about 18 in. This stone is penetrated with asphalt, and not only provides side support but makes it easy for vehicles to turn out without damaging the edge of the road surface—or the vehicle. Such a shoulder follows the contour of the road and carries surface drainage well away from the road proper. In these respects it is better than a simple concrete header and costs less.

Criticism Is Answered

By H. ELTINGE BREED

First Deputy Commissioner, New York State Highway Department, Albany

I am glad of the opportunity to reply here to the interesting "Notes on New York Road Conditions" because your paper not only has an established reputation for fairness, but also a strong influence in promulgating better highway work.

It is very true that many of our roads broke up last spring and that the repairs of these breaks were made with telford or a sub-base and drainage. The criticism of these break-ups says that all of this work should have been done before the improved road was built. That is true and that is just what this department is trying its utmost to do with every highway under construction now. But it must be remembered in respect to the old roads that the conditions of traffic under which they were built have been revolutionized by the advent of the motor and the motor truck. Roads built even as late as five years ago were calculated to endure far less strain than is being thrust upon them to-day.

Vehicle Weights Increase

This department as a department built its first roads in 1899. All of the earlier roads from that time on until about 1905 were built in the main for corresponding traffic. They were almost wholly of the gravel and waterbound types, 6 in. in thickness. During the six years there was built 519 miles of these two types and only 53 miles of brick pavement. These roads were built for existing loads of from 1 to 3 tons. To-day in many cases they carry loads of from 10 to 16 tons, and in some cases more than that. Is it any wonder that they should break up?

In design these roads were either two 3-in. courses of waterbound macadam or a 2-in. top with 4-in. bottom course. Where soft spots were encountered the poor material was removed and gravel or broken stone placed. This was customary until about 1908, when the total depth of our roads was increased from 6 to 9 in. Since then it has been increased in many cases to 12 in. in depth.

Moreover, wherever any soft spots have developed there is additional sub-base placed which forms an additional depth and gives foundation for the unstable soil. At the same time drainage is provided as a matter of economy. It was considerably cheaper occasionally to fix a small break-up by maintenance and repair than to provide extra stone the whole length of the pavement.

As an evidence of the consideration that the department is showing now in the design of its new roads, especially where they involve unusual conditions, I might cite Road No. 580 from Fancher to Brockville. This road feeds a Medina block quarry for which the shipping point is Fancher. The excessive hauling passes over about ¾ mile of this road from the railroad station to a point opposite the quarry, and this section has been constructed as Medina block pavement on concrete foundation, while the remainder of the road, 2.12 miles in length, which has lighter traffic, is being designed as bituminous macadam. This is only one of many such roads that are being built in New York State to-day.

Flat Roads

I partly agree with the writer of the foregoing article that flat roads are good. It is true that the flat crown roads encourage the spreading of traffic more uniformly over the surface of the pavement and consequently there is less wear. This department is using as crown for its roads ¼ in. to the foot on concrete, brick and pavements of the Topeka type; in general ⅜ in. to the foot on bituminous macadam, ½ in. to the foot on roads of the waterbound type and on gravel roads about ¾ in. to the foot. These crowns represent the average of conditions that we have and seem to give the best results.

In regard to the side support for bituminous roads, I might say that the suggestion of using stone block would be very costly on our state roads on account of the lack of supply of this material and the long hauls plus freight charges. While presumably the suggestion would make good practice in localities where plenty of stone blocks are available and where there is a great deal of turning out of traffic in such manner that it rapidly tears away the edge of the pavements, from what I have observed throughout the state of New York it scarcely seems as though the amount of repairs necessary to bring back the shoulders that are worn away is great enough to warrant such a very costly type of original construction. In all cases where it has seemed good economy we have provided stone shoulders to come next to the bituminous pavement. For the Topeka mix pavements that we have laid I will say that we have in practically every case provided them with a concrete edging. We have used stone-block pavement set in mortar for shoulder protection against flood since 1911. On sections of road that are subject to wash on shoulder we have provided stone paving from the edge of the pavement to the outside of the ditch. To-day we are constructing concrete block pavement on the shoulders and slopes of roads affected by flood water overflow.

Second-Class Concrete

In regard to this type of pavement very little needs to be said. These roads were built a few years ago of a 1:2½:5 mix and a 1:3:6 mix of stone in some cases, and in many other cases of gravel and run-of-bank gravel, which, with the use of average sand, gave results which in some cases have gone to pieces. However, of the large amount of this type of road built at that time some has since been repaired and covered with bituminous top, making to-day a very satisfactory pavement to ride over. The department has not, to my knowledge, built any of this type of pavement for the last two years, and it is now building only the cement concrete pavements of the 1:1½:3 mix, which needs no apologies.

I heartily agree with the writer of these comments that good concrete roads cannot be built with lean concrete mixtures, nor can they be built with poor fine or coarse aggregate. Good sand is just as essential in this type of construction as good cement, and this department to-day is taking every means possible to assure it of getting good results. We not only test all materials before they go into a pavement, but we test the mixture of the concrete as laid, 6-in. cubes being taken from batches at intervals and sent to our laboratory, where they are tested at the end of 28 days. Our requirement is for 3000-lb. compression test per square inch of surface, allowance being made for work done in the fall, and if the sample does not show this, we immediately look for the trouble. To-day we have 185.21 miles of finished and accepted concrete pavement of the 1:1½:3 mix, as well as 306.25 miles of this type under contract, and for service and durability they compare favorably with the best pavements in New York and other states.

By F. W. SARR

Second Deputy Commissioner, New York State Highway Department, Albany

Referring to the comments on the practice of this department in the construction and maintenance of improved highways as expressed in the memorandum furnished by the Engineering Record, I desire to take exception to some of the statements contained therein, particularly to

those pertaining to surface treatment of macadam pavements:

SURFACE TREATMENTS

The question of the amount of cover material to be used in connection with the treatment of macadam surfaces with light asphaltic oil or tar is a debatable one. The experience of this department has demonstrated that the best results are obtained where a minimum amount of cover material is used, particularly in the treatment of bituminous macadam pavements or waterbound macadam pavements which have been previously treated and have a close or tight surface. This contention is based on the theory that the function of a surface treatment of a bituminous macadam pavement or a waterbound macadam pavement, which has more or less of a mat on the surface formed by previous treatments, is to flux and give new life to the old bituminous material in the immediate surface of the pavement. It is not the function of a surface treatment to build up any appreciable thickness of mat under these conditions. This result being desired, a minimum amount of cover material is applied to the treatment in order to allow the new bituminous material to perform its function instead of being immediately blotted up into a heavy application of cover material.

PRIMARY FUNCTION OF SURFACE TREATMENT

The primary function of a surface treatment is to preserve the immediate surface of a pavement and not to build up additional thickness. In preserving a surface a bituminous material must withstand not only the disintegrating effect of the high speed traffic but also the abrasion of the slow moving iron-tired traffic. In the first instance it acts as a cement in bonding the fragments of crushed rock in the immediate surface of the pavement together with such cover material as is applied in conjunction with the treatment, and it is well known among users of Portland cement that the strength of the mortar is diminished as the amount of sand is increased. The same reasoning holds true in so far as the cementing qualities of the bituminous cement are concerned.

Under ordinary conditions the loose sand contains about 35 per cent of voids, which may be reduced to perhaps 20 per cent by compression. The average rate of application of a surface with cold material is about ¼ gal. per square yard. At this rate about 11½ cu. yd. of bituminous material are applied per mile of macadam pavement 16 ft. in width, which is covered with from 30 to 50 cu. yd. of sand or fine crushed stone.

BITUMINOUS MATERIAL ONLY SMALL PART

It is seen therefore that the bituminous material is only from 20 to 35 per cent of the loose aggregate of the cover material, which provides very little over the amount required to fill the voids in the cover material, not considering the amount of light volatile oils contained in cold application material which soon evaporates, and the amount that penetrates the old surface of the pavement.

In the use of Portland cement with sand for concrete purposes the practice is to provide cement equivalent to from 33 to 50 per cent of the loose sand, or about one and one-half times as much cement as compared with the sand the department uses in combining bituminous cement with sand for surface treatment of macadam pavements, notwithstanding the aforesaid loss by evaporation and penetration.

QUALITY OF SAND COVER

In connection with the use of sand for cover containing a percentage of loam or clay, it is not contended that the results obtained by the use of such sand are equal to those obtained where clean, coarse, sharp sand is used. The use of sand containing a percentage of loam or clay is simply a question of economy. It is a fair estimate to state that not more than 10 per cent of the improved highways of this state have, within 5 miles of the highway, local pits from which clean, coarse sand may be obtained. It is then a question of importing selected material or using the best local material that the community will provide. While I prefer a clean, coarse sand for cover, still, considering the results we have obtained from sand containing a percentage of loam, I am inclined to believe that the importance of the grade and quality of the material used for cover is overestimated.

It is stated in the comments that the conclusion must be drawn that quite different treatments should be applied to bituminous macadam pavements than to the waterbound type, and two highways are specifically mentioned as examples of bituminous macadam pavements which have been injured by treatments of light oil. I have driven over both of these roads two or more times during the past season and did not observe the mushy or rutted condition of the surface to which the comments refer. The statements in regard to the treatment of the roads are erroneous, and such errors would tend to discredit the statements in regard to the condition of the pavements.

CONDITION OF OIL-TREATED ROADS

It is stated that on the Ballston Road (No. 5062) the portion outside the village was given a surface treatment and the portion inside the village was not treated, and that the latter portion, which was not treated, was in much better condition than the portion of the pavement outside the village which had been given a surface treatment. The records of the department indicate that no portion of this road had been given a surface treatment until July of the present year, when the entire length of the pavement, both inside and outside the village, was given a light treatment of light oil. It is therefore evident that, provided there is any difference between the section of pavement within the village and the section without, this difference must be the result of something other than surface treatments, as both sections at all times have been in the same identical condition so far as surface treatments are concerned.

The statements in connection with Road No. 672—Columbia County—are to the effect that a surface treatment of "light oil has resulted in mushing up the surface of the road, notwithstanding which a contract for reoiling with light cold oil has been let." The records indicate that Road No. 672 is something over 6 miles in length and that in 1915 about 3 miles, or one-half the length of the road, was given a treatment with light cold oil, and this year, after observing the effects of the first treatment, the division engineer recommended the same treatment for the other half or remainder of the road. It does not appear credible that after treating one-half the length of a road and observing the effects of the treatment for a year, and providing it was apparent the treatment had been injurious to the surface, the remainder of the road would be given the same identical treatment.

The comment also states that where seal coating had been carried out with heavy asphaltic cements the results are uniformly much better than those obtained with the lighter materials. This statement is purely a theory and surely not the result of the observation of the maintenance of the New York State improved highways, for the obvious reason that only few seal coats or light surface treatments with heavy asphaltic binder have been given as a maintenance proposition to New York improved macadam highways, and none of those so treated have, to my knowledge, proved a success. Some heavy surface treatments with binder have been given to old macadam pavements for the purpose of building up and truing up the old surface by increasing the depth approximately 1 in. This treatment could not, however, be termed "seal coating," but rather a light resurfacing by the penetration method, where stone of ¾-in. size is used as the aggregate, which is rolled and consolidated with a steam roller in the manner of penetration macadam construction. The cost of such heavy treatments is at least four times as much as that of the light cold oils, and they are employed only to restore a surface which shows material deterioration and are only a makeshift for regular resurfacing necessitated by lack of funds and are not recommended.

It is therefore evident that the comments referred to are not based on a close observation of the results of the maintenance work in this state, and I do not believe, as a whole, they should be taken very seriously.

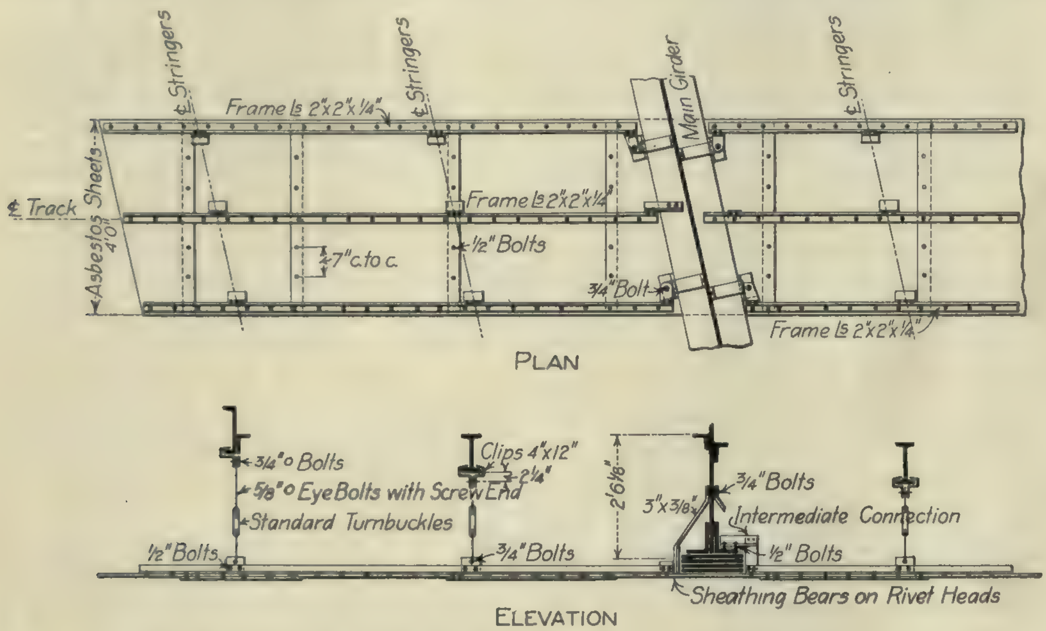
Road Maintenance Men Scarce

Few men are experienced in the maintenance of various types of roads, according to a statement by B. H. Piepmeier, maintenance engineer, Illinois State Highway Department, in the October issue of *Illinois Highways*. There seems to be a tendency to shun this phase of road work in preference for construction. The fussy methods necessary do not appeal to them. Again, the usual plan for making repairs on a road is to wait until it becomes almost impassable and then hurriedly secure the services of the first man available for doing the work, with very little thought as to his experience. A good maintenance or repair man cannot be trained in a day or one season, nor can a road be effectively maintained by only occasional consideration. Effective and efficient maintenance is accomplished only by constant attention of the experienced man that will give personal attention to all details of the work. It is the utter neglect of maintenance and improper methods followed by many road officials that have molded the sentiment of the masses of people against such work. The neglect of maintenance has not only served to destroy many useful and economical roads, but in many cases has molded sentiment to have no faith in any type of road that requires annual maintenance. This neglect and inefficiency on the part of many road officials have led road promoters to disregard the type of road which in many cases would be most economical for a community.

Asbestos Sheathing Protects Steel Overhead Bridge

Bolted Frame Hung from Under Side of Floor Above Center Line of Tracks Supports Asbestos Sheets

AFTER more than a year's service a relatively simple form of protection for the under side of the Whitehall Street bridge over the Western & Atlantic Railroad tracks in Atlanta, Ga., has proved to be completely satisfactory in preventing the loss of metal due to the cutting action of the locomotive blasts. It is claimed by the engineer who designed the asbestos sheathing and steel frame here shown that the principal cause of loss of metal in such overhead bridges is the blast, rather than corrosion or effect of gas. This claim appears to be substantiated by the fact that although the protecting shields extend only 2 ft. on each side of the center of each track under the bridge and the smoke and gases have access to the metal, no evidence of any further loss of section has been found.



FRAME SUSPENDED FROM BRIDGE STEEL SUPPORTS ASBESTOS SHEATHING

Frames 4 ft. wide over the center lines of each of the eight tracks running beneath the bridge are supported from the stringers or the main girders by clips and adjustable hangers, as shown in the drawing. Clip angles are bolted to the frame angles, and eyebolts connect to them, as noted, by ¾-in. bolts. At the main girder two types of support are used. The intermediate connection is a 2 x 2 x ¼-in. angle embedded in a 1:2 Portland cement mortar on top of the lower flanges of the girder; the outer connections are bent straps bolted to the web of the girder as shown.

The asbestos sheathing was obtained in standard 4 x 4-ft. sheets ⅜ in. thick. Instead of using brass bolts as first planned for all cases of exposed heads below the sheets, a satisfactory protection was obtained by using a 1:3 Portland cement mortar and asbestos fiber, placed as a hemispherical covering over the bolt heads by using a cup-shaped form in a small block. The bolt protection has remained intact.

This design is the result of considerable study by C. E. Kauffmann, engineer of bridges, Department of Construction, city of Atlanta. The asbestos sheathing was furnished by the Keasbey & Mattison Company, Ambler, Pa.

Recommend Isolated Sewage-Treatment Plants for Lake Cities North of Chicago

Messrs. Alvord, Eddy and Fuller Advise North Shore Sanitary District Trustees to Empty Chlorinated Effluent from Imhoff Tanks Into Lake

TO discharge the chlorinated effluent from Imhoff tanks into Lake Michigan opposite each separate municipality is the advice given to the North Shore Sanitary District trustees having in charge the disposal of sewage of 36,000 people living in a 20-mile strip 1¼ to 3 miles wide bordering on Lake Michigan in Lake County, Illinois. Seventeen different projects were studied by the board of consulting engineers, John W. Alvord, Harrison P. Eddy and George W. Fuller, after the collection of preliminary data for the trustees by Langdon Pearse and S. A. Greeley. The trustees, headed by W. J. Allen, chief engineer of the Waukegan waterworks, have recently published the report from which are taken the following basic data as to size and capacity of treatment plants and reasons for adopting the scheme:

Provision for Future

Structures such as collecting sewers, force mains and pumping-station buildings, which cannot economically be enlarged to meet the increased demand of a growing community, have been estimated to provide for a maximum of 400 gal. of sewage for each person assumed to be connected with the sewers in 1950.

Sewage treatment works can be built in units with additions added later as required, and hence the present estimates of cost are applied to structures of a size to meet the needs of the 1930 population.

Although the pumping-station buildings will be designed of a size sufficient to accommodate the machinery required to pump the 1950 maximum rate of flow, only such portion of the machinery will be installed at the outset as will be required to meet the maximum 1925 rate.

Main Features

Grit Chambers—For the Waukegan sewage from combined sewers, grit chambers will be provided to give a flow for a distance of about 60 ft. in a series of tanks in which the velocity of flow is from 8 to 12 in. per second.

Imhoff Tanks—The sedimentation compartment is taken as equivalent to 3.33 and 2.22 cu. ft. per capita for the flow of combined and separate sewers respectively. This will provide two hours' sedimentation for an average flow of 300 gal. in 25 hr. per capita, or 3 hr. sedimentation for an average flow of 200 gal. per capita in the case of combined sewers. With separate sewers there will be a 2-hr. sedimentation period at the flow of 200 gal. per 24 hr.

The piping connections and "freeboard" of the tank would be arranged so that if desired at the beginning of storms as much as 900 gal. per capita of storm flow of combined sewers could be passed through the tanks.

Capacity of Sludge-Digestion Tanks

The capacity of the sludge-digestion tanks has been estimated in accordance with Dr. Imhoff's advices, as follows: For small plants treating the flow of separate sewers and with a population of less than 5000 people, the digestion chamber is taken as 2.4 cu. ft. per capita. For materially larger plants to treat the flow of separate sewers, the volume may be reduced progressively to 1.2 cu. ft. per capita. For combined sewers in large cities like Waukegan digestion chambers are taken as having a capacity of 1.8 cu. ft. per capita.

For sludge-drying beds an area has been provided for the flow of separate sewers equal to 1/3 sq. ft. per capita, with an increase of 50 per cent in the case of the flow of combined sewers.

Trickling Filters—These have been figured on the basis of an effective depth of 6 ft. with a load factor taken as 20,000 people per acre in the case of the flow of separate sewers and 12,500 persons per acre in the case of combined sewers.

Contact Beds—Estimates have been prepared on the basis of treating the settled sewage flow from 2500 persons for each acre of contact bed of a depth of 4 ft.

Sand Filters—Estimates are prepared on the basis of treating the settled sewage flow of 1000 people per acre of filter surface with beds averaging 30 in. deep.

Chlorination—The estimates provide for automatic devices in duplicate, whereby with the aid of a weir chlorine would be applied to settled sewage and to all storm overflow in quantities as required up to about 100 lb. per 1,000,000 gal.

3-Hour Minimum Aëration Periods

Activated-Sludge Process—For the activated-sludge process estimates have been prepared on the basis of a minimum period of aëration of 3 hours at the maximum rate of sewage flow. For the aërating tanks, having an assumed depth of 15 ft., air is figured at the rate of 1 2/3 cu. ft. per gallon of sewage treated. The plans include also a sedimentation tank providing 1 hour's sedimentation at the maximum rate of sewage flow; a sludge-storage tank holding ten days' output of sludge; and sludge-drying facilities consisting of either sludge-

drying beds of an area ten times as great as that for the Imhoff tanks or else presses to treat from 0.75 to 1 ton of dry solid sludge per 1,000,000 gal. of sewage taken as of a strength of 100 gal. per capita.

Costs of Operation—It was estimated in the various projects that a central office and laboratory would cost about $4,500 per year. This sum would include the services of a superintendent and also a chemist and bacteriologist, with allowances for an automobile and various laboratory and general supplies. In the estimates of cost of construction there is an item of $15,000 allowed for a central office and laboratory building.

ALLOWANCE FOR LIQUID CHLORINE

The allowance made for liquid chlorine is on the basis of 17 cents per capita per annum, equivalent to a dose of 30 lb. per 1,000,000 gal., with chlorine at 10 cents per pound, and with the sewage assumed to be of average strength of 150 gal. per capita daily in all projects except activated sludge, dealing with the treatment of sewage on the lake shore. A further allowance for the chlorination of storm overflows has been made and taken as equivalent to 20 per cent of the cost of chlorinating the ordinary dry-weather sewage flow.

The cost of pumping is estimated on the basis of using electric current at prices quoted by the local electric company and ranges, for different-sized pumping stations, from about 1 1/3 cents to 3¾ cents per kilowatt-hour. The cost of power for aërating sewage in the activated-sludge process has been arbitrarily taken at 1 cent per kilowatt-hour at Waukegan and 2.3 cents at the other stations.

The project selected would eliminate as far as possible long and expensive collecting systems of sewers, pumping stations and other radical extensions of the present local sewer system. It would introduce new sewage-disposal plants for populations not now provided with sewage treatment, improve the plants now existing, which appear to need improvement, and properly enlarge and much better operate existing plants which appear to be of good design and of reasonable capacity.

ADVANTAGES AND DISADVANTAGES

The plan suggested can be put in operation more rapidly than any other project herein considered. It will cost less for construction and operation than any other project. It proceeds along lines in which the engineers have had large experience and which they feel certain will be successful. Under a continuing policy in systematic skilled supervision, such as is possible under the management of one board, it can be made to give satisfactory results, while under separate ownership and lack of skilled supervision and technical control it has heretofore failed. It requires less length of intercepting sewer, disruption of pavements and general upheaval of existing conditions than any other project. It has the advantage of utilizing the natural oxidizing agencies of the lake water for the final stage of purification.

Against these items are the disadvantages, as follows: The mere presence of a sewage-treatment plant, even if operated so as to be inoffensive, prevents many persons from indulging in the full enjoyment of the most attractive beauty of the lake shore. The plants are necessarily located at the mouths of the ravines, points where the public has most occasion to have access to the lake. Some of the plants are, and will be, unfortunately, near the small lake-shore parks and bathing beaches. If in the future the policy of the Sanitary District trustees should become so penurious as to restrict operating expenditures improperly, rely on untrained supervision and abandon necessary care, then the plants will become offensive and dangerous again, as is now the case. With lack of attention, as cited, and growing population, the plants, if abandoned as to care, are likely to allow the sewage so to pollute the lake as to become a menace to the water supplies of the various municipalities, even if filtered. The presence of handsome estates and beautiful homes in the immediate vicinity of the plants will always necessitate much more careful and skillful operation than is required at many sewage-treatment plants more favorably located.

Nevertheless, the engineers held that they could see no reason why this project, with proper engineering design, suitable technical supervision and adequate expenditures for maintenance as estimated, could not be made quite unobjectionable from every point of view, and, with adequate filtration of the domestic water supply, entirely safe from a sanitary standpoint. This project is also the cheapest, the estimated cost being $477,470 for sedimentation and chlorination works, and the annual cost will be $37,900. Exclusive of collecting sewers, pumping stations and land, the cost is $27,780, and the yearly cost $27,780—and this for plants which would remove practically all solid matters which would settle out in water and from 90 to 95 per cent of the bacteria in the sewage and in all storm flows. Outlet pipes extended into deep water would remove all questions of nuisances at the beaches, and no odor should be noticeable from 100 to 200 ft. from the plants.

ACTIVATED SLUDGE TOO EXPENSIVE

The activated-sludge treatment would cost something less for investment than

Before and After Building Soil Roads in Two Virginia Counties

THE effect of road improvements in Brunswick and Lunenburg counties, Virginia, is indicated by the photographs. The views on the left show conditions as they were; those on the right picturize the condition of the same two spots after improvements had been effected. In Lunenburg County 45 miles of top-soil road was built by convict labor at $800 a mile, 60 miles at a unit cost of $1,000, and 40 miles was contracted for at $1,250 a mile. The roads were graded for a width of 24 ft., with 20 ft. of resurfacing 10 in. deep at the center. In Brunswick County most of the work was on the old Petersburg-Boydton plank road, built in 1850. No repairs were made recently. Not long ago a stretch of 24 miles was improved at a cost of $1,000 a mile, as shown in the lower views. G. P. Coleman, state highway commissioner, furnished the pictures and data.

would sedimentation tanks and chlorination, but the operating cost under the unusual local conditions becomes so much in excess of that chosen that the engineers felt constrained on present evidence to advise against its adoption.

The advantages of the activated-sludge method over Imhoff tanks and chlorination are that it would remove more of the organic impurities and produce a clear, nonputrescible effluent, which would need no chlorination. It is also probable that there would be less likelihood of odor around an activated-sludge plant than near Imhoff tanks, although not much significance was attached to this point in either case.

The single disadvantage to this process seems to be in its excessive cost under local conditions, where the amount of air applied appears to be very high for this exceedingly dilute sewage because of the necessity of applying sufficient air thoroughly to mix the activated sludge with the sewage for a period of at least three or four hours. Furthermore, under local conditions the amount and cost of power due to pumping and aërating are greater than they would be for large central plants, as figured for Milwaukee or elsewhere. This is true of the scattered plants required on the southern end of the district, where it is necessary to provide several treatment plants or else to go to quite heavy expense for collecting sewers. On the question of sludge disposal, the evidence is not complete and therefore the engineers feel obliged to use estimates of cost based on experience at Worcester in pressing the sludge, with the figures expressed in tons of dry solids.

The final statement is that there is no advantage to offset the added total cost of the activated-sludge treatment in comparison with sedimentation and chlorination.

INTERIOR VIEW OF FINISHED FLOOR SHOWS DUCT OPENINGS IN COLUMNS

Hollow Columns and Roof Ducts to Ventilate Concrete Building—Floors Waterproofed

New Cluett, Peabody & Company's Factory at Troy Designed to Provide Floor Drainage and to Eliminate Dust by Ventilation System

ANOTHER example of the use of hollow columns of reinforced concrete (see the Engineering Record of Nov. 18, page 620) is Cluett, Peabody & Company's new building at Troy, N. Y., now in course of construction. Instead of cast-iron duct outlets, the columns are cast with the desired curved openings near the ceiling and additional steel reinforcement is placed around these openings. Another unusual feature of this structure is the waterproofing of parts of the two upper floors to provide drainage facilities where collars are starched after washing. Double-glazed windows are furnished in order better to insulate the building.

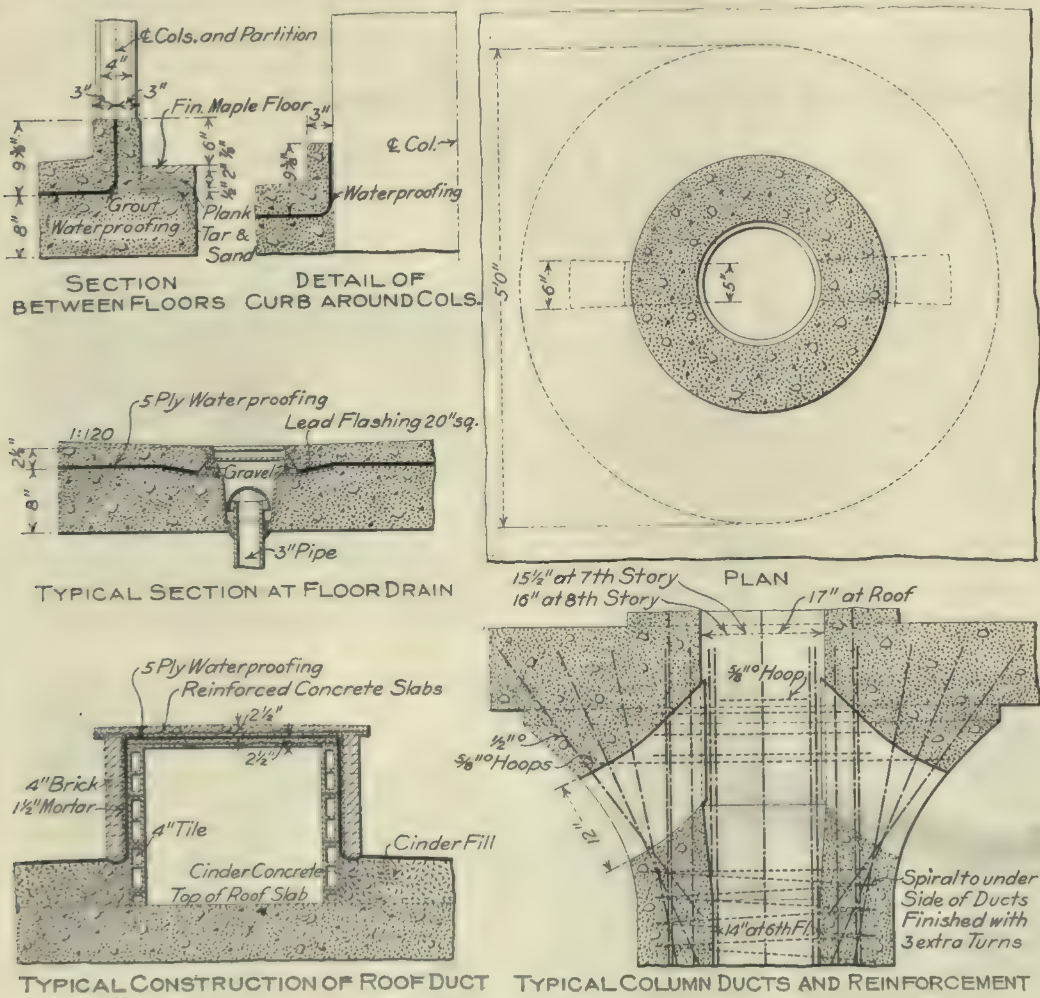
The new main manufacturing building is eight stories high, with basement, adjoining the present six-story building on the north. The plan consists of a rectangular portion 100 x 175 ft., with a projecting wing on the south side two bays wide and over five bays long. The bays are nearly equal in the two directions, forming floor slabs 20 x 22 ft. in size. The building is located at the intersection of Hutton Street and the Hudson River. As the street slopes downward toward the river on a steep grade, a retaining wall for the earth backfill was necessary. This was designed as a vertical 12-in. slab between the floors, using ¾-in. vertical reinforcing rods on 6-in. centers, with ½-in. temperature rods placed horizontally above the grade line on the outside. The basement, in which is stored coal for winter use, is often flooded when the river rises.

The typical floor slab is 8 in. thick, reinforced by ½-in. rods in two directions. Upon the rough slab is placed a leveling coat of tar (Tar Rok) ½ in. thick, then a 2-in. layer of spruce plank faced one side and the wearing surface of ⅞-in. matched maple flooring, after treating the plank underflooring with creosote oil. The two lower floors were designed for 150 lb. per square foot live load, and the upper floor for 100 lb. At heavy machines the slab was increased to 10½ in. thickness and reinforcement added.

FLOORS WATERPROOFED

Parts of the seventh and eighth floors are waterproofed by 5-ply felt and pitch, with special curb details at edges and around columns, as shown in one of the drawings. Floor drains, one in each panel, are central in one direction and about 6 ft. from the line between columns in the other direction. Tests of these floors showed absolutely watertight construction.

As the part of the building first completed contains no elevators, it was decided to furnish temporary service by constructing a shaft of timber framing on the outside, covered with galvanized iron on wooden sheathing. This frame is indicated



TYPICAL COLUMN AND ROOF DUCTS AND DETAILS OF WATERPROOFED FLOORS

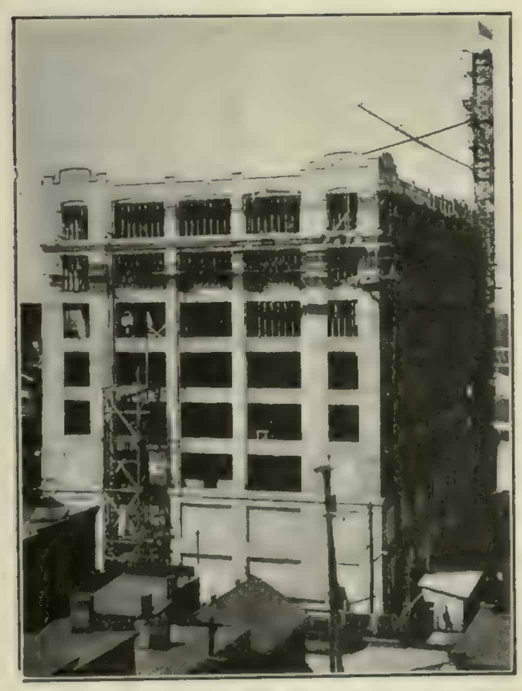
ROOF DUCTS UNDER CONSTRUCTION

in one of the photographs. A sprinkler system of the dry-pipe type is installed, as shown in the photograph of the interior.

The main columns are hollow, reinforced by vertical rods and outer spiral steel, with the spirals stopping at the duct outlets, as indicated on one of the drawings. Special rod reinforcement is provided around these openings, which are formed by the use of properly shaped curved boxes inserted before placing the concrete in the column forms. The forms were of steel inside and outside, the inner form remaining permanently in place as a duct lining. A blower system of ventilation is used, the column ducts being connected at the roof to roof ducts which converge in the pent house on the wing where the fans are located. Details of these roof ducts, which are carefully waterproofed, are shown.

As it is essential in a factory of this kind to exclude all dust, not only washed air for the ventilating system but double-glazed windows have been used. On the outside ¼-in. ribbed wire glass and in the inside ⅛-in. ribbed glass are used in the steel sash (Lupton type).

The building was designed and constructed by Westinghouse Church Kerr and Company, engineers and constructors, New York City. H. H. Forsyth was engineer in charge and D. Tattrie was superintendent of construction.



OUTSIDE ELEVATOR FRAME FOR TEMPORARY USE BEING ERECTED ON LEFT

What the Development of Foreign Trade Means to the Engineer

Expansion of His Field Depends on Investment Abroad—Progress to Date Has Been Small—Lack of Trained Men Serious Handicap

By F. LAVIS
Engineer, American International Corporation, New York

THE ANALYSIS of the present industrial situation in this country as set forth in Mr. McGraw's address (Engineering Record, Nov. 4, 1916, page 554) is most timely. It seems extremely important that engineers especially should realize what the conditions are, as on a correct solution of the problems confronting us, and especially on the possibilities of extending our activities into foreign fields, depends a great deal of their future.

Engineers are coming to realize more and more the necessity of co-ordinating their technical knowledge with a reasonable knowledge of both financial and commercial conditions, and in view of the great possibilities of extraordinary changes in the general financial and commercial situation in the near future—that is, within the next two to five years—it seems not inappropriate to emphasize further some of the features of Mr. McGraw's address and also to extend the argument somewhat.

PRESENT PROSPEROUS CONDITIONS

Our manufacturing plants are running at full blast and their capacity is increasing at a really tremendous rate. One large engineering firm of which the writer has knowledge has 250 draftsmen employed and contracts for work totaling \$20,000,000, nearly all for manufacturing plants; and this seems to be typical of general conditions all over the country, or at least in the manufacturing areas, and these latter are being rapidly extended. Our crops are good, prices are high and money is plentiful—in fact, too plentiful, as credits are tending to become too much inflated.

The writer knows personally of one manufacturing concern with a nominal capital of \$100,000 doing a business this year of nearly \$3,000,000 gross, which requires a cash capital of \$500,000, all of which is obtained with the greatest facility from the banks, which latter indeed even almost urge larger borrowing.

BASIS OF CREDIT

A quotation of \$43,000 was made a few weeks ago for a locomotive that two years ago could have been bought for \$23,000. Wages are all high, they are getting higher, the cost of living is increasing and we are building a beautiful pyramid which is a most stable structure as long as its base is solid. Our financial pyramid of credit is, however, based on our gold reserve; that is, on our stock of gold.

Frank A. Vanderlip likened our credit system and the gold reserve on which it is based to a cone of sand piled on a dime. If we increase the dime to a quarter and maintain the same ratio of height to base the volume of the cone is increased in a much greater proportion than the increase in the base.

Our present large possibilities of credit based on existing large holdings of gold will therefore be a most serious menace to the stability of our industrial structure if the base is appreciably diminished, as it will be if and when conditions cause the flow of gold to be turned back toward the European countries.

It is because of this that some of our leading financial interests, leading because they are farsighted, believe that we must encourage foreign trade in order that we may pay for our future requirements of foreign-produced goods and raw materials with materials rather than with our present store of gold.

EXCESSIVE MANUFACTURING CAPACITY

Before the war, say in 1913-14, it was estimated roughly, as I remember the figures, that our manufacturing capacity was some 25 or 30 per cent greater than our normal domestic needs, plus what little foreign trade we then had. With the present increase in manufacturing plants, even allowing for the scrapping of many of them of more or less temporary character, but realizing that the increase is likely to continue for another year and quite likely two years, we shall find ourselves by the time Europe begins to take hold again after the war, and it will not be very long after, with a manufacturing capacity two or even possibly three times as great as we need for our domestic needs.

If our foreign trade has not then developed and been placed on a sound basis we shall be faced with a very greatly lessened demand, a curtailment of credit, a generally lessened wage scale, a consequently lessened domestic consumption; in fact, unless the wisest counsels prevail in the meantime, an economic crisis.

EFFECT OF TARIFF WALL

We may possibly build a tariff wall high enough to keep out foreign staple manufactured goods, but this can be only a temporary makeshift, and we shall die of dry rot from attempting to live within ourselves. There is the most urgent need today for industrial preparedness which will permit us to fight and win the battles for the foreign markets which will be most intensely fought after the war and which we must win if we are to retain any commanding place in the markets of the world.

It is assumed to be impossible to lower the scale of wages in this country, and therefore it seems to many that we must use a high protective tariff and keep out the lower-priced goods of Europe. On the other hand, however, if we do that we keep up our high wages and thus shut ourselves out from foreign markets. A tariff which is too low means foreign competition in our domestic markets. There is undoubtedly a happy medium, but it will require something better than muddling to strike just the right mean with the tariff to keep our wage scale up to the highest reasonable level and yet permit competition in foreign markets. Experience has shown that with a wage scale quite a little higher than that of Europe we can still compete. It is entirely probable that the cost of production in Europe will be increased to some extent, but it seems improbable that we can compete and maintain our present scale of wages.

In spite of all the talk soon after the war started that we were in a position to capture a large part of the trade in the foreign markets of the world, we have made comparatively little progress. Our trade has increased, of course, because the production of Europe has been greatly reduced, but foreign nations have been buying only American goods which they needed so badly that they had to have them, and which they could not obtain elsewhere. This, however, is hardly a firm basis for an established foreign trade.

Foreign Investment

It is a *sine qua non* that our foreign trade will be firmly established only when backed up by the investment of our capital in the countries which need it for their development. Up to the present time the United States, England, France, Germany and Belgium have been the great manufacturing countries which have supplied manufactured products, particularly those of steel and the textiles, to the world. Incidentally, they have also supplied the capital for the development of these other countries which produce foods and raw materials in excess of their own needs. The people of these latter countries usually lack the capital and the natural inclination to exploit successfully the transportation systems on which their development depends, so that foreign capital and foreigners are required for the development of railways, general public utilities, water powers, sanitation, lighting, mines, etc., leaving the people of the country free to develop their own natural pastoral and agricultural resources.

It is in this development of transportation, etc., that American engineers hope to have a share. It has been previously noted that far-sighted American financiers and business men have realized the necessity for our entrance into the field of foreign investment of our capital, not only because it is solely by this means that we can obtain a firm hold on foreign markets and create a continuous demand for our manufactured products, but also because if we can make these investments safely and with the assurance of reasonable profit we have an additional means of maintaining our financial position with the leading nations of the world.

An Illustration

The following may be cited as a fairly typical illustration of the financial operation, taking an actual case.

A certain railroad which it is proposed to build in South America is estimated to cost $7,000,000. Of this not more than $3,000,000 will be spent for labor in the country, of which $2,000,000 will be returnable as subsidiary in bonds payable within, say, 10 to 20 years; that is, for an outlay of $1,000,000 in cash (gold) outside of this country we acquire a $7,000,000 investment abroad. We contribute steel rails, steel bridges, locomotives, cars, etc., our trained engineers and administrative skill and ability, but these are materials we produce ourselves. They are valuable, but they are not money, and if we retain the money we retain by that much the base of our pyramid. This is our credit, and therefore the ability to produce more goods. If we let England or France do this work and lend them the money with which to do it we reduce the base of our pyramid by $7,000,000 instead of $1,000,000. In addition we sacrifice the future market and possible foreign friends.

It seems very evident therefore that we should make foreign investments, and offhand it seems very simple. In actual practice, however, it is rather more difficult than it appears on the surface. There are two reasons for this: First, we can get a higher rate of interest on our capital right here at home than foreign countries have been accustomed to pay; second, our methods of business are different from those of the European nations with which these foreign countries have been accustomed to deal; and, third, we have only a very minute proportion of our people educated either to take up foreign securities (outside of the government loans of some of the most important countries) or as foreign administrators for construction or operation.

There has been a theory that foreign securities might be held by a corporation formed for this purpose which would issue its own debenture against them. This might well be done to a certain extent, but really its possibilities are so limited that until the investing public generally participates in such investments and absorbs them there is little hope for such a development of this field as is necessary if America is to obtain a fair share of the markets.

Trained Men Lacking

The difficulty in regard to training efficient administrators is also a serious one; with even our very limited demand to-day it is felt. We have the ability to make good, but we lack actual experience in the foreign field, and many men will be tried who have made good at home but will fail abroad, so that the process of building up a large class of men who have technical or business ability, knowledge of foreign languages and ability to live on terms of amity with foreigners in their own country, and who will not let the sometimes almost intolerable loneliness drive them to dissipation, is one which is going to require infinite patience.

The third reason, namely, that foreign countries have not been accustomed to pay as high a price for their money as we require now, because the price is regulated by the demand and we cannot make foreign investments at a lower rate than or even as low as we can obtain at home, is one which will adjust itself in time, but which is a very real factor to-day in preventing our rapid entrance into the foreign field. The European nations for years to come will probably not be able to supply capital as lavishly and at as low a rate as they formerly did; but mindful of the illustration previously given, we must not delude ourselves with the idea that they will not find means of holding their foreign markets by making the necessary developments, especially in view of the fact that the actual cash required to be sent out of the country is only a small proportion of the total investment.

In spite of our experience after two years of abnormal conditions due to the war there still seems to be an inadequate appreciation of the general principle governing our participation in foreign trade, and because of the importance of the subject for our future development it is hoped that engineers who should be and generally are interested in the necessary preliminary investigations and should have sensible visions of the future will help formulate and disseminate the true theories and principles which must govern it.

Bottom of Pipe Perforated for Air Distribution

Pipes in Sewage Tank of Edmonton Activated-Sludge Plant Have 1/8-Inch Holes on 3-Inch Centers in Under Side

AIR DISTRIBUTION in the sewage tank of the activated-sludge plant at Edmonton, Canada, is accomplished by pipe perforated on the under side. A. W. Haddow, acting city engineer, has supplied the following information regarding this feature of the works:

The air main along the center of the tanks has been started off at 10 in. diameter. This 10-in. main is of cast iron, as it is found to be best for tapping and making tight connections for the down pipes. The tank under experiment has four 1½ in. down pipes, with a valve, and a Dart union below the valve on each pipe. They are placed 30 in. on centers and branch into two 1-in. pipes at the bottom of the tank running toward each end, where they are plugged. Each down pipe with its two branches is an independent unit, and by unscrewing the union it can be lifted for examination without interfering with the blowing on the three other pipes. The two branches are supported from channel irons by means of six ⅜-in. hollow rods (pipe), which by means of a thread and nut give a slow-motion control of the air pipes. After the air pipes have been set dead level, it is necessary both to raise and to lower them by means of these nuts to obtain perfect air distribution. Mr. Haddow cannot give any reason for this.

1/8-Inch Holes on 3-Inch Centers

The air pipes have ⅛-in. holes drilled on the under side at 3-in. centers. This gives better distribution than drilling on the top or on the sides. So far, Mr. Haddow reports, the resulting air distribution is excellent. However, no sludge has yet accumulated.

Each down pipe is connected, below the valve and above the union, to a branch from a 3-in. high-pressure water main (100 lb. per square inch) for flushing purposes. These four water branches are controlled by a single valve. In addition, the water can be shut off by a main valve and steam admitted through the same piping. Provision is made for expansion on this account. Then, as already stated, each air line can be lifted independently and cleaned, if the water and steam are not sufficient. A check valve is introduced on the main air feed, near the blower, to prevent water getting into the blower in case of carelessness in operating the valves.

Railroad Income for July and August Continues Upward Climb

Gross operating revenues for July and August on the large steam railroads of the United States, according to bulletins issued by the Bureau of Railway Economics, were respectively $1,315 and $1,418 per mile, showing increases of 16.3 and 19.1 per cent as compared with July and August of 1915. Operating expenses were $848 and $882, increases of 13.1 and 15.4 per cent. Net operating revenue therefore was $467 and $536—increases of 22.7 and 25.8 per cent, and operating income was $411 and $476—increases of 24.7 and 27.1 per cent.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

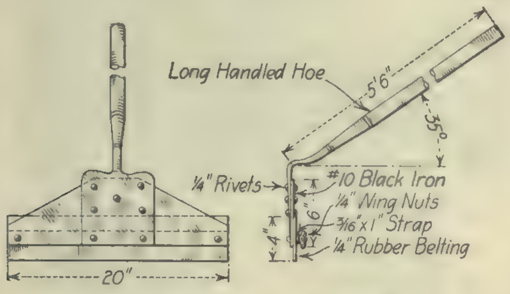
Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Makes Pavement Squeegee Out of Old Hoe

THE SQUEEGEE for working grout filler into granite-block paving used by the Brooklyn Rapid Transit Company of New York City is shown in the sketch. The demand for this tool in Brooklyn, where this method of laying granite-block paving is required by the borough, is such that in order to supply each track gang with one implement a large number of superannuated hoes have been cheated out of well-earned rest on the junk pile.

The device is described by R. C. Cram,



SQUEEGEE MADE FROM HOE

assistant engineer of the way and structure department of the company referred to, in a recent issue of the *Electric Railway Journal*. The author states that the squeegee method, which has begun to displace the practice of brooming in the grout in brick pavements, has proved much superior to the latter method in constructing modern pavements of smooth-topped granite blocks in Brooklyn.

This Paving Contractor Works All Winter—But Not Outdoors

"I CERTAINLY envy the highway contractor in winter," remarked the editor of the *Contractor's Atlas* the other day to a friend who makes his living by constructing pavements.

"No millionaire has anything on you from December first to the ides of March. All you do is to figure out your profits for the year and run away to Palm Beach or some other summery clime to spend your ill-gotten gains. That is the life!"

"Don't you believe it," retorted the contractor, "and if you really would like to know how I spend my winters, I'll tell you."

And as this contractor's plan for making the winter profitable is one that might well be followed by many others, the editor has passed it along, and here it is in the contractor's own words:

"You know I take work anywhere within a radius of 200 miles. Beginning about the first of October, I have my stenographer start a little clipping bureau. She reads all the engineering and contracting publications, and as many daily and weekly papers as we get, and from them clips all references to city, town or county highway bond issues or plans for road or pavement construction. Then, about the middle of November, when I have cleaned up my year's work, I begin to study these clippings. About the first of December I pack my bag, not forgetting a box of good cigars, and start. When I land in a town, I make the acquaintance of everyone who has anything to do with highways—and believe me, I am a real highway booster. I go after them from every angle, and can often render real assistance.

"Maybe the town has no engineer and does not intend to hire one until they know what they are going to do. So I give them the benefit of my practical experience. Possibly the committee on streets had figured on a type of construction on which no contractor would be required, doing the work by day labor. Then I get busy and talk them into a plan where they will finally need me. And all the time I am getting acquainted with them and they with me.

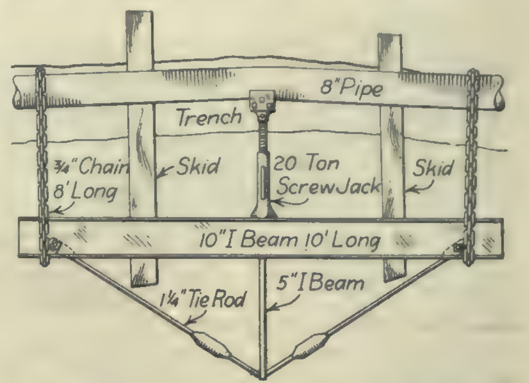
"Of course, I am home for Christmas and New Year's, but after the holidays I am away again until the middle of February. After that the seeds I have sown begin to return a harvest in the form of requests for bids on contracts. Of course, you will say that I would get many of them anyway. Right. But don't forget that by that time I know all the men who are really letting the contracts, and if they are giving out any favors or preferences in the bidding it's their old friend whose cigars they smoked in December and January who is going to get them. That's human nature. I have been doing this for several years and I find the work pays, and pays big.

"Some of my friends spend their winter months on Southern contracts, but I can't see them because you have to start work on them before your Northern jobs are done, and generally you are still working down there when you ought to be looking after new work in the North. So I stick to my natural territory and work it twelve months in the year. If you don't think it pays, ask Dunn or Bradstreet to tell you how we grow each year."

Machine Bends Eight-Inch Pipe at Low Cost in Field

THE SKETCH shows a machine in successful use by the Philadelphia & Suburban Gas Company at Chester, Pa., for bending gas mains up to 8 in. diameter in the field as they are laid. Bending the pipe cold as bends are required while laying it in the field has proved very economical with the smaller sizes, but has generally been found too expensive with pipe above 4 in. in diameter. The method of using a block and fall employed with the smaller sizes cannot be used with an 8-in. pipe in most cases, as the pull required makes it difficult to find strong enough anchorages to resist it. Even when this method can be used, it takes 25 men and costs from $3 to $6 to make a bend in this way. With the machine shown in the drawing four men can make a bend in an 8-in. pipe at a cost of from 50 cents to $2.50, depending on the radius of the bend and the total deflection that must be produced.

To operate the machine, the chains at each end are secured around the pipe and I-beam with slip links, the jack and pipe block are set in position and the jack tightened to make the bend. If only a slight deflection is required, the bend may be made with one setting of the machine. If



MACHINE COLD-BENDS HEAVY PIPE IN FIELD

the bend is a considerable one, the machine should be shifted along the pipe, making several bends of a few degrees each in succession until the required deflection is reached.

Another considerable advantage of this machine over the old method is that all the bends for a pipe line may be made continuously without waiting for the actual work of laying the pipe to reach each deflection point before the bend at that place can be made.

The machine was described at the recent annual meeting of the American Gas Institute by Charles Wilde, engineer of mains for the company mentioned.

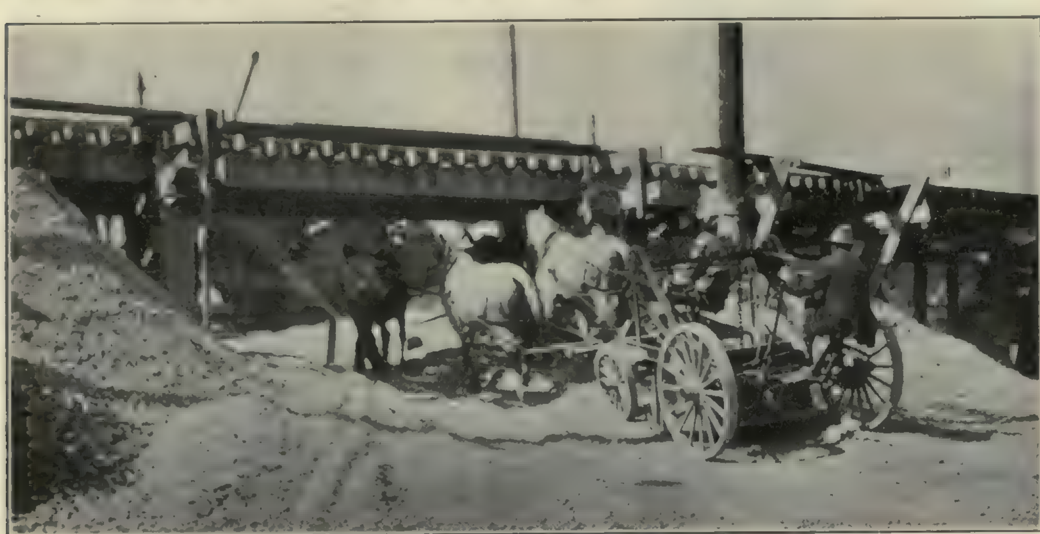
Pouring from Wheelbarrows Cuts Cost of Tar Pavement Filler

BY MIXING tar filler in wheelbarrows, pouring it over the granite-block pavement and scraping it into the cracks with shovels, instead of using a mixing apparatus and the ordinary pouring cans, the cost of placing the filler in the paving being laid on Bridge Street in Brooklyn, New York City, has been greatly reduced. The sand and tar are heated separately. About three pailsful of hot tar are drawn off into a wheelbarrow and the sand is gradually added and mixed in with a hoe. A thicker filler can be used than with the cans, reducing the amount of tar required. With the previous method, employing a hand-operated mixer with revolving paddles and pouring cans, 28 lb. of tar per square yard of pavement was required, and 20 men were employed in the pouring gang. With the present method from 17.3 to 22.6 lb. of tar is required per square yard, and the same rate of progress is maintained with only 7 men.

The work is being done by Fred Hess, subcontractor for the C. A. Meyers Contracting Company, and is in charge of W. W. Thurman.

Use Four-Wheeled Scraper to Handle Aggregate

A FOUR-WHEELED scraper is being used by an Iowa City contractor, who is building a concrete bridge over the Iowa River, to haul aggregate from an interurban trestle over the street approach to the mixing plant, some 300 ft. away. Bottom-dump cars carrying broken stone are run over the trestle and dumped into the street below. The use of the scraper to pick up the stone saved building a bin, for which there was scant headroom, as can be seen from the photograph. Four horses handle the Maney scraper while loading and pull the load up on to a material pile, where it is then handled by slip scrapers to a grizzly through which the material drops into small cars. These are hauled by cable up an incline and dumped into the mixer. William Horrabin is the contractor.



ADVANTAGE TAKEN OF CHANCE TO DUMP STONE FROM TRESTLE BY USING SCRAPER

Well Points Supply Mixer Water in Small Concrete Plant

INCLUDED in the inexpensive concrete-plant layout for a large box factory at East Chicago, Ind., is a well point supply pumped to an ordinary barrel by means of a diaphragm pump, both pump and barrel being elevated for this purpose, as shown in the photograph.

The level of the site was raised several feet with loose, fine sand, making the hauling of concrete materials for the necessary deep concrete walls and piers difficult. In consequence, it was decided to locate the concrete plant at one point and bring the materials from a railroad siding 200 ft. away, over an inclined industrial track, on a trestle about 10 ft. high at the inner end. All sand, stone and brick required in the construction of the work were hauled up this incline in a 4-yd. car, by means of a cable operated by a gasoline-driven hoist placed ahead of the inner end of the incline, the grade being sufficient to return the car to loading position by gravity. This arrangement permitted the sand and stone to be discharged in piles very close to the mixer, and the brick deposited along the incline nearest to the pockets where they were needed.

A 10-ft. Standard mixer was located about 20 ft. away from one side of the trestle. The remainder of the equipment consisted of a hoist with a 4-hp. Novo engine housed on a truck for operating the cable, and another 4-hp. engine mounted and housed on skids midway between the diaphragm pump and an extra hoist, so that the engine could operate either. At the loading switch two cars were shifted at a time by a hand winch and cable, and kept spotted so that material could be shoveled directly into the 4-yd. hopper car without rehandling.

The work was carried out by John F. Rahn, building contractor for the Indiana Box Company.

PUMP SUPPLIES MIXER WATER FROM WELL POINTS IN SAND AT RIGHT

Build Track on Top of Pipe to Remove Muck from Tunnel

By A. C. FRANCIS
Operating Department, San Diego, Cal.

IN CONNECTION with repair work being done by San Diego, Cal., to its water system, an accumulation of muck is being removed from the four tunnels on the Otay-San Diego pipe line in cars running on tracks on top of the pipe, one of which is shown in the photograph. For about eight years these tunnels had been allowed to stand just as they were constructed. Their ends became filled with fallen material; they did not drain and small leaks filled the tunnels with water. The water rotted out the lower timbering, sloughed off the sides of the tunnels and caused material to pile up against the lower portion of the pipe. This earth and rotted timber, when mixed with water, formed a muck which caused rapid deterioration in the pipe of all four tunnels.

TRACK LAID ON TOP OF PIPE TO REMOVE MUCK FROM TUNNEL

A break in one of the pipes late in 1915 made immediate attention imperative. The job of rebanding the pipe, mucking out fallen material and retimbering the tunnels was a slow one, as only about fourteen men could be utilized at a time. The muck had to be cleaned out first. To accelerate progress a track was laid on timbers placed on top of the pipe. A small dump car was operated along this track by a hoisting engine located at the entrance of the tunnel.

Small Sewage Plants Predominate

The committee on sewage works operation of the American Public Health Association has made an analysis of sewage-treatment plants in the following fifteen states: California, Illinois, Iowa, Kansas, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, New York, Ohio, Pennsylvania, Texas, Virginia and Wisconsin. The total number of plants reported was 1294. Of these, one-third are designed for populations of less than 500; over one-half for populations between 500 and 10,000; and only 7 per cent for populations over 10,000. Only 29 of the 1294 plants are equipped with complete laboratories, and of this number 17 are in the state of Pennsylvania.

NEWS OF THE WEEK

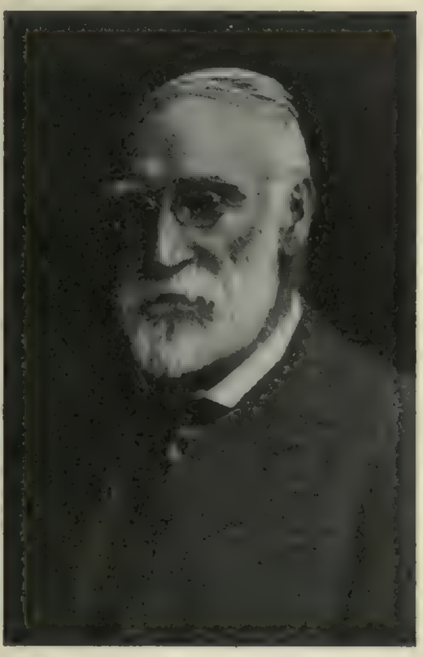
Passing Events in the Civil Engineering and Contracting Fields

Gives $100,000 to Society for Technical Library

James Douglas, President of Phelps, Dodge & Company, Makes Generous Gift to United Engineering Society

Dr. James Douglas, president of Phelps, Dodge & Company, New York City, has presented the United Engineering Society with $100,000, the income from which is to be used in the development and extension of the library. The trustees of the society are endeavoring to secure endowments aggregating $1,000,000 for the purpose of making the collection of engineering literature in the Engineering Societies Building of maximum possible value. Now that the library of the American Society of Civil Engineers has been added to those of the other national engineering organizations in the building, the combined collection forms the greatest source of technical information in the world.

Mining Engineer Gives $100,000 for Engineering Library



DR. JAMES DOUGLAS

Dr. Douglas stands in the front rank of mining engineers. During more than forty years of a constantly active career he has engaged principally in the mining and production of copper, although he has also won acknowledgment of his ability as a railroad executive. He is a native of Quebec, Canada, and received his education at Queen's College, Kingston, Ontario, and at Edinburgh University, Scotland. For several years after graduation he served as professor of chemistry in Morrin College, Quebec. During that period, with the assistance of the late Dr. T. Sterry Hunt, he made a special study of metallurgical treatment of copper ores. These experiments led to the discovery of the Hunt-Douglas processes —an important development in the modern methods in the metallurgy of copper.

Dr. Douglas came to the United States in 1875, at the age of 38, to take charge of the copper works at Phoenixville, Pa. About 36 years ago he became identified with copper industries in the Southwest and northern Mexico. He soon formed the nucleus of the great copper-mining enterprises which, under his management, have taken a place in the first rank of American industry. As president of Phelps, Dodge & Company Dr. Douglas directs the management of the Copper Queen Consolidated Mining Company, the Montezuma Copper Company, Detroit Copper Mining Company, the Burro Mountain Copper Company and the Stag Cañon Fuel Company. In 1887 he was made president of the Arizona & Northeastern Railroad, and since July, 1901, has been president of the El Paso & Southwestern Railroad, which took over the Arizona & Southeastern and other lines in Arizona and which, in 1905, absorbed the El Paso & Northeastern. He is also president of the Nacozari Railroad.

He is a member and has twice been president of the American Institute of Mining Engineers. He is also the author of several books, among which are "Canadian Independence," "Imperial Federation and Annexation" and "Untechnical Addresses on Technical Subjects," and has contributed extensively to the technical press.

New Shipbuilding Works at San Francisco

Union Iron Works Enlarges Plant to Handle $60,000,000 Government Contracts—$20,000,000 for Improvements

Officials of the Union Iron Works of San Francisco announced Nov. 11 that 125 acres of land adjoining the present plant at Alameda had been purchased and that improvements to cost about $20,000,000 will be undertaken at once. This increase in capacity is necessary to provide facilities for handling recently awarded contracts, chief among which are those for the government, which will amount to a total of about $60,000,000.

The new plant, it is said, will be equipped with a 250 x 850-ft. plate shop, ten commercial slips for building vessels up to 15,000 tons, slips for building submarines, two slips for building large battle cruisers and a complete plant for building Diesel and semi-Diesel engines. The large floating drydock which is now being built at Hunters Point will be towed to the Alameda works when completed.

Government contracts, the report continues, include two battle cruisers, one scout cruiser and ten submarines. Possibly four more battle cruisers will be built at a cost of about $15,000,000 each. In enlarging its plant the company is inaugurating a scheme for domiciling the workmen who will be engaged there. Plans for a system whereby a force of 6000 workmen will be assisted in buying their own homes near the plant are being prepared.

18-Mile Tunnel to Be Driven for New York Water Supply

An 18-mile tunnel, which will be one of the longest in the world, is to be driven between Prattsville, N. Y., on Schoharie Creek, and a point on Esopus Creek near Shandaken, through one of the main ranges of the Catskill Mountains. The tunnel will be contracted for next spring by the Board of Water Supply of New York City. It will supply the necessary 250,000,000 to 300,000,000 gal. daily to operate the Catskill aqueduct at full capacity.

The tunnel is to be horseshoe shaped, about 13 ft. in diameter, and lined with concrete. There will be seven or eight shafts, varying in depth from 100 to 640 ft. The distance between shafts will vary from about 10,400 to 14,200 ft. The dam to form the Schoharie reservoir will be located at Gilboa.

Discuss Proposed Motor-Truck Legislation

Motor-Truck Men Oppose "Discriminatory Rules" at Special Hearing in Albany—Only Two Highway Engineers Present

As a preliminary to New York State legislation regulating the operation of motor trucks, which it is planned to put into effect on Jan. 1, 1917, a hearing before a special commission, consisting of the state highway commissioner, the state engineer and the state superintendent of public works, was held in the state capitol at Albany Nov. 21. There were present representatives of the Motor Truck Club of America, manufacturers and users of trucks, trailers and tires, and only two highway engineers, the audience numbering about fifty. Commissioner Edwin Duffey of the state highway department presided at the session, and with him sat William B. Landreth, deputy state engineer, and General Wotherspoon, superintendent of public works. The purpose of the hearing, as outlined by Mr. Duffey, was to receive suggestions from those who would be affected by the proposed new law, in order that the commission might have at hand all data which would aid in fixing an equitable new schedule of fees for motor trucks.

Claim Measure Discriminates

Speaking for the Automobile Chamber of Commerce of the United States, Thaddeus T. Terry, its counsel, objected to the proposed measure as a piece of discriminatory legislation, inasmuch as it placed a burden of taxation upon the motor truck without requiring anything from the horse-drawn vehicle, which, he claimed, was responsible, in part at least, for the destruction of highways. He asserted that the constitutionality of any such regulation was open to grave doubt. "But even if the commission proceeds with the fixing of this schedule of motor-truck fees," he said, "it is attempting an impossible task. The commission is instructed to base the new tax upon the amount of wear and tear on highways caused by motor vehicles of various types. The scientific determination of a just tax on this basis is not feasible." Roads, Mr. Terry held, should be considered purely as a governmental function, like a police or fire department. Their upkeep, therefore, he argued, should not fall upon a special class of users but should be paid for out of general funds.

Roderick Stephens, president of the Motor Truck Club of America, offered to the commission a number of concrete suggestions. Among them were that a competent automobile engineer be employed by the commission to aid it in the technical phases of its work; that a preliminary draft of the measure be made public before its final adoption; that another hearing be held in New York City; and that it should be realized that the owners of motor trucks were not the only ones who benefited by the operation of these vehicles. He characterized the proposed rules as discriminatory.

Must Get Accurate Data

George H. Pride, another Motor Truck Club member, urged the need of accurate data on road wear before final action is taken. One of his points was that trucks operating exclusively in a city such as New York should not be compelled to contribute to the maintenance of state highways which these city vehicles never used. The same stand was taken by counsel for the Fifth Avenue Coach Company of New York City. Of 16,000 trucks registered in New York State, according to Mr. Pride, only from 10 to 15 per cent ever use the state

highway system. All their work is done on city pavements. Speaking of the proposed tax on motor trucks Mr. Pride said: "If we are charged more we cannot absorb it but must pass it on."

A. F. Masury, a motor designer, spoke of the technical features involved in the proposed law. Consideration should be given, he said, to whether or not the vehicle is provided with springs and what part of the load is borne by the springs and what part is on the "dead axle."

That trailers should not be compelled to have steel tires was another of the arguments of the motor truck men.

A. Jackson Marshall, representing the electric vehicle interests, maintained that the various differences between electric trucks and gasoline trucks should receive due consideration.

Eugene W. Stern, chief engineer of highways, Borough of Manhattan, New York City, cited the damage done to granite-block and sheet-asphalt pavements by an excessively heavy steel-tired tractor-trailer outfit used on the subway work. New York City, Mr. Stern said, is now framing an ordinance governing the use of city streets by motor vehicles.

Plan $5,000,000 Hotel

Plans for an apartment and hotel building in Chicago to cost $5,000,000 are being prepared by Marshall & Fox, architects, according to an announcement made last Saturday by the Drake Hotel Company. It is stated that the structure will occupy the southeast corner of the Lake Shore Drive and Lincoln Parkway. This land, formerly owned by the Potter Palmer estate, is 216 x 400 ft.

Contractor Sent to Penitentiary

Thomas Kelly, contractor, of Winnipeg, Canada, was sentenced Nov. 19 to serve two and one-half years in the penitentiary, according to reports. He was convicted at the summer assizes on charges arising from alleged fraudulent dealings in connection with contracts for the Manitoba Parliament building.

Peoria (Ill.) Viaduct Nearly Completed

The steel viaduct at Peoria, Ill., over the tracks of the Chicago, Burlington & Quincy, the Chicago, Milwaukee & St. Paul and the Minneapolis & St. Louis railroads is expected to be completed by Jan. 1.

John Fritz Medal to Be Presented to Dr. Elihu Thomson

The John Fritz Medal, which was awarded last January to Dr. Elihu Thomson for achievements in electrical inventions, in electrical engineering and industrial development, and in scientific research, will be presented at a meeting to be held in Boston Dec. 8. The presentation will take place in the Central Lecture Hall of the new buildings of the Massachusetts Institute of Technology.

Cut Bridges to Allow Dredge to Pass

Two bents, comprising a section 46½ ft. wide in the Stone Avenue bridge, across the Lake Washington Canal in Seattle, were cut Nov. 12 and the government dredge was permitted to pass. Early in the morning of Nov. 15 the Latona Avenue bridge was closed to traffic, an operation similar to the one at Stone Avenue was performed and the dredge resumed its voyage. The work at the Stone Avenue structure consumed more time than was originally planned. The street department deemed it advisable to cut the piling about 9 ft. below the water and to replace the ends on their former resting places after the dredge had passed. This plan was abandoned. The piles under water were pulled and new ones driven in their places.

General Dan C. Kingman Is Dead

Passed Away After Forty-one Years of Service—Three Years as Head of Corps of Engineers, U. S. A.

Brig.-Gen. Dan C. Kingman, Corps of Engineers, U. S. A., formerly chief of engineers of the army, died Nov. 14 at Atlantic City, at the age of 64. For two and one-half years—October, 1913, to March, 1916—he was in command of the Corps of Engineers and in charge of the Engineer Department, after which he was relieved from active service.

General Kingman was born in 1852 in New Hampshire. When he was graduated from West Point in 1875 he stood second in his class. For three years thereafter he served with the engineer battalion at Willets Point, N. Y., and during the next three years was assistant professor of engineering at the academy. Following that he was assigned to duty in Western states. He spent two years at Omaha, four years in charge of improvement of Yellowstone National Park and was also a member of the committee to examine the penitentiary at Sioux Falls, S. D. His transfer to New Orleans late in 1886 gave him his first experience on river and harbor work. That his work there was of a high character is evidenced by the message he received from the Louisiana legislature thanking him "for the splendid services rendered our state during the high water of 1890."

Former Chief of Engineers, U. S. A., Is Dead

Photo by Harris & Ewing, Washington

BRIG.-GEN. DAN C. KINGMAN

In that year General Kingman was transferred to Oswego, N. Y., where for five years he was in charge of the defense works on the lake shores of New York and various harbor improvements. At Chattanooga, where he was stationed from 1895 to 1901, and at Cleveland, from 1901 to 1906, he had charge of harbor improvements, reported on several large bridge projects and was a member of the board to consider and report upon proposed methods for driving a tunnel under the Detroit River.

Returning to the South in 1906, with headquarters at Savannah, Ga., General Kingman immediately directed his energies toward effecting many improvements on defense works and harbors in that territory. His appointment to command of the Corps of Engineers and the Engineer Department came Oct. 10, 1913. His retirement from active service went into effect in March of this year.

$20,000,000 Factory Community for Chicago

More Than Eighty Buildings to Be Erected on 100-Acre Plot on Thirty-ninth Street, Between Ashland and Western Avenues

Establishment of a model factory and warehouse community in which there will be constructed more than eighty buildings that will represent an ultimate expenditure of approximately $20,000,000 is under way on the southwest side of Chicago. The community will form part of the central manufacturing district and will be located on a tract of 100 acres on Thirty-ninth Street between Ashland and Western avenues.

Two tunnel systems, which will cost approximately $150,000, are under construction. The site of the community is that which about two years ago had been selected as the location of a produce terminal, to which the South Water Street merchants were to be brought, but which plan has been abandoned.

$1,200,000 Freight Terminal

The first of the community's buildings will be a six-story and basement cold storage warehouse now being constructed on Thirty-ninth near Robey Street. Excavation work on the site of the new union freight station and loft building has been started. The building will be of brick and concrete construction, will cover a plot about 600 x 500 ft. and will cost more than $1,200,000.

Construction work upon the new central power plant for the community will be begun within the next thirty days. The structure will contain sprinkler tanks with a capacity of more than 200 000 gal., high-pressure pumps, hot-water heaters, coke and ash conveyors and other modern facilities. This building will cost about $250,000.

Commerce Body to Solve Sewage Problem of Chicago

Co-ordination between the city of Chicago, the Sanitary District, the state legislature and Congress, as related to Chicago's sewage problem and in directing an intelligent opinion locally and nationally, is the aim of the Chicago Association of Commerce. At a recent preliminary conference between association committee members and representatives of the Sanitary District, including George M. Wisner, chief engineer, and Langdon Pearse, division engineer, the following points were developed:

The association could aid in giving the authorities at Washington a correct impression of the Chicago situation.

Informal continuance of the discussion of the problem should wait upon the decision in the case now pending before Federal Judge Landis, with reference to the diversion of water for the drainage canal.

The association could aid in having other lake cities rightly understand the question of water diversion.

Effort should be made to bring about the construction of compensating works in the St. Clair and Detroit rivers with a view to maintaining present lake levels.

There should be some supplementary methods of sewage disposal even though Chicago is permitted to take all the water for dilution purposes now required under the present system. Should the decision of the federal court be adverse to the desires and practice of Chicago in sewage dilution, there would probably be allowed a reasonable time in which Chicago might decide upon the nature of supplementary disposal works and in which to construct the same.

It is important that a clear understanding be reached as to the conditions which are to be brought about in the drainage canal and the Chicago River.

It is desirable that the Sanitary District should make provisional arrangements for possible sewage-disposal plants.

It should be impressed upon the Washington authorities that the main interest of the Sanitary District is in the problem of sewage disposal and the protection of the water supply of Chicago.

It is a question whether the people of Chicago are willing to pay for methods of sewage disposal other than dilution.

Engineering Society Activities

Western Society of Engineers at its Dec. 4 meeting at Chicago will hear an outline of the work of the Naval Consulting Board by Bion J. Arnold.

Concrete Institute met Nov. 23 in Westminster, England, for the first time this year. The feature of the evening was the presidential address by F. E. Wentworth-Shields. At the Dec. 21 gathering Prof. Henry Adams will discuss pile driving and the supporting power of piles.

Engineers' Society of Western Pennsylvania's nominating committee has selected the following members for office: President, A. L. Hoerr; vice-president, George H. Neilson; treasurer, A. E. Frost; directors, E. W. Pittman and George H. Barbour.

Steel Treating Research Club held a meeting Nov. 21 in the rooms of the Detroit Engineering Society. Richard P. Brown, president of the Brown Instrument and the Keystone Electrical Instrument Companies, spoke on "Pyrometers—Past, Present and Future." F. F. Beall, vice-president of the Packard Motor Car Company, will address the club in January.

Engineers' Society of Northwestern Pennsylvania held its monthly meeting at the Engineers' Club, Scranton, Nov. 16, adjourning to the board of trade auditorium for the lecture by G. H. Hill, assistant engineer of the railway and traction department of the General Electric Company. The electrification of the Chicago, Milwaukee & St. Paul Railway was his subject. The development of transportation and the various steps in the construction of a modern electric locomotive were picturized by slides and "movies."

Engineers' Society of Pennsylvania, Harrisburg, heard Samuel T. Wagner, chief engineer of the bridge department of the Philadelphia & Reading Railway, lecture on grade separation at the Nov. 17 meeting. The work done in Philadelphia several years ago was detailed by Mr. Wagner. F. Herbert Snow, chief engineer of the Pennsylvania Public Service Commission, introduced the speaker. In his introductory remarks Mr. Snow mentioned the 1200 grade crossings in Pennsylvania which he hopes to eliminate gradually.

What Engineers and Contractors Are Doing

G. W. SMITH has resigned as architectural engineer for the Hodgin Construction Company, of St. Paul, to enter the service of the Ford Motor Company. He is now at Kansas City superintending the construction of the new power plant being built in connection with the new assembly plant in that city.

R. Z. KIRKPATRICK has been transferred from the Panama Canal, where he was assistant chief hydrographer, to the Bureau of Yards and Docks, Washington. In his new work Mr. Kirkpatrick will be engaged in structural-steel design. After graduation from the Iowa State College of Agriculture and Mechanics in 1907 he spent several years with Western steel companies and a year on irrigation work. Since 1910 he has been on the Panama Canal, first as draftsman in the office of the chief engineer at Culebra and later as junior engineer on the Pacific locks. He was appointed assistant chief hydrographer in January, 1915.

A. R. ROSS has resigned as engineer in charge of the St. Louis Municipal Bridge to enter the contracting field. He is now at Murphysboro, Ill., erecting two steel bridges and six pile-and-timber trestles for the Murphysboro & Illinois Railway, a new traction line connecting Murphysboro with Carbondale. S. A. Robertson and G. L. Miller are associated with Mr. Ross under the firm name of Ross, Robertson & Miller.

OLAF LAURGAARD, consulting civil engineer, of Portland, Ore., was recently elected by an overwhelming vote as a Multnomah County representative to the state Legislature. Mr. Laurgaard is well known throughout the Northwest due to his activities on various irrigation projects. This is his initial appearance in the political field. He is 36 years old, a graduate of the University of Wisconsin, and has been a resident of Portland since 1910.

J. M. DOUGAN, formerly president of the Sound Construction Company, Portland, Ore., is now engaged in the contracting business as the J. M. Dougan Company. Offices of the concern are maintained in the former offices of the Sound Construction Company in the Couch Building. The firm recently secured a contract for building the $75,000 court house at Grants Pass, Ore., for Josephine County.

C. E. PARIS has been appointed general manager of the Imperial Irrigation District, with headquarters at El Centro, Cal. During the last ten years Mr. Paris has been general superintendent of the W. F. Holt properties with headquarters at Holtville, Cal. The Holt properties include the Holton Power Company, the Holton Interurban Railway, the Imperial Valley Gas Company and the Coachella Valley Ice & Electric Company.

R. P. MOORE has been made general superintendent of the Holton Power Company and the Holton Interurban Railway at Holtville, Cal., to succeed C. E. Paris, whose resignation is noted elsewhere in this issue.

G. C. HABERMEYER was recently appointed assistant engineer of the Illinois state water survey.

A. L. CRISSINGER has been made state highway superintendent of Beaver County, Pennsylvania. He has been in the employ of the highway department for three years.

J. W. FRAZIER has resigned as road superintendent of Potter County, Pennsylvania, to enter private business.

A. B. HOWARD has been made general foreman of highways in Jefferson County, Pennsylvania. The position of superintendent, made vacant by the promotion of N. M. Dorwart, will not be filled at present.

CALEB BERRY, formerly city engineer of Centralia, Wash., has been engaged to make preliminary surveys for a proposed irrigation district in Ford's and Waunch's prairies, near Centralia.

S. E. JUNKINS & COMPANY, of Montreal, who recently secured the contract for the extension of the Canadian Pacific Railway pier at the foot of Granville Street, Vancouver, B. C., will open an office in that city at an early date.

A. LECKIE, formerly division engineer of the Arkansas Western Railway, has been appointed to a similar position with the Kansas City Southern Railway. He will have headquarters at Kansas City.

CHARLES A. LEMMON has resigned as chief engineer of the Butte, Anaconda & Pacific Railway to become assistant to the general manager of the Anaconda Copper Mining Company.

N. M. DORWART was recently promoted from the superintendency of Jefferson County to a similar office in Potter County, Pennsylvania. Mr. Dorwart is a graduate of Franklin and Marshall College and has been with the Pennsylvania highway department about five years.

MONROE L. PATZIG has resigned as general manager of the Monarch Engineering Company, Des Moines, Iowa, to engage in private consulting practice. He will specialize in paving work.

E. L. WILLIAMSON, who was shaft engineer on the Newark side of the tunnel under Newark Bay, built as part of the Passaic valley sewer system, is now working on a 1-mile trunk sewer in the Borough of the Bronx. He has been with the New York & New Jersey Construction Company for the last two years.

Obituary Notes

FRANK O. SINCLAIR, consulting engineer, of Burlington, Vt., died Nov. 15 in that city. Since 1914 he had been city engineer, and at the time of his death was consulting engineer to the Public Service Commission of Vermont. Mr. Sinclair was born in 1860 in Burlington and was graduated from the University of Vermont in 1882. After graduation he went to Leavenworth, Kan., to become assistant city engineer. He next turned his attention to railroad work and in 1884 was made assistant engineer for the Missouri Pacific Railway. After a year with that road he went to the Chicago, Rock Island & Pacific Railway as division and assistant engineer. Two years later found him principal assistant engineer in charge of construction of the Atlantic, Knoxville & Northern Railway. He remained with that road until 1890, following which he was for short periods employed by the West Virginia & Pittsburgh Railroad and the Ducktown Mineral Railway. Mr. Sinclair returned to his native city early in 1893 to become chief engineer on the construction of the Winooski & Burlington Electric Railway. Since then he has been employed by several railroads and other organizations in Vermont in a consulting capacity. He was past president of the Vermont Society of Civil Engineers.

FRED E. WEYMOUTH, head of the Weymouth Construction Company, of Seattle, died recently at the age of 56. Mr. Weymouth had lived in Seattle for thirteen years, going there from Tacoma, where he has resided twenty years. During four years of his residence in Tacoma he was division superintendent of the Northern Pacific Railway. The Weymouth Construction Company is one of the largest contracting firms in the Northwest.

JOHN ROBERT MOORE, a civil engineer, who was for many years connected with the New Jersey Central Railroad, died recently at his home in Merrick, L. I. He was graduated from Norwich University and was for the last twenty-five years with the New York Department of Highways.

Civil Service Examinations

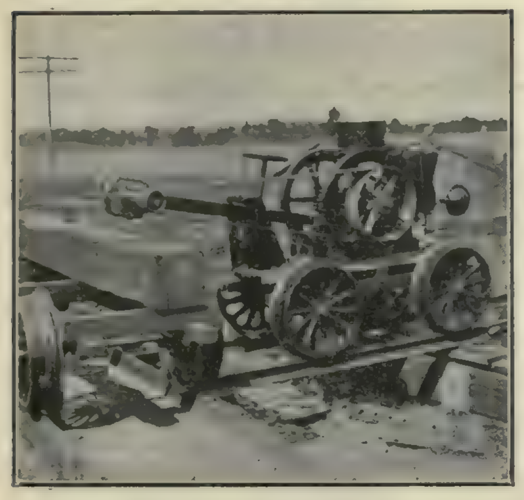
United States—Examinations will be held Dec. 13 and 14 for assistant engineer inspector of weights and measures, salary $1,000 to $1,600. Other examinations will be held at the same time for structural engineer and draftsman, salary $1,600 to $1,800, and for laboratory apprentice, salary $480. Examinations will be held Dec. 11 for designing engineers, Navy Department, salary $10 to $15 per day. Form 1312 should be filled in.

Examinations Previously Announced

Date		See Eng. Rec.
Dec. 2.	Junior assistant engineer, junior electrical engineer and supervisor dredging plant, New York State	Nov. 18
Dec. 11.	Civil and sanitary engineers, Massachusetts	Nov. 18

Motor-Driven Adzing Machine Saves Labor

Due to the scarcity of labor, the machine illustrated may be of more than usual interest to contractors. It is portable, requires one man to operate and is said to do more work than six mechanics. It is especially adapted for framing bridge ties and guard rails for railroad bridges. A gasoline engine mounted on a small car of 2-ft. gage has hinged to it an adjustable arm supporting a cutter head at its outer end. This arm, belted to the engine, is adjusted for depth of cut by a vertical screw. The material is carried at right angles to the machine on a longer car of 2-ft. gage.



ADZING MACHINE SAVES LABOR

To proceed with the work, the arm is adjusted to give the proper depth of cut and clamped in that position. The small car is moved back and forth by a lever clamped to the forward wheel. This gives the cutter head a direct horizontal movement over the work. Each movement forward and backward gives a 2-in. cut each way. As those cuts are made, the material car is moved 2 in. Thus any width or depth of cut can be made.

The machine was invented by J. E. Toohey of Grand Rapids, Mich.

Hydraulic Pump Supplies Large Volume at High Pressure

The pump illustrated is a recent addition to the line of high-pressure hydraulic pumps built by the Hydraulic Press Manufacturing Company, Mount Gilead, Ohio. It is of the horizontal, four-plunger type and designed to fill the requirements for a simple, heavy duty, hydraulic pump for supplying a large volume of water or other fluid against a high pressure.

This pump is designed so that it may be equipped with sixteen different sizes of plungers ranging from 1⅜ to 5 in. in diameter, advancing by quarter inches. The water cylinders are made of forged steel for the highest pressures. For the medium pressures—1500 to 2900 lb. per square inch inclusive—cast steel is used; for the lowest pressures the cylinders are semi-steel. The pressures range from 700 to 9500 lb. per square inch, and the water capacity from 24 to 326 gal. per minute. All sizes have bronze valve seats and bronze or nickel steel valves.

This pump is built for motor drive, requires 150 hp. to operate and is equipped with a flexible shaft coupling for motor connection. The stroke of the plungers is 16 in. and the two cranks are set at 90 deg., so that a uniform flow may be obtained. The frame or pump bed consists of two heavy castings securely bolted together. The crosshead guides and main bearing containers are machined in this frame to insure perfect alignment and give rigid construction. The pump occupies a floor space about 19 by 7 ft.

PUMP EQUIPPED WITH SPUR GEAR AND PINION CAN ALSO BE FITTED WITH HERRINGBONE GEAR AND PINION—OPERATED BY 150-HP. MOTOR

Error in Reporting Patent Case Decisions

It was reported in the Engineering Record of Nov. 4, page 576, that two patent decisions had been handed down recently by United States circuit courts of appeals. The statement was in error. Both cases (Turner vs. Lauter Piano Company and Turner vs. Deere & Webber) were in United States district courts. The decisions therefore are appealable; and the subsequent statement in the news item, that "the decision would seem to settle for all time claims which Mr. Turner has made since his earlier losses in the courts," was without foundation.

Backfilling Machine Used as Dragline Excavator

With a new heavy backfilling machine having corduroy grip traction and extensible boom, dragline operations on a small scale were carried out to remove black earth from the spoil of a sewer trench to adjoining vacant lots for fill. This work was carried out in building sewers in Chicago by Alphonso Scully, sub-contractor to W. F. Healy, with a 7½-ton Pawling & Harnischfeger backfilling machine recently placed on the market in this large size. In operating as a dragline the material was pulled over to one side of the 26-ft. street in front of the self-acting scraper, 4 ft. wide.

ONE MAN OPERATES HEAVY BACKFILLING MACHINE WHICH IS FITTED WITH DRAGLINE EXCAVATOR AND CORDUROY GRIP TRACTION

The 22-ft. timber boom, which was extended to 30 ft., is arranged to swivel 4 ft. on either side of the center line to allow the scraper to be moved to this extent without moving the machine. The photograph shows the regular backfilling operation, filling about 700 ft. per day of 24-in. trench 10 ft. deep.

Completely Equipped Plant to Handle Reinforcing Steel

As an indication of what a staple line steel bars for reinforced-concrete is becoming, a recent announcement by the Republic Structural Iron Works Company, of Cleveland, is of special interest. That company has taken over the entire plant of the Avery Stamping Company, covering 100,000 sq. ft.

On this site will be installed a complete plant for fabricating and shipping bars for concrete. With this plant in operation, it is said that a contractor can place his order for a complete building. The steel can be fabricated, placed in storage and sent to the job as required. It is said that facilities will be available for handling 4000 tons of steel.

Business Notes

Standard Scale & Supply Company has removed its Philadelphia office and warerooms to 523 Arch Street. The new quarters permit storage of the concrete mixers, engines, trucks and repair parts handled by the company.

Jamestown Shale Paving Brick Company of Jamestown, N. Y., has become a licensee of the Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio.

Lynn B. Dudley has been appointed advertising manager of the Federal Motor Truck Company to succeed George W. Cushing, who recently went to the Hudson Motor Car Company. Mr. Dudley has had twelve years' experience in the editorial and advertising departments of newspapers. For three years he was connected with the Campbell-Ewald Company, advertising agents.

Edward T. Hendee, secretary of Joseph T. Ryerson & Son, Chicago, died Nov. 12 in Minneapolis.

D. Fukuzawn, of the Meishosha Company, Tokio, Japan, is seeking American agencies on building materials and machinery for paper mills. His address is care of the Standard Paint Company, Woolworth Building, New York.

Trade Publications

The following companies have recently issued trade literature:

Buffalo Forge Company. Catalog, 6 x 9 in.; 54 pages; illustrated. Devoted to "Armor Plate" punches and shears.

Greenfield Tap & Die Corporation, Greenfield, Mass. Catalog 67, 4¾ x 7¼ in.; 270 pages; illustrated. Gives sizes and prices of cutting tools.

Templeton, Kenley & Company, Toronto, Canada. Catalog 216, 6 x 9 in. Describes various types of Simplex jacks and their uses.

Spray Engineering Company, Boston. Bulletin 310, 3½ x 6 in.; 10 pages; illustrated. Describes the "Spraco" paint gun.

Portland Cement Association, Chicago. Booklet, 9 x 6 in.; 24 pages; illustrated. Deals with the use of concrete as an alley-paving material.

Mitchell-Tappen Company, New York. Bulletin 14, 4¼ x 9½ in.; 12 pages. Illustrates and describes applications of "Standard metal gaging."

Chicago Pneumatic Tool Company, Chicago. Bulletin 34-Z, 6 x 9 in.; 20 pages. Describes steam-driven single compressors.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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For Stricter Scrutiny

IN ORDER TO SECURE more definite information regarding the qualifications of applicants for membership and to be able to check the applicant's statements as to his experience, the American Society of Civil Engineers has adopted the new form of application blank illustrated on page 673. The characteristic feature is the provision for detailed tabulation of the applicant's professional record as to character, dates and length of engagement. Moreover, the applicant must refer to someone (not necessarily a member of the society) familiar with each engagement, preferably the person to whom he reported. In this way the society will be able to check the estimate placed by the writer on the character of his own experience. The reference to at least five corporate members of the society will still be required. The step taken by the board of direction in devising this new form is a highly commendable one. In the past, merely the reference to five corporate members was necessary, and these members might have little or no knowledge of the character of the applicant's work. It was not necessary that they should have had professional contact with the applicant. The rules as to reference to corporate members have not been changed, but the provision that requires of each applicant reference to someone familiar with each of his engagements will enable the society to learn with exactness the character of the experience which he offers as his qualification for membership.

Planetable for Railroads

THE successful use of the planetable in mapping a large railroad yard to meet the requirements of the government in connection with the valuation of the railroads is described by R. E. Davis on page 674. The article should be very suggestive to railroad men. Mr. Davis puts his finger squarely on the weaknesses of the tape-and-transit method. Where the notes are to be plotted in the office it is, as Mr. Davis states, necessary to get and record "extra information" to make the notes intelligible, even when a member of the survey party plots the notes, and by the same token it is highly probable that important data will "turn up missing" during the plotting. And under the policy of some roads of having the surveys made by men ignorant of what they will be used for, and the notes in turn plotted by men who have never been on the ground, it is almost inevitable that there be several attempts made in the field, with great loss of time, before the map is complete. For one-day or two-day surveys the planetable would probably be too cumbersome to haul around, and, too, the transit can be worked in weather that would drive the planetable to cover. But for surveys of greater length, made in fair weather, the planetable seems to possess many advantages, and it is to be hoped that it will be given a trial.

Conservancy Plans Approved

IT WILL BE good news to those who have watched the long struggle of Dayton and adjoining communities to embark on plans for safeguarding themselves from flood damage to know that the conservancy court has approved the plan proposed by the engineers of the Miami Conservancy District, headed by Mr. Morgan as chief engineer. As those who have followed the history of the development in this journal well know, a most strenuous fight has been made against the detention basin plan. The original attack was made not upon the plan itself, but on the conservancy law under which the Dayton scheme was to be carried out. The constitutionality of the measure was attacked, but was finally sustained by the Ohio Supreme Court. Now the conservancy court, consisting of a judge from each of the nine counties into which the district extends, after hearings lasting from Oct. 6 to Nov. 24, has made the detention-basin scheme official and the real work of making the dirt fly comes measurably near. The plan provides for the construction of five "dry" reservoirs, combined with a certain amount of channel improvement, as was described in the Engineering Record of March 28, 1914, page 356, and March 11, 1916, page 348. The decision should be of general interest, for it establishes for the first time widespread co-operation in handling floods. Dayton and its associated communities have fought valiantly for the correct solution of this great engineering problem. The men who have directed the fight deserve to be congratulated on the successful issue of their efforts.

To Fight Water Waste

IF WATER-WASTE prevention plans of a small but influential body of Chicago engineers can be put into effect, that city will soon be able to curtail its 65-per cent loss and have something constructive to report to the New England Waterworks Association's water-waste committee. The matter was recently brought to the attention of subdivision 63, the engineers' subdivision, of the Chicago Association of Commerce in the form of an address by John E. Ericson, city engineer. That steps should be taken at once to stop the waste was conceded. A mere recital of statistics was cause for action. The prospective saving of water and of dollars commended itself to railroad chief engineers and consulting electrical engineers accustomed to the sale of transportation or current by measure only. Municipal engineers needed no argument to convince them of the merits of the project. In consequence a committee was appointed, not to investigate metering, underground leakage or any other technical subject, but to discover ways and means and to formulate a campaign of education through the Chicago Association of Commerce, and bring the weight of that organization to bear on the public and officials. The committee is headed by C. W. Morse, chief engineer of the Chicago, Rock Island & Pacific Railway. Other members are W. B. Jackson, Isham Randolph, John W. Alvord and Dabney H. Maury. consulting engineers. Results of value should follow the committee's work. Other municipalities might well adopt the Chicago method.

Safeguards at Movable Bridges

FOLLOWING the two recent serious accidents caused by defective safeguards at movable bridges, one in Chicago, where four people were killed when an automobile plunged into the Chicago River at an open drawbridge on Twelfth Street, and the other in Boston, where nearly fifty passengers were drowned when an electric car ran through the gates at the Summer Street drawbridge and fell into the Fort Point Channel, exhaustive investigations of the whole subject of proper safeguards at such bridge openings have been made. As briefly noted in the news pages of this issue, the investigating commissions independently arrived at similar recommendations. Of the two reports, however, that of the Chicago commission is much more drastic in its proposals. Its recommendations include strong illumination of the approaches, special stop signals and bells, the installation of double safety gates instead of a single gate (one a light signal gate and the other a barrier gate sufficiently heavy to absorb the impact of moving vehicles), interlocked with the bridge-moving mechanism to insure a positive stop when the bridge is open. Interlocking gates are also specified by the Massachusetts Public Service Commission; or, in case they are impracticable, a "smash-board" signal must be provided at a reasonable braking distance from the opening. The interlocking device specified in both cases requires that bridge operation shall be impossible unless the gates are in position. Bridge engineers will be interested in these requirements, and doubtless will contribute their share toward the solution of the practical difficulties which will arise.

Settling Labor Disputes in Public-Service Utilities

A WAGE commission to settle disputes between public-service corporations and their men was proposed last week before the Academy of Political Science by Oscar S. Straus. The commission would be vested with full power to enforce its findings. Mr. Straus supported his views by carefully marshaled arguments in which the responsibility of both operators and employees to the public was brought out, and repeated the indisputable reason for depriving men engaged in public service from exercising the right to strike. Since on this point—the compulsory power of the commission proposed by Mr. Straus—labor would make most serious objection, attention is directed particularly to it.

Mr. Straus made it clear that employment in this class of work is in a different category from that in strictly private enterprises. Public-utility companies stand in a special relation to the general public. In return for performing a quasi-public function they are vested with monopolistic rights. But this relationship carried with it the contract to render, within reasonable limits, such a service and at such rates as the public shall lay down. In other words, in return for what it gets from the public the public utility must give up certain rights which inhere in the operation of a strictly private enterprise.

What applies to the public-utility company must also extend down to its operatives, for the utility is a dead thing and of no value to the public unless, in addition to material equipment, it has the necessary men to keep it going and to perform the service for which it has been established. The employees necessarily, therefore, must subordinate themselves to the public good. They must, as Mr. Straus said, give up some of their group rights. They may as individuals leave the service of the company, since the resignation of an individual —provided the resignation is truly an individual action—can have little or no effect in curtailing the service to the public. But if the men give up some of their group rights they are entitled to compensation. The things which they may legitimately demand in return are, in Mr. Straus' opinion, exceptional wages and conditions of service.

Two controlling theses must, therefore, be borne in mind—one by the public and one by the employees. The public must admit that in return for the surrender of certain rights the employees must have compensating advantages. The employees must concede that their service is "affected with a public interest," and that the right to strike, to make the public suffer, must be given up by those who engage in service with a public-utility corporation.

From the practical standpoint it is interesting to know that Mr. Straus will shortly, on behalf of the Public Service Commission of the First District, New York, of which he is chairman, initiate hearings on the advantages and disadvantages of his plan, to the end that a bill may be formulated and introduced into the New York Legislature at the coming winter's session. Should it prevail, an opportunity will be afforded to find the actual workings of the scheme. But whether it materializes now or not, the plan is based upon sound reasoning and deserves the thoughtful consideration of those who are concerned with the public-service labor problem.

Overdoing Standardization

IT is generally agreed that the adoption of standard shapes and sizes in many branches of engineering tends to economy and convenience. Experience shows, however, that one can easily go too far in trying to reduce the design of a screw, a machine or a building to a general typical average. For example, no instance of standardization is better known or is more useful than that of machine screws. The gain in interchangeability is very great, yet there is no particular use in the reductio ad absurdum which would follow an attempt to carry the same rules for the relations of form, pitch, and diameter into jack screws for wrecking cars, or the almost invisible product of the watchmaker. Such special articles gain nothing in forming a part of a generalized scale.

Articles for common interchangeable use should conform to standard relations. Those which have no possible connection with such a scale may as well be one thing as another, provided they are adapted to their particular uses and agree among themselves so far as is convenient. In other words, standardization is good so long as it actually tends to general convenience, but it ceases to be good when it leads to the adoption of a thing imperfectly fitted to its use for the sake of being perfectly fitted to agreement with something quite different. Special operations require special tools, and the economy of these operations depends on the adaptation of the tool to its use.

These minor examples of screws and tools, however, are only a few that come under the general principle that care must be exercised lest in the attempt to secure uniformity and symmetry these qualities are obtained at the expense of usefulness. In bridges, for example, standardization may tend to simplify construction, but it may or may not lead to a finished product of maximum fitness for its purpose. In other words, standardization, either in machine screws or bridges, is a good and convenient thing, provided it is not attempted to push it over too wide a range. Many a machine and many a structure has suffered from an obsession of symmetry on the part of the designer, or from an attempt to use standard sizes and shapes where they lead to inconvenience. What would happen if there were an attempt to adapt all milling machines to a set of standard cuts and to dragoon all machine designers into the use of these cuts for the sake of uniformity in the tools. Experience has taught that to perform certain operations in the most efficient manner special machines and tools are necessary, and in the long run pay many times over for their deviation from standard practice in general machine-tool design.

The long and short of the matter is that common sense lies back of standardization and its limitations, for standardization is a means to an end, rather than an end in itself. It is immensely convenient and economical within a certain range; outside of that range it may become a serious handicap to efficiency.

The Camera on Engineering Work

DURING recent years the camera on engineering work has come to be regarded not as a plaything but as a decidedly useful adjunct to field equipment. On such great projects as the Panama Canal, the Catskill and Los Angeles aqueducts, the Reclamation Service developments and on all of the big railroads, it is common to employ a staff photographer who devotes his entire time to picture-taking.

Engineers themselves, however, have failed to take full advantage of the small hand camera on their own work. Picture-taking with the hand camera of to-day has been developed into an exceedingly simple process—so simple in fact that many people believe that the mere squeezing of a bulb or the pushing of a lever is the only thing to think of. There is much more to it than this, as the reader of Mr. Campbell's article on page 670 of this issue will discover. While he gives some valuable advice regarding the selection of cameras, shutters and lenses, one of the most interesting parts of his paper is that which deals with the composition of a picture. What will the picture show? This is the question which every camera user should ask himself before exposing a film. By attempting to visualize the finished print, the taking of many useless pictures will be avoided.

It is highly important to have the camera in the right position to show what is wanted. Very often the interesting feature is not the entire structure, but some detail of it. As a rule, engineer-photographers entirely overlook this important point. Thus, if the structure be a dam of standard type, the real point of interest might be not the dam itself, but some detail of the outlet gate or gatehouse. Let the photographer therefore get a "close-up" of this feature rather than a landscape view, in which such a detail would be lost.

Of course, every camera user develops hobbies of his own and it is fair to assume that everyone will not agree with everything that Mr. Campbell has to say. Thus, Mr. Campbell places very little value on exposure meters, designed to indicate to the user the proper timing of his exposure, while certain other camera users regard them as indispensable. Then, too, Mr. Campbell says that only by learning how to develop negatives and to make prints can the camera user school himself in making correct exposures. A great deal of evidence could be brought forth to controvert this statement. Nevertheless, a knowledge of developing and printing is exceedingly valuable to the camera user. It is not, however, essential for the taking of good pictures.

There are so many ways in which the camera can be used to good advantage in recording progress or special features of

engineering work that more men should own the smaller machines—those which may be carried around on the job with little or no effort—and learn the proper way to use them. Every picture taker is at a loss, sometimes, to know why his photographs do not turn out well. After reading carefully what Mr. Campbell has to say his percentage of failures should be reduced to a negligible quantity.

Railway Rates and Wages—Here and Abroad

WITH one exception in each case the railroads of the United States in 1913 paid their employees the highest average yearly wage and charged the lowest average ton-mile rate in the world, according to statistics compiled for thirty-eight countries and states by the Bureau of Railway Economics. In Western Australia the average compensation was about 6 per cent more than in the United States, and in India the average ton-mile charges were slightly (4 per cent) less than in this country. In Western Australia the ton-mile charges are double those of the United States; in India wages are very low.

Unfortunately there are gaps in the figures, owing to the inability of the bureau in some cases to obtain comparably acceptable information, so that it is impossible to draw a complete parallel between the United States and the principal European countries. The average compensation in this country of $756.83 compares, however, with corresponding figures of $408.97 for Germany, $376.81 for Italy and $211.40 for Russia, neither France nor the United Kingdom being given. On the other hand, while the table of ton-mile charges does not include either Italy or the United Kingdom, the figure for the United States, 0.729 cent, may be compared with 1.244 cents for Germany, 1.183 for France (in 1912) and 0.933 for Russia. Japan's average ton-mile charge was only 0.774 cent, but the average compensation was only $112.56.

If we were to make up a new figure, average yearly compensation per one cent charged per ton-mile, for the countries in which both average compensation and average ton-mile charges were known, we would get the following: United States, $1,038; Canada, $855; New South Wales, $388; Germany, $329; Sweden, $298; Holland, $275; Hungary, $247; Russia, $227; Austria $223; Rumania, $192; Japan, $145, and Switzerland, $139. While this is perhaps a fantastic unit it seems to show rather well how the employees fare in proportion to the unit freight returns, and it is seen that in this respect only our neighbor on the north is at all in the running with us. Of course both the relatively long haul and the large percentage of low-grade freight in the United States tend to keep down the rate per ton-mile. The high compensation can probably be attributed to our large cars and long trains, making it possible to use comparatively fewer men and pay them better. But however analyzed, it is hard to make the figures reflect other than credit to the American railroad.

A Lesson in Efficient Convention Management

THE CONVENTION of the City Managers' Association at Springfield, Mass., last week did more than furnish a fund of valuable information on the conduct of public business under this comparatively new form of municipal administration. From city managers we have been led to expect efficient methods of doing things—the substitution of direct for roundabout procedure. These expectations were fully realized in the handling of the Springfield meeting. Lost motion, the bane of nearly every engineering gathering at which papers are presented or discussed, was eliminated. Interest was always well sustained. Discussion was participated in freely. Addresses were terse and to the point. The program gave evidence of intelligent advance planning by President Henry M. Waite, city manager of Dayton, and his associates, and the proceedings throughout ran with clocklike precision.

It is high time for other engineering organizations to realize the importance of efficient convention management and to apply the principles which the city managers used so effectively at their annual meeting last week. We have had enough of programs in which business and technical sessions, banquets, trips of inspection, election of officers, selection of place of meeting and a varied assortment of entertainment features are thrown pell-mell into a program which soon becomes a veritable grab-bag of uncertainty.

An analysis of the city managers' program makes an interesting study, and one from which a moral may be drawn. Apparently it was prepared upon what might be termed the budget principle. Those who had charge of it grasped the vital point that the convention had a definite amount of time to spend. With this factor known, addresses and discussions were scheduled to consume this time and no more. Every hour was definitely accounted for. For example, the program for one afternoon was as follows: 2 p. m.—"Can a City Manager Succeed Where the Commission Is Dominated by Politics?" (general discussion); 3 p. m.—"Best Method of Keeping Cost Records" (general discussion, 5 minutes to each member); 4 p. m.—"The Best Method of Getting Proper Constructive Publicity" (discussion, 5 minutes to each member); 7 p. m.—dinner (roundtable discussion), Room A, "What City Managers Can Do to Further Advance Good Government," Vice-President Barnwell presiding.

It is so simple to build a program which will definitely utilize the time available that it is hard to understand why the practice does not become universal. Slavish adherence to precedents of former years, not applicable to-day, and the inertia of secretaries and local committees are responsible in large part for present conditions in other engineering organizations.

But it is one thing to prepare a program and another to have it proceed as arranged. Much depends on the presiding officer. A far too general conception of his duties seems to be merely the occupation of a chair on the rostrum. The most carefully prepared program can be knocked into the semblance of a crazy-quilt by a well-meaning but incompetent presiding officer—one who takes no heed of time and goes to the extreme either of letting discussion run wild or of doing absolutely nothing to stimulate it when it lags. The Springfield meeting of the city managers was fortunate in having Mr. Waite in the chair. If discussion on a certain subject was scheduled for 3 o'clock, it took place at 3 o'clock and not 10 o'clock the next morning or the morning after that. If there was a man in the audience qualified to express an opinion he was called upon by name. Bits of information from the presiding officer's own experience were given to keep things moving. But most important of all, there were no postponements of addresses and no omissions. Everything proceeded with businesslike dispatch. The disgruntled author of a paper and the disappointed auditor, figures not unknown at other conventions, were nowhere to be found.

Is it worth while to have conventions of this sort? Ask the man who goes to a meeting to hear a certain paper on a certain day and then discovers that it has been postponed or entirely eliminated. Ask the author whose paper is "read by title" because, through lack of advance planning, there is no opportunity for giving him a hearing. Ask the specialist who is urgently invited to be present to discuss a subject and who arrives upon the scene only to find that there is to be no discussion. Some men can afford only a day's time at a convention. Imagine their chagrin when they reach the meeting and discover that the paper they wanted to hear, scheduled for a specific day, had been arbitrarily advanced on the program to take the place of something else the day before.

There is a constructive lesson to be learned from the Springfield meeting of city managers. It is the lesson of getting the most out of engineering conventions by advance planning and efficient conduct of meetings. Too often it happens that a zealous secretary, intent upon making a big showing in the program for his convention, sends out broadcast to engineers requests for technical papers and discussions. No thought is given to the amount of time available for disposing of this material at the meeting. The main point seems to be to secure as many papers as possible and then to unload upon the meeting "as much as the traffic will bear." This kind of procedure defeats its own ends. It is merely another case of "ambition o'erleaping itself." If it continues long, engineers will be reluctant to prepare papers for conventions unless they can be guaranteed a hearing. It is the business of the convention management to issue this guarantee in the form of a program, prepared on the budget principle, which takes into account the amount of work to be done and the amount of time available in which to do it. Recognition of this fundamental fact made the convention of the City Managers' Association an unqualified success.

Camera's Use on Engineering Work Worth Learning

Technique Can Readily Be Mastered—Choice of Lens Important—Care Should Be Given to the Composition of the Picture—Don't Underexpose Films

By H. COLIN CAMPBELL
Concrete and Sanitary Engineer, Chicago, Illinois

STATISTICS have been compiled for all offenses except those committed in the name of photography. When the census taker makes his rounds to tabulate criminal offenses he can secure a great many of the necessary figures from the engineering and contracting professions. With his mind trained to do precise work there is really no excuse for the engineer being such an indifferent photographer as he often is. This art-science would serve him well if he were willing to devote a little systematic study to the subject and to graduate from the ranks of button-pushers. He should not let any one "do the rest," for only by doing all himself can he learn why the plates or films that he has been having developed by some one else have turned out unsatisfactorily. Only by mastering the mechanics of photography, which may be easily learned and applied, can he hope for success.

Best Type of Camera

For all-around purposes in the field, no other camera, where the user must be limited to one which can be carried handily, will serve the engineer-photographer in so great a degree as one of the folding types of 3¼ x 4¼-in. size, or thereabouts. Sharp negatives made with this camera can be enlarged to 8 x 10 in. or larger if desired, and at less expense than will result from using a larger camera exclusively, since one does not always need the larger pictures. This should be equipped with one of the high-grade lenses of the anastigmat type, working at a speed of about F6.8. This designation means that the ratio between working aperture of the lens and its focal length is as 1 in. to 6.8 in. In other words, a lens is known as an F8 lens if the working aperture is 1 in. and the focal length 8 in. A lens of 16-in. focal length, for instance, that worked at F8 would have a 2-in. aperture.

Lenses

Lenses are mounted in shutters equipped with what is known as an iris diaphragm, which permits reducing the working aperture of a lens as may be necessary to compensate for conditions of intense light, to increase the sharpness of the image over the plate or film and to increase the depth of focus of the lens. Depth of focus is a term used to describe the property which a lens has of defining with equal sharpness objects both near and far from the position from which the camera is used while taking a picture. Depth of focus is dependent, in the first instance, upon a number of conditions. Lenses of long focal length have relatively less depth of focus than lenses of short focal length. For instance, a lens of 2-in. focus, such as used on motion-picture cameras, will, so far as the eye can detect, define objects from 8 or 10 to 100 ft. distant from the camera with equal sharpness when the lens is used at its full working aperture. As the focal length increases, however, depth of focus diminishes. This is why lenses or shutters in which lenses are mounted are equipped with an iris diaphragm.

Closing this diaphragm, or, as it is called, "stopping down the lens," increases the depth of focus, and in some cases—that is, in lenses of the rectilinear type—increases sharpness of the image all over the plane of the plate. Rectilinear lenses, however, are not now commonly used, the modern anastigmat lens having taken its place. This lens eliminates many of the optical errors that were inherent in the early types. Even at full aperture it will reproduce or define straight lines, both vertical and horizontal, truly straight and sharp to the limits of the plate. There is not sufficient space at our disposal to define all of the technical requirements of a good lens. These can readily be learned from the catalog of a lens manufacturer.

Pictures as Records

Photography properly applied enables the engineer to record progress and all details of construction on any piece of work, gives him a check on memory, and records details that are hidden in the finished structure. Not every negative that may be made is likely to possess a distinct value. There is more to photography than the ability to secure a sharp, photographically good negative that will yield equally good prints.

SIZE SHOWN BY CONTRAST

Massiveness of these large gates in the Arrowrock Dam is clearly disclosed by having human figures standing in the picture near the gates. One thereby gets a correct idea of size. No one will claim that great care was used to construct forms so that smooth concrete faces would result. The reverse is quite evident from the microscopic detail in the picture, which is so faithful as to show the ends of wire ties used. This exposure is from a correctly timed negative made in very strong sunlight.

To be of value to the engineer on construction, a picture should serve as a useful record of some particular piece of work or some stage of progress of that work; or perhaps record some practical operation or a scientific fact.

Those who practice photography to-day have little knowledge of the disadvantages under which the early photographic worker labored. Carrying around the cumbersome outfit with necessary paraphernalia to prepare wet plates immediately before the exposure could be made, and usually the possibility of losing some associated incident that it would have been very desirable to record, because of lack of speed in plates and lenses, made such photography quite different from pushing the button. It is unfortunate, however, that many are tempted, through the very ease of operating the modern camera, to take "snapshots" of everything, right and left, without a display of the discriminating judgment necessary to choose subjects or opportune moments for the true value which the proper record would have. As a result many photographs are made which although technically good have no value for practical purposes.

What Will the Picture Show?

Among the questions which the camera user should ask himself before taking a picture are the following:

Is the picture merely a repetition of one already made? If it is, would there be any useful purpose served by taking it from a different viewpoint? Will the photograph illustrate fully some fact or process, some point of progress, or does it simply show a group of workmen or bystanders posing for their portraits? What will the picture show by itself; or will it be of advantage only when made a part of a series? Many photographs which are taken show one stage of a very interesting operation, but only one, therefore by themselves are practically useless. When the camera user has asked and carefully answered for himself these questions, much of the "snapshotting" will be eliminated.

Pictures intended to arouse popular interest—that is, to have strictly a news value—may quite properly, in fact should, possess different qualities or display different composition from that which is desirable in a photograph made solely for scientific record. In the latter case the object of taking the picture should be kept uppermost in mind and no other considerations be allowed to interfere with the clearness and accuracy of the record. For news value, animal life gives human interest, but nothing does more to mar an engineering picture than to see workmen on a job grouped and posed solely for the purpose of having their portraits taken.

News interest is enhanced by action, but action is not expressed where workmen are resting on their shovels, directing a fixed stare toward the camera.

Many "attachments" have been invented and marketed with a view to impressing

WHERE POSITION OF CAMERA COUNTS

In this photograph, showing a portion of the Big Creek dam, immensity is at once suggested by the looking-downward point of view. The group of figures gives one an idea of the dam's thickness, while the figure of the man standing on the fourth "step" helps one to grasp the total height of the structure. If the camera had not been pointed downward, as it was when taking this picture, length instead of thickness and height would have been the impression first conveyed.

LANDSCAPE AND ENGINEERING ARTISTICALLY COMBINED

Flow line and dam, conduit plant of the Northwestern Electric Company, Portland, Ore. The point of view is so high that the monstrous serpent-like pipe seems almost to fit rather than mar the landscape. Had the view been taken lower down so as to exaggerate the size of the pipe, the landscape setting would have been subordinated. A "picture" would have thus been lost. Unfortunately, modern periodical printing methods are such as to prevent even the finest halftone from showing all the fine details of an original.

the camera user that success depended upon hanging all of these on his outfit. Nothing could in general be farther from the truth. One should not experiment with ray screens, telephoto lenses, back combinations, etc., without knowing just what the result will be. It is surprising what excellent work can be turned out with the old types of rectilinear lenses in the hands of persons who know how to use a camera. In fact, one is safe in recommending that unless the camera user is willing to devote enough practice and study to picture-taking —to the mechanics of photography—to become relatively expert, he can hope for just as good results, if not better, from a camera equipped with a rectilinear lens as from one of the speedy modern anastigmats.

Speed of Lens

Speed of lens, as has been suggested before, depends on the relative working aperture. A lens which works at F4.5 at full aperture can be slowed down so as to compel greatly increased exposure, by closing the lens or shutter diaphragm. The amount of exposure necessary then depends on the degree this aperture is diminished and is in direct ratio to the area of the aperture (circle) compared with full aperture.

By far the greater number of photographic negatives are under rather than over exposed. Detail cannot come from underexposure, nor can any of the laboratory or darkroom makeshifts, such as intensification and similar manipulations, bring out an image which has never been impressed on the plate by the chemical action of light. A fully timed or even an overexposed plate or film—if such condition is known to have existed—can be manipulated to almost any reasonable degree with good prospects of satisfactory results. A correctly timed negative can be developed in almost any kind of photographic developer with the assurance that the resulting picture will be all that could be desired. Even the faulty negative may have some of its errors compensated for through the wide latitude offered in the great variety of printing papers now on the market. Of course, what is not there cannot be manipulated nor shown.

Sometimes absolute sharpness of detail is essential under conditions where rapid exposure must be made. Then the result may best be secured with a camera having a lens of relatively short focus, since, as already mentioned, such lenses define objects near and far from the camera with apparently equal sharpness. If lenses of too short focus are used, however, perspective will always be distorted. Lack of sharpness impairs the value of a picture for illustration and record.

Several objections to the small cameras not easily remedied might be mentioned. Little dependence can be placed on the viewfinders with which such cameras are supplied. They serve a certain purpose well; that is, they enable the photographer to know whether he has an object nearly centered on the plate or film. But as finders do not occupy the same position that the lens does, their point of view is that much different so they do not "place" the object exactly as the lens will. Also, the angle of view of camera finders varies, and rarely or never is this angle of view the same as that of the lens. The finder may include more or less of a scene than will be actually recorded by the lens. In photographing near objects, all finders are practically worthless. Then a ground-glass screen and focusing are necessary. The erratic "reading" or indications of finders are responsible for many photographs failing to show certain parts of a view that it was thought was being included in the picture.

Reflecting Type of Camera

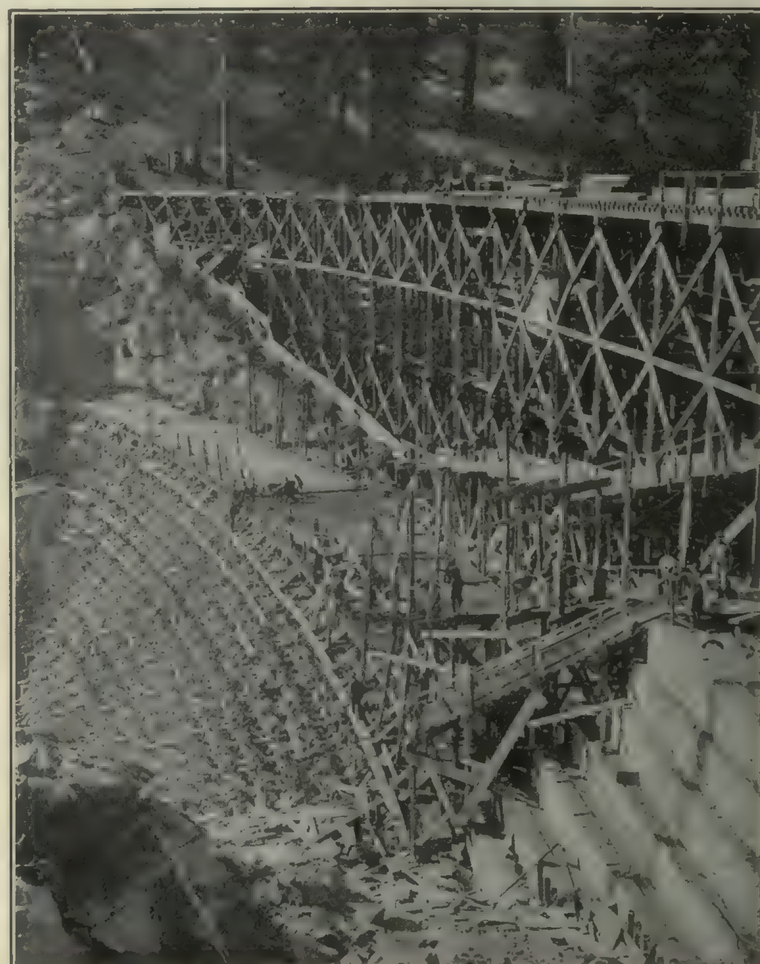
Cameras of the reflecting type display the image on a ground-glass screen right side up and permit instant adjustment of focus. Pictures made with them are certain to be sharp, while those taken with a camera where a focusing scale is used depend for sharpness largely upon the ability of the camera user to guess distances correctly. Errors of estimating distances are not so noticeable where the objects being photographed are 50 ft. or more distant from the camera and the lens is slightly stopped down, as then the depth of focus is increased and errors of focusing concealed; but as the camera is brought nearer to the object, then any errors of estimating distance become much more noticeable and cannot always be corrected by stopping down the lens. This is especially true when the camera is held in the hand, as a long or slow exposure is impossible because of the certainty that the camera will be moved while the shutter is open.

Properly used, the reflecting types of cameras serve a better purpose for all-

around photography than any other type now made. They eliminate absolutely the guessing of distances. The picture is seen right side up on the focusing screen to the moment of exposure, although of course reversed; and where motion must be arrested—that is, where the scenes of real life and action must be taken—the focal plane shutters used in these cameras permit of such a wide range of speed that to all appearances motion can be absolutely arrested. These shutters consist of a curtain having slots of various widths in them, and passing immediately in front of the plate admitting for the entire length of the exposure a uniform volume of light over the whole plate. The main objection to the reflecting camera is its bulkiness as compared with a folding camera.

VIEW REMARKABLE FOR MAGNIFICENT DETAIL

A photograph of the Arrowrock Dam looking down from a point near the spillway. This picture has an exceptionally pleasing sparkle of light and shadow. The point of view helps the suggestion of massiveness and magnitude. At the time of taking this picture the sun was to the right and front of the camera. Such conditions require that care be taken to shade the lens, and particularly to make certain that full exposure is given.



FORMWORK DETAILED BY PHOTOGRAPH

Formwork on Big Creek Dam No. 3, Pacific Light & Power Corporation. Another remarkable construction view which almost details formwork to the careful observer. This picture also was taken with the sun slightly in front of the camera, yet notice that exposure has been sufficient to show detail under the trees in the distance and almost inside the intricate maze of form timbers. Some of the clearness, of course, is lost in reproduction.

Don't Use Highest Speed

Many persons who have high-grade cameras equipped with high-grade lenses and speedy shutters cannot school themselves against the tendency to use the apparatus at its highest possible speed. If their camera shutter is rated to work at a possible two hundredth or three hundredth of a second, they think that they are losing money unless they take full advantage of the feature. This is responsible for the large majority of underexposed negatives.

"Exposure meters" are made in varieties galore in the attempt to offer the camera user a means of determining correct exposure under many conditions. Experience has proved that some of these devices are of questionable value, all are largely of theoretical value only. Nothing equals experience, and before one can adjust one of these devices and determine requirements, the picture setting may have changed from what was at first desirable to record. A common fault with many pictures is that the camera was held with the long dimension of the plate vertical when it should have been horizontal.

One should not attempt to take photographs from moving trains, nor can good results be expected on a dark, hazy day, no matter how high grade the camera, unless due allowance is made for light conditions, and the exposure regulated accordingly.

Snapshots can never be so good as pictures made by resting the camera on a tripod, stopping down the lens properly and giving the correct time exposure.

Photographs were once inadmissible as evidence in court; now, however, it has become a common practice to so admit them. This suggests that proper record should be made of all attendant facts associated with a picture, especially the time and place of taking, and by whom made.

Value of Photography to Engineer

Photography can be made to serve the engineer in many ways that space does not permit discussing. Copies of tracings, contracts, records and similar papers often are desirable to complete a file, that could not be done if the only way were to place originals with correspondence or other papers on the same subject. For copying, however, the small camera will not serve, since the length of bellows does not in most cases permit reducing a plan to the full limit of the size of the plate.

Pictures should not be made with the camera pointed directly toward the sun. The sun should either be at one's back or to the right or left a sufficient number of degrees so that its direct rays will not be focused by the lens, thus causing fog, or what is known as "halation," on the plate. Sometimes, of course, it is necessary to photograph an object with the camera pointed directly toward the position of the sun in the heavens. Then one should be careful to shield the lens from direct sun rays. If this is not possible wait until a cloudy day or take the picture earlier or later.

Methods of Development

Only by learning how to develop negatives and to make prints can the camera user school himself as to correct exposures; and in learning to make negatives and prints he should not be misguided by every one who wants to suggest some private developing formula as one which will produce the most remarkable results—better than any recommended by the film or plate maker. It is safe to assume that the manufacturers of photographic apparatus and materials have expended a great deal of money in advancing the art-science of photography to its present notable position. There is never any better developing formula for a particular make of plate or film than the formula recommended by the manufacturer; and not until the person dabbling in photography has graduated from the dabbler's ranks and has learned from experience the chemistry of photography and the various processes which take place in fixing the photographic image on the plate or film, should he attempt to substitute solutions differing from those recommended by the plate or film manufacturer.

Detailed Information Required from Am. Soc. C. E. Candidates

CERTAIN changes in the form of application for admission to the American Society of Civil Engineers have recently been put into effect. The new forms are reproduced herewith. It will be noted that specific information concerning the time of each professional engagement is required and that each statement must be attested by "some one familiar with each engagement, preferably the person to whom applicant reported." It will be seen therefore that references from non-members are now admissible. It is still necessary, however, to refer to five corporate members of the society.

All communications in reference to applications should be addressed to THE SECRETARY, AMERICAN SOCIETY OF CIVIL ENGINEERS, 220 WEST 57th STREET, NEW YORK.

American Society of Civil Engineers.

APPLICATION.

I, ... FULL CHRISTIAN NAMES AND SURNAME of Applicant.

residing at .... City or Town. County. State. ...., *being*

desirous of *admission into** / *transfer to a higher grade in* *the American Society of Civil Engineers, submit the following as my professional record:*

I was born at .... Place of Birth.

on .... Date of Birth. *18*

I was graduated from .... School of Engineering.

on .... *19* ...., *and received the degree of* ....

.... State were any additional degrees

.... and by whom conferred.

I refer to the following Corporate Members:

Give the names of at least five CORPORATE MEMBERS (Members or Associate Members).

Corporate Members of the American Society of Civil Engineers.

*Strike out the line not applicable

Date. From	Date. To	TITLE OF POSITION AND CHARACTER OF EACH ENGAGEMENT. (Make statement brief and concise: any necessary amplification may be made by letter.)	Time. (Years and Decimals.) Total Time.	In Responsible Charge.	In Design.	NAME AND ADDRESS of some one familiar with each Engagement, preferably the person to whom Applicant reported
(Please number each Engagement.)						

In my opinion, I am eligible for the grade of .... This may be filled or not, at discretion of Applicant. The statement will not be published.

I will conform to the requirements of membership, if elected.

.... Applicant will sign here

Dated .... *191* .... Applicant will fill in this date.

.... and give his present post office address.

NEW FORM OF MEMBERSHIP APPLICATION FOR AMERICAN SOCIETY OF CIVIL ENGINEERS

Miami Flood-Prevention Plans Sustained

Court Decision by Vote of Seven to Two Approves Program Proposed for Protection of Dayton District

BY A DECISION rendered Nov. 24 the flood-prevention plans of the Miami Conservancy District, which includes Dayton and Hamilton, Ohio, were sustained. Nine judges had been hearing the arguments on the plans, and the vote was seven for and two against. The judges were: Carroll Sprigg, Montgomery County; Otway J. Cosgrove, Hamilton; Willard J. Wright, Warren; Clarence Murphy, Butler; Frank Geiger, Clark; C. H. Kyle, Green; A. C. Risinger, Preble; Hugh Mathers, Shelby, and Walter D. Jones, Miami. Judges Mathers and Jones cast the dissenting votes.

The general scheme of flood prevention for the district was presented in the Engineering Record of March 28, 1914, page 356, while further details, dimensions and estimates of the completed plans were set forth in the issue of March 11, 1916, page 348.

The decision in full is as follows:

1. The court is of the opinion that the question raised as to the constitutionality of the law by reason of the decisions in the cases of Baumann vs. Dayton in the 66 O. S., and commissioners vs. Gates in the 83 O. S. is not now properly before the court for the reason that it does not appear that any assessment has been made against any specific piece of property and that therefore no one is now in a position to complain; and for the same reason other questions as to the unconstitutionality of the act on account of the method provided for the raising of funds is not now before the court.

To this finding Judge Mathers dissents.

2. The court is of the opinion that the Miami River is not a navigable stream in law or fact.

3. The court is of the opinion that any obstruction that may occur from the adoption of the plan to the public use or navigation of the Miami and Erie Canal is authorized by the contract between the conservancy board and the state officials as provided for in the conservancy act.

Full Protection

4. As to the objection that no construction shall be made under the authority of the act which will cause the flooding of any village or city unless the board shall have acquired and paid for the right to use the land affected for such purpose and shall have paid all damages incident thereto, the court is of the opinion that such provision of the law does not prevent the adoption of the official plan.

5. The court is of the opinion that channel improvement alone for the entire conservancy district is not feasible or practicable, and is prohibitive in cost and would not adequately protect the district from flood waters.

Judge Mathers dissents from the proposition that channel improvement alone would not adequately protect against floods.

6. The court is of the opinion that the combination of dams and dry detention basins, together with channel improvement, is the only practical and efficient method of protecting the Miami valley from the results of destructive floods.

Earthen Dams

7. The court is of the opinion that earthen dams, with concrete conduits and spillways as provided for in the official plan, are safe and will be of sufficient strength to sustain at all times any burden that may be placed upon them by impounded water.

Judges Jones, Mathers and Kyle do not fully concur in the foregoing, but find that a preponderance of the evidence shows that

the dams as provided will be reasonably safe.

8. The court is of the opinion that it would not be feasible to reduce the height of the Huffman dam or its spillway. To this Judges Kyle and Geiger dissent.

9. The court is of the opinion that the Lockington dam should not be eliminated from the official plan.

To this Judges Jones, Mathers and Geiger dissent.

10. The court is of the opinion that the objections filed to the official plan as proposed by the board of directors of the conservancy district should be overruled; that the work proposed in said plans is necessary and that the same will be conducive to and conserve the public health, safety, convenience and welfare of the Miami conservancy district, and the court therefore adopts the said official plan.

To the judgment of the court adopting the official plan, Judges Jones and Mathers dissent by reason of the finding made by the court in the ninth syllable hereof refusing to eliminate the Lockington dam; otherwise concurring with the majority of the court.

600-Foot Head Produces 2000 Horsepower

Guaso River Controlled as It Emerges from Cave—Head Operates Two Impulse Wheels and One Exciter Wheel

BY MEANS of a hydroelectric project now under construction in Cuba the power of the Guaso River is being developed from the source to a point about 2 miles away, where a 600-ft. head can be utilized to produce about 2000 hp. The Guaso River emerges from a mountain through the mouth of the cave, at which point a concrete dam and intake have been built. The minimum flow was estimated at 30 sec.-ft. during the dry season.

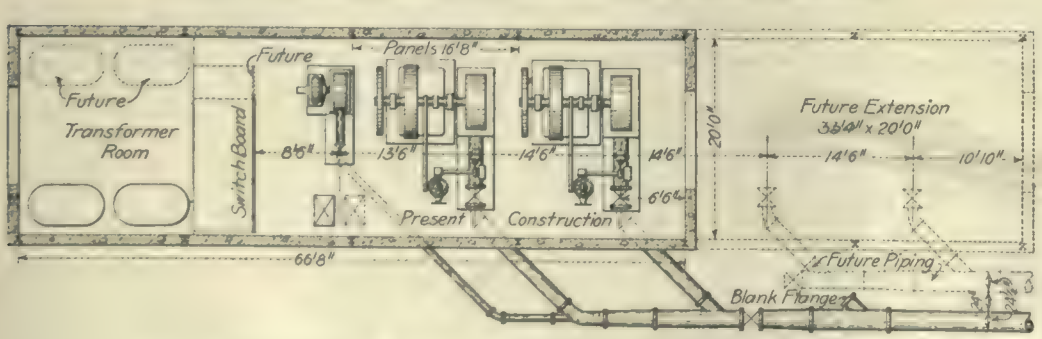
The sizes of pipe, profile of the line and location of the standpipe are shown in one of the drawings. Water is delivered to two Allis-Chalmers 560-hp. impulse wheels and a 60-hp. exciter wheel. These are direct-connected to 470-kva. 2300-volt three-phase 60-cycle Westinghouse alternators. Two 500-kw. step-up transformers of the oil-insulated, self-cooling type raise the voltage from 2300 to 23,000 for transmission. The power-house plans provide for the future installation of two more units. The switchboard was furnished by the General Electric Company.

Current will be transmitted to the city of Guantanamo and there reduced to 2200 volts. The present power house of the former Guantanamo Electric Company will be used as a substation and its steam plant kept as a reserve.

The value of the location was discovered in 1900 by Eduardo J. Chibas and Arthur S. Hobby when they explored the upper part of the Guaso River during the first American intervention in Cuba. The concessions were granted soon after that and the new Guantanamo Electric Company was organized. The first plans and estimates were made by Mr. Chibas and approved by the government. Cary T. Hutchinson and C. F. Cook then made a thorough investigation of the project and presented their final report in June, 1915.

The work of construction is being executed by the Montreal Engineering Company, of which Carl G. Giles is president and A. E. French engineer in charge.

PROFILE INDICATES LOCATION OF STANDPIPE AND SIZES OF SECTIONS



PLAN OF POWER HOUSE, SHOWING EXTENSIONS FOR FUTURE DEVELOPMENT

American Shipbuilding Approaches British in Volume

According to figures made public by the Department of Commerce, the shipbuilding industry in this country is reaching proportions comparable with those of the industry in the British Isles. On September 30 last, there were ordered and under construction in the shipyards of this country 417 steel vessels, aggregating 1,454,000 gross tons. There were at the same time under construction in the United Kingdom 469 vessels of the same class aggregating 1,789,000 gross tons. The Delaware River district exceeded by 13 vessels and 17,000 gross tons the New Castle district.

Planetable Facilitates Making Station Maps

Success in Mapping Large Yard for Valuation Suggests Desirability of More General Use by Railroads

By R. E. DAVIS
Instructor in Civil Engineering, University of Illinois, Urbana, Ill.

AT PRESENT the valuation departments of many of the railroads of the United States are engaged in the field and office work incidental to the construction of the station and right-of-way maps and profiles required by the Interstate Commerce Commission. It seems appropriate to bring to the attention of engineers engaged in this work the possibilities of the planetable as an instrument for mapping to large scale, particularly for mapping extensive areas when there are many congested details, such as is usually the case with our large yards and terminals.

Weaknesses of Transit-and-Tape Methods

Inquiries from men actively engaged in making the resurveys in various sections of the country indicate that the average railroad engineer is acquainted with the planetable only to the extent of believing that it may economically and properly be used solely on intermediate or small-scale topographic work; and the general practice seems to be to make the surveys for station maps entirely by use of the transit and tape, the usually voluminous notes being "worked up" in the office and more than likely interpreted by one never on the scene of the survey. Those engaged in work of this kind (where all data are collected in the form of field notes) well realize the immense amount of time spent in gathering what may be termed "extra information," without which the principal data would be perfectly clear to one on the ground, but quite unintelligible to the office draftsman. Moreover, it is rarely the case on an extensive survey, where there are many details within the area to be mapped, that there are not vital omissions from the field notes which become apparent only after the office work has been started and the party making the survey has moved to other work.

During the past summer, on the resurvey of the northern division of the Chicago & Alton Railroad, the planetable has been used extensively in mapping complicated layouts, and an account of the mapping of the terminal freight yards at Glenn, 10 miles from Chicago, will illustrate the advantages of the method. The track layout at Glenn is 2 miles long and varies in width from a few hundred feet to half a mile. There are about 30 miles of track, together with yard offices, a roundhouse, transfer house, railroad Y. M. C. A., coal chutes, freight-car repair shops and the many other details usually to be found in a large terminal yard.

Horizontal Control

The method of procedure was first to run a series of closed transit and tape traverses, stations being established every 100 ft., the traverse lines being for the most part along the center lines of the ladders and the principal outer tracks of the various subdivisions of the yard, and the transit stations being placed at the P.I.'s. Approximately 8 miles of traverses

with thirty transit stations furnished control for the entire yard.

The latitudes and departures of the traverse lines were then computed, each traverse adjusted to closure, the co-ordinates of the transit stations computed and the traverse lines plotted on 24 x 30-in. planetable sheets, the sheets being carefully cut with square corners and straight edges so that they might be butted together when plotting the traverses and also later when tracing the whole map.

It will be noted that up to this point field notes, except a record of the traverse angles and distances, have been unnecessary. It will also be seen that since 100-ft. stations have been established there are a large number of control points (the positions of which are shown on the planetable sheet) which may become planetable stations or may be conveniently utilized in establishing planetable stations in more convenient locations, or may be used as points of reference for direct linear measurements.

DETAILS

The method of constructing the detail of the sheets was as follows:

The planetable operator, with the planetable oriented at one of the control points or set up at some other convenient point and located by tape measurements from two control points, plotted the frog and switch points, and the P.C.'s and P.T.'s falling on the traverse lines, the distances from the control points being measured direct by two chainmen and the pluses being called out to the planetable operator. At the same time the plotting and chaining were checked by getting the direction to each point with a peep-sight alidade and the stadia distance with the telescopic alidade, the stadia rod being carried by the head chainman and being graduated to hundredths of a foot.

It was found with a rod graduated in this manner that for short distances (the distance from planetable to rod did not exceed 300 ft., and in general the maximum length of sight from each station did not exceed 200 ft.) the precision with which distances could be determined by stadia was consistent with the scale of the map (50 ft. to 1 in.). When getting direction to a point it is possible to manipulate the peep-sight alidade with much greater rapidity than the telescopic alidade, the latter being used only for getting the stadia distance, except on long shots.

Points on curves and on other tracks off the traverse lines were located by using the planetable as described, the plotted position of each point being checked, when convenient to do so, by scaling the distance to the nearest control point and comparing it with the corresponding actual distance as measured by the chainmen. Distances between parallel tracks were determined by direct measurement, the plotted position of the outer tracks being checked by direction and stadia distance as cited.

Buildings and other details of like character, as the work of plotting track progressed, were located by graphical triangulation from two or more planetable stations, or by direction and stadia distance if graphical triangulation was not practicable, and the plotted positions of buildings were checked by direct measurement of the sides.

It was found that the methods here outlined produced results, as far as the accuracy of the map was concerned, in every way the equal of results to be obtained by the more usual methods, the large number of control points and the manner in which the planetable was utilized making it possible to locate each point with respect to all other points as closely as the scale of the map would allow. Since the detail of the map was constructed in the field a much smaller number of observations was necessary than otherwise would have been the case, and there was no necessity for taking field notes. Since the map was made in the field the danger of omissions was reduced to a minimum, and the system of checking made serious mistakes, both in the observations and in the plotting, impossible.

Progress was rapid; an instrumentman and two rodmen ran the control traverses in three days, computed the latitudes, departures and co-ordinates and plotted the control on the planetable sheets in two days, and filled in the details of the entire map in six days. The office work was reduced to tracing the assembled planetable sheets.

Comparison of the time spent in the field with the time spent on similar surveys on which the more common methods have been used makes it seem not unlikely that the saving was 100 per cent, and with all survey data in the form of notes it is doubtful if a draftsman working alone could have plotted the map in pencil in less than ten days.

If this estimate is at all conservative it is quite obvious that the average railroad engineer cannot well afford to do without the planetable outfit as a part of his regular surveying equipment.

Difficult Problems Solved in Placing New Members and Larger Pins in Drawspan

Arthur Kill Drawbridge Near Elizabeth, N. J., Repaired by Special Methods—Bents on Fender Pier Fail to Support Loads as Planned

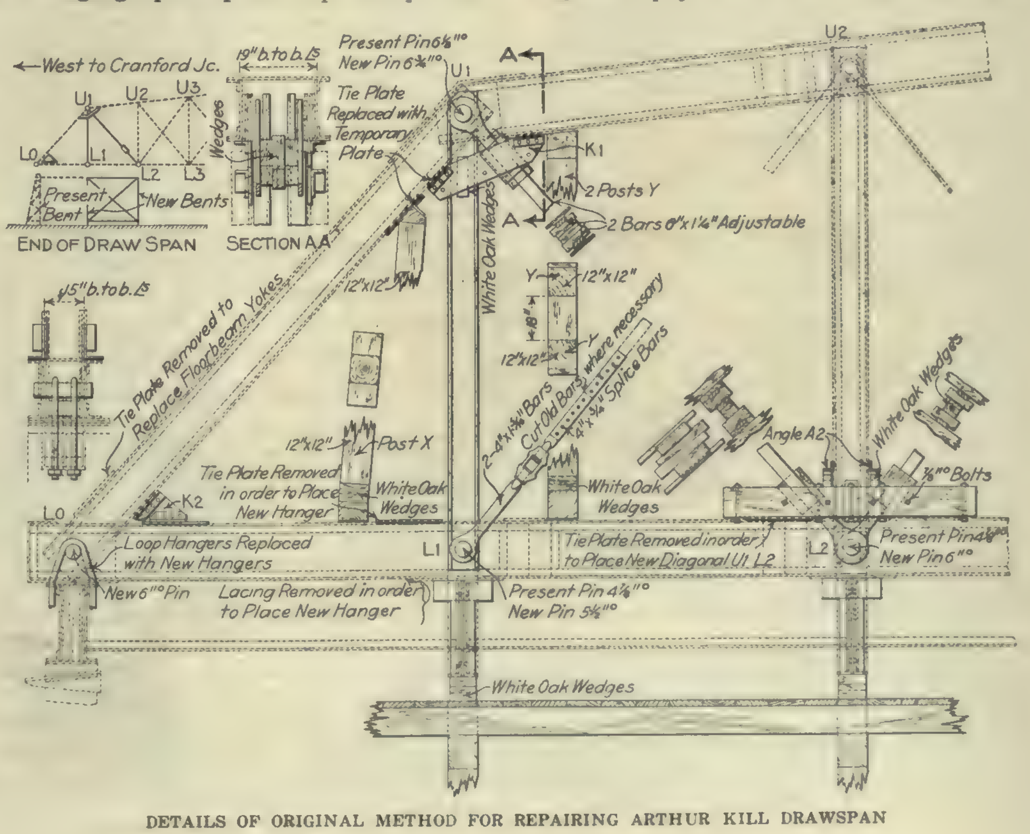
UNUSUAL difficulties encountered while replacing worn pins at the panel points near the ends of the long Arthur Kill swingspan of the Baltimore & Ohio Railroad, near Elizabeth, N. J., necessitated the adoption of an auxiliary adjustable diagonal attached to temporary brackets. This requirement arose from the fact that, in blocking up the panel points L_1 and L_2 from temporary timber bents placed under the span in its open position, it was found that instead of wedging the panel points up, the bents were forced down.

A well-planned schedule had been drawn up for reboring the pinholes at points L_0, U_1 and L_2, replacing the old pins by larger new pins, replacing the hanger U_1L_1 and the main diagonal U_1L_2 by new members, and splicing the diagonal L_1U_2 to make it adjustable. Temporary timber bents were built upon the old fender piers for wedging up the points L_1 and L_2. This schedule had to be revised with regard to points L_1 when it was found that the fender piers, constructed of timber cribs filled with soft material, settled under the temporary bents, so that it was necessary to supplement them by other means.

ADJUSTABLE RODS ADOPTED

This was accomplished by the use of temporary plate and angle brackets attached to the chords to carry pins to which four adjustable square rods were attached by means of stirrups and turnbuckles, as indicated in the sketch. This auxiliary diagonal was drawn up as found necessary to relieve the tendency to settle at the points L_1 and L_2. The pins used for this temporary work were old pins removed from other bridges and turned down to the required diameter.

To replace a bar found to be bent in the diagonal L_1U_2, and to enable that member

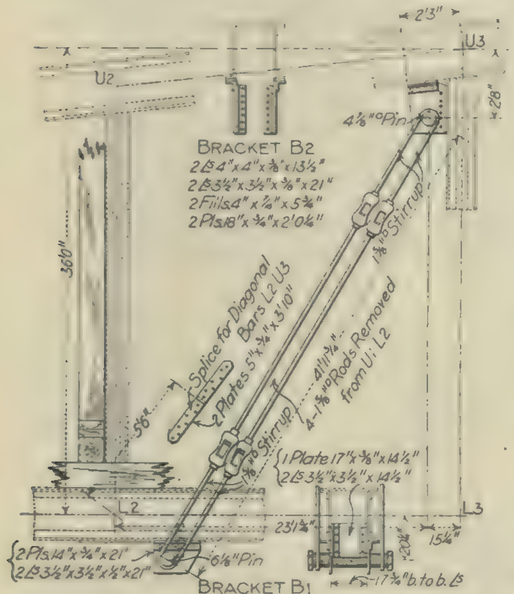


DETAILS OF ORIGINAL METHOD FOR REPAIRING ARTHUR KILL DRAWSPAN

to be adjusted to take its proper share of stress, a new end piece connected with splice bars was introduced.

PRELIMINARY WORK

Before any of the main repair work was started, the two temporary bents shown in one of the drawings were erected on the fender pier under the panel points L_1 and L_2 at each end, with the span in open position. All rivets in tie plates, lattice bars and portal struts which had to be removed to allow new members and pins to be placed were cut out between trains and replaced by bolts, the temporary tie plates and lug angles bolted on, and holes drilled for the splice bars to be attached to diagonal L_1U_2, in order to introduce the new adjusting



AUXILIARY DIAGONAL USED WHEN BENT AT L_2 SETTLED

turnbuckles and short connecting bars at the lower end, as shown.

The necessary timber blocking and wedges were prepared, and the timber posts X and Y on each side of the hanger U_1L_1 placed and lashed securely, without driving the wedges. In the succeeding operations one end of one truss was completed before work was begun at the other points, and the panel points L_0, L_1 and L_2 were supported at both ends of both trusses, in all instances, when pins were knocked out or when old material was replaced with new.

REPLACING PINS AT L_0

The end pin at L_0 was replaced by blocking up points L_0 and L_1 and supporting the end post by the bracket K_2 at the lower end and by wedging up the timber post X, removing the tie plate above L_0 and the old floorbeam hanger and placing blocking between the members to hold them in position, removing the old pin and reboring the pinhole to 6 1-32 in. diameter, driving new pin and placing new floorbeam hanger. The brackets K_2 were then removed, the wedges under post X loosened and all tie plates replaced and bolted up before the bridge was swung closed and traffic resumed.

To insert the new members U_1L_1 and U_1L_2 the following sequence of operations was planned:

The panel points L_0, L_1 and L_2 were to be blocked up on the bents, the wedges under posts X and Y driven until the weights of the end post and top chord were released from pin U_1, brackets K_1 placed, the tie plate at L_1 removed and two horizontal 6 x 12-in. timbers placed over the lower chord to take the wedges under angles A_3, which were to be driven until the pin at L_2 was released from the weight of the post. The pins at U_1, L_1 and L_2 could then be removed and, after cutting out the necessary tie plates and lacing in the lower chord, the hanger U_1L_1, diagonal U_1L_2 and the lower ends of diagonal L_1U_2, after cutting old bars as shown, were to be removed and the new diagonal U_1L_2, the new hanger U_1L_1 and the bars with splice plates and turnbuckles in diagonal L_1U_2 placed in position.

The turnbuckles in the diagonals were then to be turned up, new pins of the old size driven at L_1 and L_2, and all members at U_1 blocked and clamped securely, the pinhole at U_1 rebored for the 6¾-in. pin and the new pin driven. The blocking and wedges could then be removed, the posts released, brackets K_1 removed, the tie plates and lacing replaced, the main diagonal adjusted and the bridge closed ready for traffic.

PROCEDURE REVISED

Owing to the fact that the wedges at the bents under joints L_1 and L_2 did not develop the required reactions because the timber bents and pier deflected, it was necessary to revise the foregoing procedure by adding the new temporary diagonal as described. The procedure was then as follows:

Posts X and Y, brackets K_1 and 6 x 12-in. timbers at L_2 were placed, and the panel points blocked up as originally planned. In addition, the timber posts adjusted by wedges were placed between the 6 x 12-in. blocks at L_2 and the top chord and temporary brackets B_1 and B_2 and the auxiliary rod diagonals shown in one of the drawings, using old rods U_1L_2, were erected. The end point L_0 was wedged up as much as possible to relieve diagonal L_2U_3 of load, and the auxiliary diagonal tightened. Thus the pinholes in the members at L_2 were brought to line and the work of replacing members and pins carried out as originally planned. The auxiliary diagonals and timber wedges were then loosened, the tie plates, lattice bars, etc., bolted on and traffic resumed.

In replacing the 4⅞-in. pin at L_2 with a new 6-in. pin, the members bearing on the pin were relieved of stress by again driving wedges under the timber posts, jacking up the end of the bridge and pulling up the auxiliary diagonals. When the bars L_2U_3 were relieved of stress and the holes properly lined, all members were securely clamped, the pinhole rebored and new pin driven.

The work was carried out by company forces under the supervision of W. S. Bouton, engineer of bridges, Baltimore & Ohio Railroad, Baltimore, Md.

Rainfall Statistics at Panama

The rainfall for the calendar year 1915 at Panama was above the average at 10 stations and deficient at 8 stations. The average precipitation over the Pacific section, as given in the report of Major-Gen. George W. Goethls for the year ended June 30, 1916, was 74.98 in.; over the central section, 102.61 in.; and over the Atlantic section, 148.60 in. The maximum 24-hr. rainfall recorded during the year was 8.30 in. at Gatun, on April 3 and 4. The rainfall during the first six months of 1916 has been above normal over the Pacific section and southern part of the central section, and below normal over the Atlantic section and northern part of the central section.

Relay Brick Pavement on Wet Concrete Cushion

Sunken Places Over Trenches and Sand Flows Obviated by Monolithic Construction, Reusing Seventeen-Year-Old Bricks

An experimental monolithic brick pavement has recently been laid in Champaign, Ill., on top of the existing base, reusing the original brick laid seventeen years ago. Prior to 1906 the brick pavements were practically all sand-filled, laid on a natural cement base over a 2-in. sand cushion. At the points where excavations were made before the laying of the pavement, most of the foundations have given away, leaving ruts in the roadway from 1 to 4 in. deep. Also, the sand cushion in many places has flowed to such an extent as to leave the surface rough. The original brick were of the repressed type and have spalled badly.

TWO PIECES OF PAVEMENT SELECTED

Two pieces of pavement of about 150 sq. yd. each were selected. The first was a stretch where the brick were badly worn and the surface exceedingly rough. In the second the brick were not so badly worn, but the surface was rough and uneven. Both pavements were subject to heavy traffic.

The repair work was carried out as follows: Upon the cleaned original foundation was spread a 2-in. layer of concrete composed of 1 part cement, 3 parts sand and 2 parts roofing gravel. The brick, which had been thoroughly cleaned with wire brushes, were laid on the gravel foundation, inspected, rolled with a hand roller weighing 40 lb. per linear inch of bearing and grouted. The grout consisted of 1 part cement to 1 part sand. The sand was screened and the grout mixed and applied according to standard specifications. The street was then blocked for a period of fifteen days in order to allow the foundations to set properly.

EXPERIENCE GAINED

In commenting on the work as carried out, the city engineer makes the following statements: In the first or badly worn section the brick varied in thickness from 2½ to 4 in. As no effort was made to size them, it was very difficult to get a good, smooth surface. In this respect it is now believed a mistake was made. If the brick had been replaced in such a manner as to have the worn ones next to the curb and those not worn in the center of the street, a better and longer-lived surface would have been obtained. About 10 per cent of the old brick had to be replaced with new brick on the first section. On the other section where the original brick were in good condition, none of the above-mentioned difficulties were encountered.

All work was done by the street-repair gang, and as it was not very well equipped for this kind of work the cost, 80 cents per square yard, was considered high. Under the contract system, and with proper equipment, it is believed the cost can be reduced and still leave sufficient profit for the contractor.

The work was planned and carried out by F. C. Lohmann, city engineer, who states that these sections, opened the latter part of October, compare favorably in appearance with a new pavement, at one-fourth the cost to the taxpayer.

Develop Four Types of Bank Protection in Washington

Improved Design of Weighted Brush Mats Results on King and Pierce Counties River-Improvement Work

IN the intercounty improvement project which King and Pierce counties are jointly carrying out in the state of Washington, protection of the banks forms an important part of the work. Much of the natural river channel had to be relocated and some form of bank protection was required for the newly excavated slopes. The usual weighted brush mat construction was improved several times. A type was finally developed which is thought to embrace all the advantages of the several methods tried out. A general description of the project appeared in the Engineering Record of Nov. 11, 1916, page 587.

First Brush Mattresses $5 Per Foot

The first protection work undertaken consisted of four layers of brush mattresses, each 2 ft. thick, covering a 20-ft. strip along each bank. These were weighted with bags of concrete and river boulders. The construction in this case was of the same type as that used extensively elsewhere in the Northwest. An 1800-ft. stretch of this work near the Auburn dam, shown in one of the pictures, cost $9,000, or about $5 per linear foot.

THIS WEIGHTED BRUSH MAT REVETMENT (TYPE 1) COST $5 PER FOOT

TYPE 3, COSTING $5.12 PER FOOT, HAS A FLEXIBLE MATTRESS AT TOE

DETAILS OF CHEAPEST AND BEST REVETMENT (TYPE 4)

Concrete Block Protection Costs $5.82 Per Foot

After this portion of the work was completed it was decided that a better method of placing the concrete on the brush would be to use removable wooden forms. By this system the weight of concrete used was increased at the same time that the cost per unit of weight was decreased. Additional strength and flexibility were added by stringing a cable through the forms before pouring the concrete. These concrete blocks, weighing 3600 lb. each, cover a 3 x 6-ft. area and are 16 in. deep. Of this construction, shown as type 2 in the illustrations, 1100 ft. was laid at a cost of $6,400, or $5.82 per foot.

Still another scheme of construction, known as type 3, was used for a distance of 837 ft. at a cost of $4,300, or about $5.12 per linear foot. This consisted of slabs 5 ft. square and 4 in. thick, containing triangular wire reinforcement and hinged together with ½-in. steel rods bent to interlock. The toe on the slope in this case was protected by four to six rows of reinforced-concrete blocks 2½ ft. square and 4 in. thick. These blocks were fastened together by ½-in. rods so as to form a flexible mattress.

A type preferred to all of the others consisted of a brush mattress 16 ft. wide and 18 to 24 in. thick, weighted with two or more rows of heavy concrete blocks, usually 3 ft. wide, 6 ft. long and 16 in. thick, cabled together as in type 2. From the toe of the slope to the high water line the banks, which have been graded on a 3:1 slope, were protected by a 4-in. reinforced slab 32 ft. wide. Of this type of construction 10,500 lin. ft. were placed at a cost of $51,130, or $4.86 per linear foot.

An analysis of cost on a 2631-ft. length of work, using type 4 construction, showed that by using 3.8 sacks of cement per cubic yard, and making a total of 1150 cu. yd., the total material cost in the weighted mattress section was $2,280. The corresponding labor cost was $2,300. For the concrete slab section, exclusive of slope grading, and using 4.2 sacks of cement per cubic yard, the material costs totaled $3,260, and the labor cost, while laying 1135 cu. yd., totaled $2,916. Under this arrangement 0.865 cu. yd. of concrete was used per linear foot of protected bank.

The intercounty river improvement project has been under the supervision of W. J. Roberts, chief engineer.

Annual Sand Catcher Costs at Columbus

Sewage from the East Side interceptor, a combined system in Columbus, Ohio, passes over a sand catcher with floors sloping to a narrow trough in which a motor-driven endless bucket conveyor travels. The conveyor is operated at frequent intervals before large accumulations are deposited. The power cost of operating the conveyor 2468 times in 1915 was only $2.30, according to the last annual report of C. B. Hoover, chemist in charge of the division of sewage disposal. There were 3837 wheelbarrow loads of sand and refuse removed. The power cost of raising and lowering the motor-driven vertical bar screens set in cages in tandem ahead of the pumps 1347 times was $3.50. The screenings amounted to 4122 wheelbarrow loads. The refuse from the sand catcher and the screens is spread over waste places near the station and does not produce a nuisance. The life of the small ⅜-in. bars in the rear screens after seven years' service has nearly been reached, as they are so badly rusted that some are broken and others badly bent out of position.

CONCRETE BLOCKS CONNECTED BY CABLES (TYPE 2, LEFT) COST $5.82 PER FOOT—RIGHT, TYPE 4 CONSTRUCTION, COST $4.86 PER FOOT

How Office Machinery for Spending a $1,500,000 County Road Bond Issue Works

Graphic Reports Posted in Chief's Office—Full Force Accounts and Early Checking of Extras Minimize Differences with Contractors

EXCEPT within the last few years, the expenditure of $1,500,000 in a period of two years on roads in a single county would have been considered a stupendous task for the organization having it in hand. Such a work is progressing smoothly in Vermilion County, and it is probable that all contracts will be completed on time Nov. 1, 1917. The way the superintending engineer and his force handle this amount of work to the apparent satisfaction of all concerned, from contractor to taxpayer, seemed, to a representative of the Engineering Record who recently studied the organization from top to bottom, almost more important than the details of construction.

Preliminary Work

When the present engineer took charge in 1915 the road routes had been selected and surveys made, but there remained the task of drawing up plans and profiles and calculating quantities on 166.15 miles of highway. A principal assistant engineer handled much of the detail of this work, assigning to it, as needed, engineers who would later fill the nine positions of division engineers as soon as the contracts were let. These men were not all taken on at once, but the work was laid out so that it was cumulative, and the eighth and ninth men were not put to work until the last week or so before the office work was complete. This method familiarized the future division engineers with their work, and for several weeks before the actual construction commenced the superintending engineer held a school of instruction in which not only specifications and methods of construction were discussed, but also tact in dealing with contractors and the people living along the roads.

The story of the methods by which 135 bids were obtained on the nine divisions and the service to the contractors in supplying all possible data as to transportation and availability of material has already been told (see Engineering Record, April 15, 1916, page 524).

Graphic Weekly Reports

With each division engineer having about 20 miles of work, a graphic method of recording progress seemed the only way to make it comprehensible. Nine weekly charts on letter-size paper come to the chief and are posted on a bulletin board back of his desk for the following week. At a glance he can tell in what mile work is going on, for the division engineer plots in black the amounts previously reported and in red the current week's work. Two lines are used—the upper one to record miles and the lower one stations beyond the even quarter miles. At the end of the line is given, in figures, the total amount complete and the percentage of the whole. The following items are plotted: Excavation, subgrade, coarse aggregate placed, fine aggregate placed, pavement laid, macadam or gravel shoulders placed, road complete and road accepted.

Labor accounts are kept by the division engineers, and once a week a report on letter-size sheets is turned in to the main office, giving hours and amounts for each job, itemized by days for superintendence, excavation, shaping and rolling subgrade, hauling sand, stone, cement and brick, incidental hauling, hauling and placing tile and catchbasins, building side forms, mixing and placing concrete, handling joints, laying and rolling brick, grouting joints in brick, covering, seasoning and cleaning pavement, hauling and placing macadam or gravel shoulders, and finishing earth shoulders. The totals by days must equal the totals by items. This information is tabulated in the office to get at the final costs.

Of materials, the engineers report in detail on cement, sand, gravel or stone and brick, the cars and amount received and quantity used on miscellaneous materials, such as screenings, joint and shoulder material. For tile and lumber, totals only are given. Special reports on the cost and amount of labor and material are made on culverts as these are completed.

These four reports and the chart then give checks on the cost and progress of every job.

Daily Reports on Post Cards

Daily reports are made on post cards. On cement, which the county furnishes, a full record is kept of amount on hand, received, used and remaining. Amounts used in each slab are recorded and the difference between this and amount required for the day's work is reported in amount and in per cent. These figures are tabulated on a single sheet in the office and form the basis of settlement at the time of each monthly payment. The county furnishes the cement and the contractor must pay for all over 2 per cent in excess of the required amount. If less than 2 per cent under the required amount is used, the work must be torn out. The daily check has kept the amounts used remarkably close to the cement required. On one contract 13,577.2 bbl. were used and 13,580.8 bbl. required. Differences are not allowed to be carried forward beyond each payment date. In fact all differences are adjusted each month with the contractor so that there is a minimum chance for controversy when the job is completed.

VERTICAL FILE CASE HOLDS 1200 BLUEPRINTS

Every day a post card with report of work done is sent in. This includes pavement laid, earth covered, canvas covered, watered in morning and afternoon, opened to traffic, quality of concrete work, coarse and fine aggregate, culvert work and position of grading gang.

How Disputes Are Avoided

The division engineer settles any controversy he can, sending notice of it in triplicate to the chief for O. K. One copy goes to the contractor, one to the engineer and the third is filed. At the end of the construction of a section the division engineer resurveys the road in company with the contractor, so that all extras and deductions can be checked up at that time. A report and certification to this effect is then made to the chief with a request for final inspection. All additions and deductions from the work as originally contemplated are tabulated in the main office. They are all approved once a month by the county board, so that the engineer knows at all times his working balance.

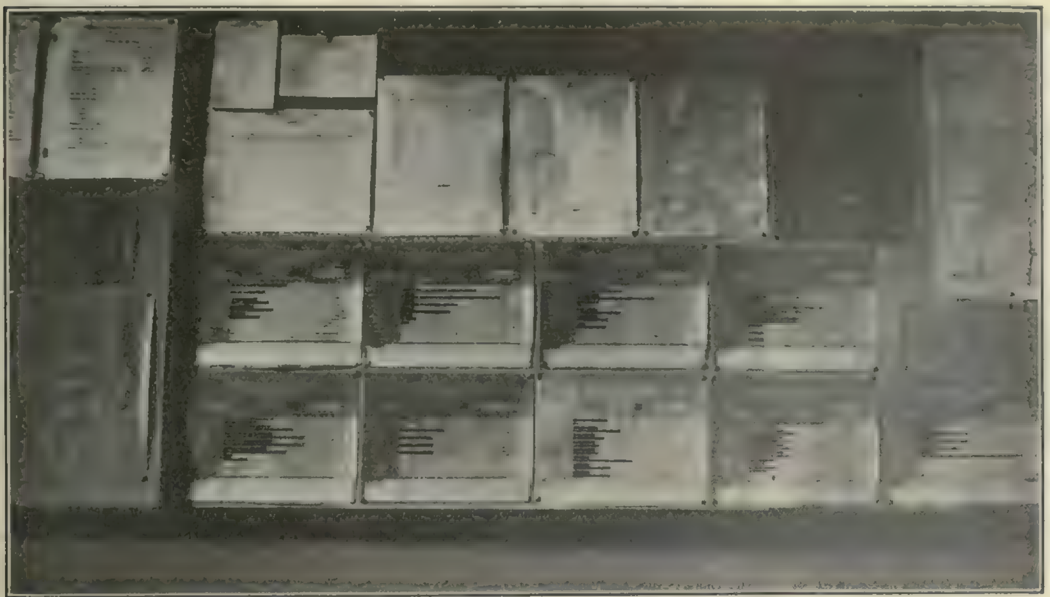
A brick inspector is located at the plant to cull as many as he can when the cars are being loaded. He selects ten bricks which he knows will go into the road and sends these to the office. A rattler outfit has been built in the basement of the county building on the clay floor. It is a double wall, soundproof room, 10 x 10 ft. in plan, with 1-in. flooring on the outside and beaver board on the inside walls and ceiling to retain the dust and noise. The machine rests on a 4-in. concrete floor which does not reach to within 3 in. of the side walls so as to eliminate any chance of carrying vibrations. The switches for both motor and lights are on the outside. To retain the dust, a special galvanized iron hood was made to cover the rattler, which is of the approved type. The 2-hp. Fairbanks-Morse motor furnished with the outfit, although subjected to the dust of the room, has shown no deterioration in a year's use. After a test has been completed the dust in the room settles sufficiently in one minute, so that the double doors, which have glass panels, may be opened. Without the hood it was necessary to wait ten minutes before entering the room.

The specifications call for a loss not to exceed 23 per cent and no individual brick to exceed 27 per cent. Ten bricks are tested at a time, and the average loss to date is 17½ per cent.

Testing the Cement

Cement is tested at the mill by a representative of the Pittsburgh Testing Laboratory, who sends the division engineer the results of the soundness test. Complete test sheets follow each carload. Usually the engineer gets the card about the same time the car arrives. For check purposes the division engineers send a sample of every tenth car to the laboratory at the county building.

Every car of sand and gravel is sampled on receipt. Tests are made in the field by the engineer, and a sample is also sent to the main office. For the field tests each division engineer has sets of sieves to test



WEEKLY PROGRESS CHARTS ARE EXHIBITED ON THE CHIEF'S BULLETIN BOARD FOR A WEEK

coarse and fine aggregate, scales and filter paper to test for clay and loam. The broken stone is inspected at the quarry. Samples for every car are examined before the car is allowed to leave the quarry yard. The result is immediately sent to the division engineer and once a week a detailed report on each is sent to the main office.

OFFICE HINTS

Plans and profiles of the roads under contract, although they number 1200, are all kept in a small vertical filing case, as shown in one of the photographs. The case is a simple wood frame made of 1 x 3-in. strips, 20 x 30 in. in plan and 4 ft. high. The drawings for each of the nine divisions are bound up with staples and secured by leather strips to hooks on 1 x 1-in. sticks resting on the frame.

The plans and profiles are kept separate from the cross-sections. The prints are about 3½ ft. long and 12 in. wide. There are about 100 blueprints required for each division.

The bulletin board mentioned previously is a 5 x 10-ft. piece of beaver board bound with ¼ x 2-in. wood strips. There are two of them in the chief's office. In addition to the progress charts there are exhibited maps of the roads, contractors' bids, blank forms of reports, any new ideas contractors are using to keep track of their own progress, recent photographs of the road, events and news items, and hints for the contractor in the way of new equipment or new ways of doing things. A political map shows the name of every one of the supervisors and township highway commissioners in the county, so that at a glance the chief knows with whom he has to deal in any township.

To get the work done on time is the ambition of the whole organization. Every legitimate means is used to spur on the contractors. Rivalry among them is called into play by a report each one receives every month, giving comparative figures of the divisions as to the amount done, rate, and rate at which work must proceed to finish on time. The accompanying table shows that the rate varies from 152 to 561 ft. per day, and that some of the contracts must proceed at a rate of more than 600 ft. per day during every one of the 156 remaining days.

CHIEF MAINTAINS CONSTANT CONTACT WITH WORK

Every week it is the custom of the chief to visit every one of the pieces of work going on in the county. Thus no long conferences are needed. Decisions are made on the job before they multiply. He averages 100 miles per day throughout the season. Incidentally his Ford has gone 13,000 miles this year and been in the shop but one-half day. His visits are pretty well timed, but not so those of the principal assistant, who gets out as much as the inside work will permit. The latter is the only other engineer in the main office. Primarily the work is being carried on in the field, only a clerk being in charge of the main office most of the time. Each division engineer drives his own car and is allowed $30 per month for upkeep and gasoline. The Vermilion County organization is headed by P. C. McArdle, superintending engineer. His assistant is C. A. Clark.

Ingenious Road Map Aids Travelers

South Carolina is one of the states that have marked the poles and signboards along the main roads by colored signs indicating the various routes of which the roads form parts. There are nine through routes crossing the state in every direction. To make it as easy as possible for the traveler to follow any of them, the state has issued a map in which the routes are indicated by the same colors that are used in the wayside marking.

RATE OF PROGRESS TABLE

Divisions	1	2	3	4	5	6	7	8	9
Actual number of days paving to Oct. 30	27	40	80	87	67	[illegible]	51	74	52
Linear feet of pavement laid	10,397	10,539	19,931	48,830	34,569	608	20,463	31,832	13,307
Average linear feet of pavement per day	385	263	249	561	516	152	401	430	256
Estimated number of working days remaining	156	156	156	156	156	156	156	156	156
Linear feet of pavement to be laid	94,800	95,131	75,285	20,709	63,290	89,100	7,463	72,427	88,510
Average linear feet pavement to lay per day	607	609	482	132	405	571	478	464	566

Favors Levees to Control Lower Colorado River

F. L. Sellew Presents Runoff Statistics and Discusses Probable Costs of Revetment Work to Protect Irrigated Lands

THE PROBLEM of where and how to control the flow of the Colorado River so as best to conserve irrigation interests with the least expenditure was discussed in a paper recently presented before the Southern California Association of Members of the American Society of Civil Engineers by F. L. Sellew. These notes have been taken from his paper. Mr. Sellew disagrees with the advocates of storage dams for flood control in the upper part of the Colorado system and believes that levees constitute the best and cheapest methods of protecting irrigated lands. He estimates that the entire expenditure for the protection of 200 miles would be only $12,000,000, as compared with $35,000,000 for controlling dams. The total area of irrigation importance, including 530,000 acres in Mexico, is 1,500,000 acres.

WHERE FLOOD PROTECTION IS JUSTIFIED

There are five areas along the lower Colorado, Mr. Sellew states, where flood protection by revetment is justified. These are Needles, Parker, Palo Verde, Yuma and Imperial Valley. The agricultural possibilities in the areas between these locations do not warrant the construction of levees, and here the river may be allowed to meander at will. The levees required at the five points mentioned range in length from 30 to 50 miles each, with a total length in the five districts of 200 miles. These levees should not exceed 8 ft. in height, he affirmed, and should be built with a crown width of 10 ft., with side slopes of 3:1, containing about 53,000 cu. yd. per mile.

The cost of the levee proper would be about $13,200 per mile, or $2,640,000 for the 200 miles; but it would be necessary to protect these levees with rock facings in order to insure their permanency. This rock work, allowing for the average 25-mile haul required in this district, would cost about $40,000 per mile, or $8,000,000 for the 200 miles. A sum of $1,500,000 should be added for a light track on the levee, which would bring the total levee cost for the 200 miles up to $12,000,000. This expenditure, he asserted, would develop a channel that would carry maximum floods without menace to adjacent interests.

To accomplish this same purpose by means of controlling dams would require storage capacity totaling 7,000,000 acre-feet, which he estimates would cost $35,000,000. So far as flood control is concerned, therefore, the levee method is indicated as the preferable plan. Assuming 1,000,000 acres of irrigable land depending upon the control of the stream, the total land value at $200 per acre would be $200,000,000; hence the cost of levee protection would be but 6 per cent of the value of the protected area.

FIVE AREAS OF IRRIGATION IMPORTANCE

The five areas of irrigation importance are as follows: Needles Valley, 60,000 acres; Parker, 200,000 acres; Palo Verde Valley, 100,000 acres; Yuma, 160,000 acres; Imperial Valley, 450,000 acres—total, 970,000 acres. Adding to this area, which is in the United States, the irrigable

areas in lower California would swell the total to about 1,500,000 acres.

Assuming the annual duty of water at the diversion point as 5½ acre-feet per acre, the maximum storage for continuous irrigation would have been necessary during the low flow of 1902-03. In that season a storage capacity of 2,400,000 acre-feet would have provided for the entire 1,500,000 acres. Assuming the cost of an acre-foot of storage at $5, $12,000,000 would provide for the 1,500,000 acres, and adding to this the $12,000,000 required for levee work, a total of $24,000,000 would furnish both protection and a sufficient minimum flow. Taking the 1,500,000-acre total, this cost would be at the rate of $16 per acre.

Storage of Upper Waters Not Feasible

Referring to Water-Supply Paper 393, by E. C. LaRue, Mr. Sellew "heartily disagrees" with the idea that sites can be developed on the upper Colorado River system behind which could be stored a total of 30,000,000 acre-feet. Reviewing the available data regarding the sites at Marble Cañon, Bluff on the San Juan, Junction of the Green and the Grand River, and Kremmling on the Grand River, Mr. Sellew submits reasons why the possibilities in each case are not promising. In most cases the doubt rests on the improbability of suitable foundations, but in the case of the Kremmling site "in order to use it Congress would have to reverse a former chief executive who decided that Gore Cañon was more useful for a railroad than it was for a dam."

The three sites that may be counted upon, Mr. Sellew states, are in Green River, as follows: Flaming Gorge, 2,000,000 acre-feet; Juniper Mountain, 1,400,000; Minnie Maud, 4,000,000 (perhaps), or a total of 7,400,000 acre-feet, which is all that he believes has been proved feasible at the present time. This would be further reduced by the fact that the runoff of the Green River will justify the creation of only 6,000,000 acre-feet of storage. From these facts he concludes that "in the light of present knowledge the Colorado River cannot be controlled by reservoirs, however desirable such a result may be."

Grade Crossing Is Eliminated by Special Construction Methods to Maintain Traffic

River Road Concrete Bridge Near Hoboken on 36-Degree Skew Erected in Two Parts, Using Construction Girder and Temporary Columns

LIMITED right-of-way space and the necessity for maintaining the double-track traffic at the grade-crossing elimination on the Main Line, Boonton Branch, of the Delaware, Lackawanna & Western Railroad at Delawanna, 10 miles west of Hoboken, N. J., where River Road is being depressed under a reinforced-concrete bridge wide enough for five tracks, required the design of a special construction girder and temporary columns. After diverting traffic as far as possible to the south, the excavation and construction of the north half were completed. The traffic was then diverted to the permanent tracks on this portion after the concrete had set for 28 days, and the remainder of the bridge is now being completed. The construction girder carries the skew corner loading on the first part while the second part is being completed, and then becomes a part of the finished bridge not essential for the strength of the slab, since the reinforcement of the latter is continuous through the girder. The temporary columns were poured simultaneously with the half arch of the pier up to the construction joint to insure support of the construction girder until the arch is completed, after which the columns are removed.

Abutment Walls Vertical Slabs

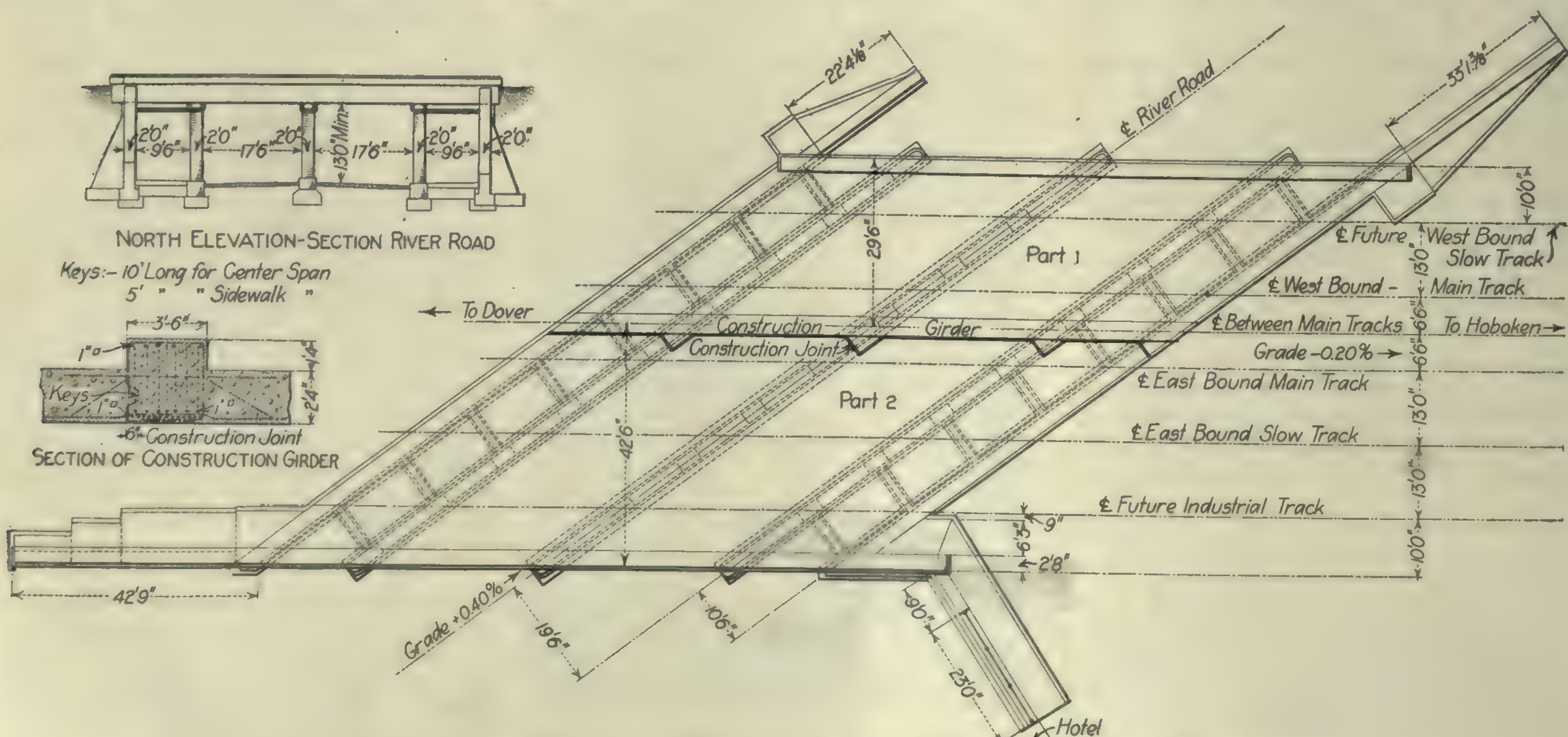
Economy in the amount of concrete needed for the structure was obtained in the design of the long abutment walls as vertical slabs, with struts to the adjacent piers, and of the intermediate piers as beams and columns, with curved openings to improve the appearance from the street. The parapet walls are designed as girders to carry the skew corner loading to the piers and abutments, the reinforcement in the heavy slab being laid perpendicular to the latter.

As indicated by the plan and elevations, three existing tracks and two future tracks are carried over the depressed River Road at an angle of skew of 36 deg. and about 13 ft. minimum vertical clearance. The concrete slab varies in thickness from 28 in. to 18 in., and is reinforced by ¾-in. and 1-in. square bars laid perpendicular to the supporting piers and abutments. In order to save concrete and improve the appearance, the intermediate piers are designed as columns and beams, with openings having elliptical curves at the top. The abutments are designed as vertical slabs between the roadway slab at the top and a horizontal beam at the bottom. Struts top and bottom are provided at the columns about 14 ft. apart to transfer the pressure to the adjacent piers.

Skew Requires Construction Girder

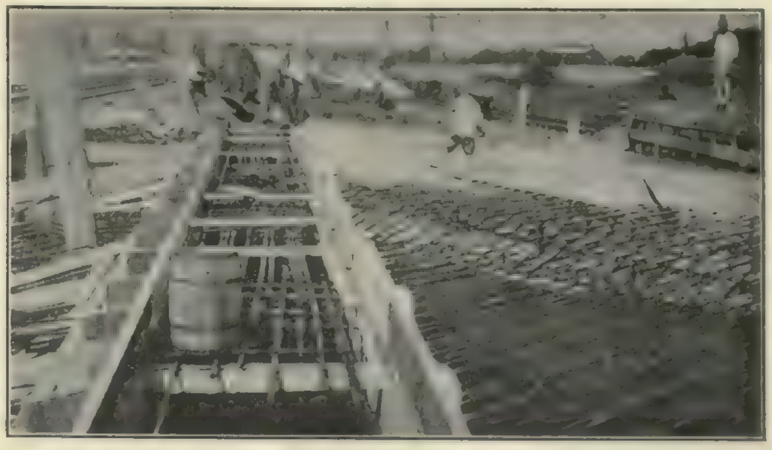
Traffic on the two main tracks was maintained by the use of two temporary tracks laid on the company's right-of-way as far to the south as possible, without encroaching on hotel property immediately adjacent. These tracks still interfered with the construction of the bridge, so that it was found necessary to build the structure in two parts. Part 1 on the north side was carried up to a construction joint just beyond the center line between the main tracks, as shown, so that it cleared the sloped embankment supporting the temporary tracks.

As the steel in the slab is placed perpendicularly between the piers and made continuous over them, it was necessary to support the loading on the skew corners of Part 1, after the tracks had been shifted to this part and until the south part could be constructed and the projecting rods concreted into the slab. This was accomplished by the use of a construction girder formed by increasing the slab depth 18 in. on the upper side for a width of 3 ft. 6 in. on the center lines, as noted, and adding the tem-



GENERAL LAYOUT AND PLAN OF CONSTRUCTION FOR RIVER ROAD BRIDGE—SECTION OF CONSTRUCTION GIRDER

SLAB REINFORCEMENT—CONSTRUCTION GIRDER IN BACKGROUND



SLAB AND CONSTRUCTION GIRDER POURED IN ONE OPERATION

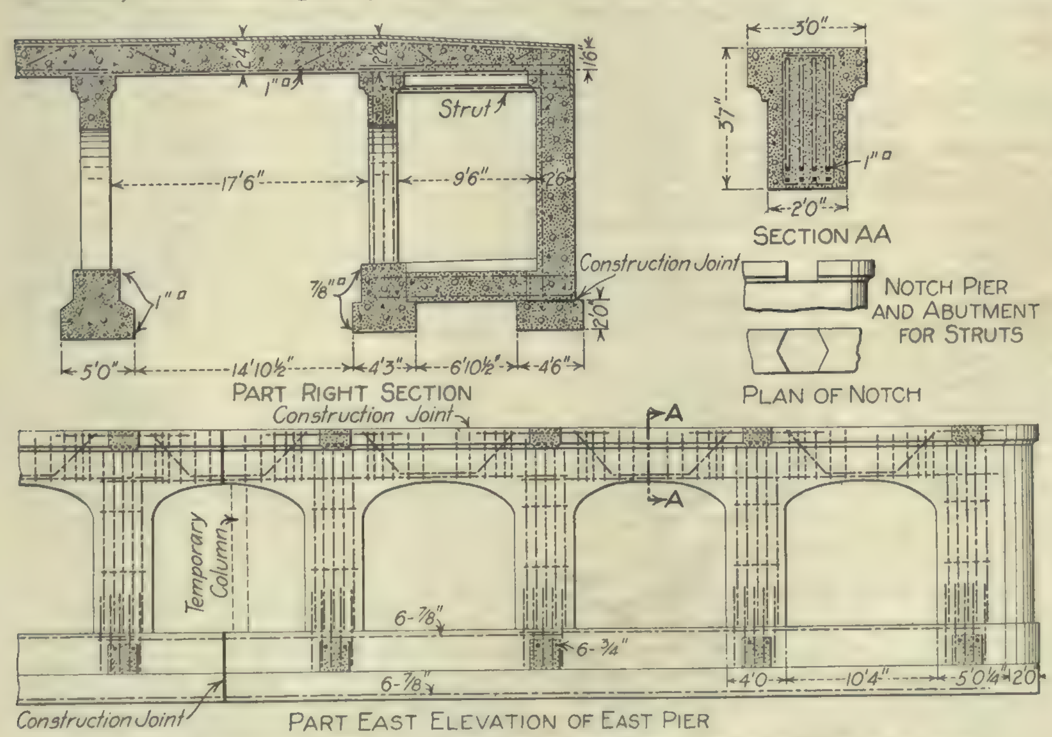
porary columns already mentioned. The outside skew corner loading is carried to the parapet walls, which are designed as beams to carry the loads to the piers and abutments. The concrete in the slabs, in the construction girder and the parapet girders was cast in one operation.

DESIGN LOADING

The bridge is designed for a standard engine loading about equivalent to Cooper's E-60 on each track, assumed to be uniformly distributed over a width of 13 ft. laterally. Placing wheels in position for maximum bending moment in the long skew span, an equivalent uniform load per square foot was obtained. This was used as the loading on the short span between piers and abutments in designing the slab, beams and columns. An impact stress of $L^2/(L+D)$ was included, L being live-load stress and D dead-load stress. Dead load included 12 in. of ballast under the ties.

When completed, the maximum grade of River Road will be 5 per cent for 214 ft. at the north side of the crossing. Two clear roadways 17 ft. 6 in. wide and clear sidewalks 9 ft. 6 in. wide will be furnished, and thus afford ample trafficway for this important thoroughfare.

The bridge was designed under the supervision of G. J. Ray, chief engineer of the Delaware, Lackawanna & Western Railroad Company, under the direction of A. B. Cohen, concrete engineer, and constructed under the supervision of G. T. Hand, division engineer, with G. B. Barackman as assistant engineer in charge. James A. Hart of New York City is the contractor.



PART RIGHT SECTION THROUGH BRIDGE AND LONGITUDINAL ELEVATION OF EAST PIER

Corrosion Develops at Panama Lock Gates and Valves

General Goethals, in Annual Report, Discusses Extent of Damage and Methods of Repair

IN the maintenance of the locks of the Panama Canal the protective paints on the gates and electrolytic action in the valves and their various parts developed unexpected difficulties this year, according to the annual report for the year ended June 30, 1916, of Major-Gen. George W. Goethals, governor of the Panama Canal. The report, which was made public this week, gives the following information regarding the condition of the gates and valves:

LOCK GATES RECOATED

At the time the locks were watered all the gates had been painted and put in first-class condition. The interiors of the gates were coated with Bitumastic enamel under a five-year guarantee, and the exteriors were covered with various kinds of submarine paints. When the floating caisson arrived in December, 1914, it was installed at the lower east lock at Miraflores and the chamber pumped out, permitting an examination of the gates, valves, and fixed irons. At that time they were found to be in good condition, although there was some rusting of the plates and rivets. In January, 1915, the west chamber at Miraflores was pumped out after being submerged about 15 months. The paint on the gates was blistering badly, and from experience gained from various paints applied at other lock gates it was decided that something must be adopted that would give better protection than anything in the paint line that had yet been used.

Difficulty had been experienced with paints applied to the spillway gates at Gatun, and because of the condition of the interior of the gates on which Bitumastic enamel had been used it was decided to test out the use of this material on one of the spillway gates. It appeared to give adequate protection, and as the contractor guaranteed the effectiveness of this material for five years a contract was entered into for coating all of the lock gates with Bitumastic enamel. The gates at Gatun were coated and the work finished. Due to the condition of the pumps in the caisson, the impeller blades of cast iron being entirely eaten away, work on the Pacific side was not completed.

VALVES CORRODED

Observations during the past year disclosed that the corrosive action on the cylindrical valves has been severe. In July, 1915, the west flight of Gatun locks was drained, and all the accessible cylindrical valves were examined. Marked corrosion was taking place on certain parts of the valves, although the entire valve was made of cast iron or steel, no bronze parts being adopted in the original design. In the lower level an average of 75 per cent of the seal segment nuts were corroded; in some cases fully half the nut had disappeared. It was also found that the bolts holding the stops in place were in such condition that they had to be replaced in every valve in the lower level. All valves were put in good condition and painted with red lead. On the Pacific locks no examination was made of the valves at Pedro Miguel or those on the west side of the Miraflores center wall, but the east valves at this site were found to be in good condition. However, as all painted surfaces of the valves had failed, it was decided to coat all exposed iron and steel surfaces with enamel, and a contract was entered into for doing this work.

Considerable corrosion has taken place in the rising stem valves. The ½-in. plates have been attacked in a manner similar to those on the lock gates, and portions in

the vicinity of the rivets in the lower valves at Gatun and the upper and lower valves at Miraflores have been violently attacked. The bottom seal casting of the valve which comes in contact with the babbitt-metal seal on the bottom of the valve is being rapidly eaten away. A number of the valves at the Pacific locks were in such condition that the bottom seal had to be machined off to make the valve tight. In order to protect the valve from any further electrolytic action between the cast-steel seal and the lower babbitt-metal seal, all babbitt metal was removed and replaced with a seal of greenheart lumber. Some of the bronze side seals and springs were found to be broken both at Miraflores and Gatun. Otherwise the seals were in good condition, and required only a small amount of draw filing to make the contact surfaces perfect. The top gate-valve seal is of cast steel, and is held in place by bronze bolts. In practically every instance the corrosion has been excessive around the heads of the bronze bolts, cutting away the metal, and in some cases allowing the bolts to loosen and fall out. Several castings had to be replaced. The worst case of corrosion of the seal occurred on the upper valves at Miraflores.

Lignum Vitæ for Seals

At Gatun, practically all valves were installed with fixed side seal castings, which all gave evidence of considerable corrosion, but not sufficient to cause any leaks. At Miraflores, removable side-seal strips were of machinery steel, and in every case corrosion had reached such a point that all side seals had to be replaced. Inasmuch as the corrosion had apparently been aided by the proximity of the bronze side seals which bear upon them, it was decided to replace all machinery steel with lignum-vitæ wood, in this way tending to place an insulating substance in contact with the bronze. All porous concrete around the fixed irons was removed and replaced with cement, and wherever babbitt metal had been used to fill the recessed holes for bolt heads at the Pacific locks the metal was removed and replaced with cement.

At both the Atlantic and Pacific locks considerable corrosion of roller trains has occurred, the rollers of which are made of tool steel. At the Atlantic locks a number of rollers, bolts and filler castings were missing. All were replaced, and the heads of all bolts were riveted over to prevent further losses. Similar conditions were found at the Pacific locks, and as it is impossible to protect the rollers by any paint, arrangements were made to install ½-in. pipe from the tunnel floors down to the base of the roller-train tracks. Crude oil is forced through the pipes, and it is believed from the results of experiments made with a model that the crude oil will rise along the surface of the roller-train track and in this way protect the rollers by coating them with oil.

As a result of the examination of the valves at Gatun it was decided to have them coated with Bitumastic enamel. At the Pacific locks more complete protective measures were taken, as follows: (1) All bronze side seals were lined up and strips of zinc bolted to the valve, each side of the seals, at the bottom of the valve; (2) where necessary, the bottom valve seal was machined off to give solid metal contact with the bottom seal; (3) all removable side seal strips were taken out and replaced with lignum-vitæ wood strips. Where removable strips were not installed, the fixed irons were milled down to take the wooden side seals; (4) all babbitt metal used in the assembly of the valve for embedding and protecting boltheads from corrosion, and for calking purposes, was removed and replaced with cement; (5) all babbitt metal used in the bottom seal was removed and replaced with greenheart lumber; (6) all steelwork of the valve was coated with Bitumastic enamel. This left only the bronze side seals exposed; (7) all fixed irons were coated with Bitumastic enamel; (8) the channel-iron supports for the rollers were coated with Bitumastic enamel, and arrangements made to lubricate the roller trains and tracks with crude oil during operation and while the valves are submerged; (9) all submerged portions of the valve stems were coated with Bitumastic enamel; (10) all bronze bolts are being replaced with steel as fast as breakage occurs.

Bronze Bolts Fail

On Oct. 10, 1915, the counterweight of spillway gate 13 at Gatun gave way and dropped into its pit, demolishing all weights. This machine had not been operated for several days, and was not being operated at the time of the accident. On investigation it was found that all four manganese bronze counterweight bolts had given way. Each spillway counterweight consists of 56 cast-iron blocks weighing 750 lb. each, resting on a cast-iron base plate and supported by four 1¾-in. manganese bronze bolts running into a cast-steel yoke at the top. The total weight of the counterweight is 45,700 lb., and, assuming that the load is equally distributed, each bolt supports 11,425 lb., or a stress of 4750 lb. per square inch of metal. Sections of the bolts were sent to the mechanical division for test, which gave an ultimate tensile strength of 61,400 lb. and 63,900 lb. per square inch respectively for the two bolts tested. This would indicate a factor of safety of about 13.

All guard-valve counterweight bolts were examined, and instructions given to replace the defective ones with steel bolts. An examination of the Miraflores spillway counterweight bolts resulted in finding two bolts broken off at the head and others with surface cracks, indicating probable failure. All counterweight bolts of the spillway gate machines have been replaced with steel, and bronze bolts are being replaced with steel wherever failures occur.

Stock Rolls Stones on Road

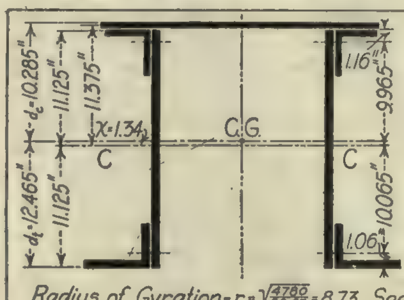
Removal of rocks rolled onto the road by stock feeding along the sidehill above the road and dragging are the principal duties of a caretaker maintaining the 12-mile Mongollon-Hill section of the Prescott-Flagstaff highway in Arizona.

To Compute Properties of Unsymmetrical Sections

Tabular Form Simplifies Determination of Radius of Gyration or Section Modulus of Column Section by Slide-Rule Method

BASED upon the well-known relation between moment of inertia I_g about an axis through the centroid or center of gravity of a given area A and the moment of inertia I_c about any other parallel axis x in. from the centroid, the tabular form of computation here given is found to simplify the computation of required properties for unsymmetrical column sections. Bridge chords, for example, are designed for both direct and bending stresses—the radius of gyration is necessary in order to obtain the allowable unit stress and the section modulus for the compression side is required in computing the bending stress.

In the fundamental formula $I_c = I_g + Ax^2$, the value of I_c about some convenient axis, preferably the center line of the web plates, is first computed, and the eccentricity x, or distance from the center of gravity to this axis, is found by area moments of the unsymmetrical parts, as indicated in the table; that is, the resultant moment is divided by the area A. The desired



Section	Area □"	Lever Arm "	Moment M	Multiplier for Area	I_c-Axis CC
1 Cov. Pl. 26x½	13.00	11.375	148	11.375^2	1680
2 ∟s 4x4x7/16	6.62	9.965	66	9.965^2	660-2∟s 10
2 Web Pls. 22x11/16	30.25	—	214	$22^2/12$	1220
2 ∟s 6x4x11/16	12.80	10.065	130	10.065^2	1300-2∟s 20
	A=62.67		84		30 30

$M \div A = x = 1.34$

$I_c = 4890$
$Ax^2 = 110$
$I_g = 4780$

Radius of Gyration $= r = \sqrt{\frac{4780}{62.67}} = 8.73$ Section Modulus: Compression $\frac{I_g}{d_c} = \frac{4780}{10.285} = 465$; Tension $\frac{I_g}{d_t} = \frac{4780}{12.465} = 384$

COMPUTATION FOR RADIUS OF GYRATION AND SECTION MODULUS OF UNSYMMETRICAL SECTION

moment of inertia I_g about an axis through the center of gravity is then easily computed by the equation $I_g = I_c - Ax^2$. This explains the procedure in the table. The value of the section moduli, I_g/d_c for compression or I_g/d_t for tension are then obtained, if desired.

The values of I_c for moment of inertia, given in the last column, require some explanation. For the cover plate, flange plates and angles, the areas are multiplied by the square of the distance from the axis CC. This is the significant term in the equation $I_c = I_g + Ax^2$. The I_g for the horizontal plates is negligible and the nearest round figure for the I_g of the angles has been used. In most cases, even this value for the angles is a small percentage of the other figures, and will not affect ordinary slide-rule work. Of course the I for the vertical webs is found from $bd^3/12$ or $Ad^2/12$.

Although for approximate preliminary computation, rough ratios of the depth can be used for radii of gyration, r, the final design requires exact values for these quantities. Hence any decrease in the time of computation is a vital factor. The advantages in the form presented herewith are in the elimination of the usual work in computing new lever arms after the position of the center of gravity is determined, and in the combination of the simplest method for finding the center of gravity with the computation for I_c in simultaneous operations, followed by a simple operation to obtain I_g, the desired moment of inertia.

British Government Fosters Application of Scientific Research to Industrial Problems

Advisory Council Reports Activity of Past Year in Methodical Investigation to Insure Effective Co-operation for Trade Expansion

REPORTING the activities of the first year of its work, and discussing in full detail in a 56-page pamphlet the plans and needs for future success, the advisory council of the British Committee for Scientific and Industrial Research is developing principles about which engineers in this country should be informed. In view of the efforts being made in the United States through the work of the Naval Consulting Board and the National Research Board (the latter discussed editorially on page 639 of last week's issue), the following abstract of the first annual report has direct application to the problems which will face us when the war is over.

OBJECT AND APPROPRIATIONS

The advisory council to the committee of the Privy Council for Scientific and Industrial Research, reporting to the British Parliament, was created July 28, 1915, "for (1) instituting specific researches; (2) establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades; and (3) the establishment and award of research studentships and fellowships." Its chairman is Sir William S. McCormick.

In the first annual report of the committee, recently issued, it is stated that twenty scientific investigations of industrial importance have been approved and grants made to a number of individual research workers, not exceeding £6,000 (about $30,000) for the first year. The amount appropriated for the initiation of the scheme was £25,000, and for the current year £40,000 was voted.

SCOPE OF REPORT OF ADVISORY COUNCIL

The first annual report of the advisory council discusses previous government action relating to the advancement of trade and industry by means of scientific research, the present government scheme, the details of the methods used, parallel movements, trade associations, impediments to industrial research, the need for a new outlook, American and German practice, the sphere of universities and technical schools and of special research institutes, research and government departments, and, finally, research and the empire.

The scope of the present work is further indicated by the statement that the government intends to deal with this problem as an integral part of a comprehensive improvement in the educational system.

NECESSITY FOR CENTRAL CONTROL

It is pointed out that while the necessity for central control of the machinery for war has been obvious for centuries, not until this war revealed the essential unity of the knowledge required for both the military and industrial efforts of a country was this vital fact understood. The instruments of war are now forged by the man of science. "This is equally true of the weapons of industry. The brains, even the very processes, that to-day are necessary to the output of munitions were yesterday needed, and will be needed again to-morrow, for the arts of peace. This is the central fact which justifies the establishment of the new machinery in the midst of a struggle that is absorbing the whole energies of the nation in a way no previous war has done."

WHY PURE SCIENCE MUST BE NEGLECTED

In view of the average manufacturer's requirement of quick returns, and as a present basis for a considered program and policy, the council decided to give applied science precedence over pure science. The universities, which are the natural homes of research in pure science, have been so depleted of both students and teachers by the war that they are barely able to continue routine work and cannot command either the leisure or the detachment which is an essential condition of original research. Inquiries show that "any effective encouragement of research in pure science must await the return of peace."

To save certain researches being conducted by professional associations which were in danger of enforced abandonment, the council recommended the payment of a series of grants to the societies concerned. Many interviews have been had not alone with the principal engineering society representatives but with others from professional and manufacturers' associations. It is noted that the most highly organized industries are those which have made the most use of scientific research—especially the engineering trades, backed by distinguished professional societies.

SURVEY OF RESEARCHES

A careful survey is being made of "the amount and the character of the provision made in our higher educational institutions for research work," as a part of the preparatory arrangements for a systematic program of aid to individual researchers. It is hoped, also, to induce industrial firms to inform the council, in confidence, of the problems they have in hand or in contemplation. "It is obvious that even this modest degree of co-ordination will be abortive unless the principal manufacturers are willing to trust the discretion of the council."

There are found indications or a change in view among certain firms, resulting from the necessities of the war, leading to interchange of information, which may survive the present critical days. "In the numerous conferences we have had with representatives of different industries we have been impressed with the spirit of co-operation which is growing up and the willingness to accept our suggestions for the initiation of research for the benefit of the trade as a whole. Co-operative research, when it has done its utmost, will always leave ample room for individual initiative and ability in the application of its results, more than sufficient as an incentive and as a means to outstanding success. Co-operation is not the negation of individual effort; it raises initiative to a higher power."

In spite of the grave effects of the war on the field of research in educational institutions, the council has recommended grants to some forty individuals. It is stated that "research in pure science should be as much our care as research in applied science; it is the necessary precedent of all industrial applications, and the universities are peculiarly fitted to pursue it, though for the reasons already explained it is not possible to do much in this direction during the war." The council hopes to bring more reality into academic laboratories now dominated by the textbook and the syllabus of examination, and "so encourage a better professional training for chemists, physicists and other men of science."

DANGER IN APPLIED RESEARCHES

On the other hand, the report says: "At the same time we recognize that there is a danger in bringing technical problems too pressingly to the notice of teachers and students in educational institutions. We must not tempt those capable of making advances in natural knowledge to abandon their austere studies for the sake of solving temporary and local technical problems. Still less must students be encouraged to take up such questions except as stimulating incidents in their general training. On the other hand, pure science has in the past owed much to observations, suggestions and difficulties which have come from activities external to the laboratory or study. So it will be again; and it is our desire so to order the relations of workers in pure science to the industries going on around them that they may receive the stimulus of a wider outlook than is always attainable under the limitations of an academic system of syllabus and examination. In this way it may be possible in the end to create such an atmosphere that the new generation of students will cease to draw a distinction between 'theory' and 'practice,' and technologists of all ranks will through them attain to the view that sound practice is only theory tempered by compromise."

Applications for aid were received from the professional societies, and this led to the formation of a group of standing committees to assist in surveying the whole field of research and dealing with such applications. Three standing committees have been set up—a committee on metallurgy, a committee on engineering under Sir Maurice Fitzmaurice as chairman, and a committee on mining. Each committee consists of about fifteen members, of whom approximately one-half have been nominated by the professional society concerned.

BEST ADVICE SOUGHT

"The council hope with the assistance of their standing committees, the professional societies, the Home Office and the Board of Trade gradually to construct panels of names which will enable them to obtain the very best advice on the different aspects of the problems they are called upon to solve. The advice they need may be commercial, economic, financial, or scientific. The best opinion in all these spheres will, it is hoped, be available on the panels for the guidance of the council and their standing committees, and will insure the confidence of the industries concerned that the steps proposed have been considered in all their aspects."

Discussing the need for a new outlook, the council says: "If a healthy condition of inquiry is to be fostered in the scientific industries, they must for some time to come expend a good deal of attention and money upon convincing the manufac-

turing world in general that scientific research is a paying proposition. They believe that the shortest means to this end is an attack upon the pressing problems of manufacture which arise in the course of the ordinary routine—problems which the manufacturers ought, no doubt, to solve by means of their own scientific staffs, but which their present staffs are too small to undertake, often because the firms are too small to bear the necessary cost. It was in this way that the universities of the middle states of America convinced the farmers that science was useful to agriculture."

Reference is made to the work of the Mellon Institute, of Pittsburgh, and to support given by certain trades to research at Yale University, and also to special grants made by the German government to single firms in certain unusual cases.

Conditions of Success

In conclusion, the report refers to a full list of the researches aided up to the present, given in an appendix. The probable insufficiency of trained research workers after the war is emphasized, and further, the need not so much for outstanding minds of exceptional power, but for systematized work of more ordinary investigators under competent direction. "There is as much place and need for plodding labor in scientific research as in other kinds of work." Greater progress in co-operative effort is given as the second condition of success, and the report says: "If the general level of manufacture can be rapidly raised by co-operative effort in the exchange of information between firms, and in the support of national trade institutes for research, as well as in the improvement of the conditions and efficiency of labor, this country will have gone far toward establishing its industrial prosperity on a firm basis."

Tidal Lock with Special Safety Devices for Large Dock at Chemulpo, Korea

Japanese Government Is Making Important Improvements in Harbor Works—Great Range in Tide Makes Unusual Precautions Necessary

By HENRY GOLDMARK

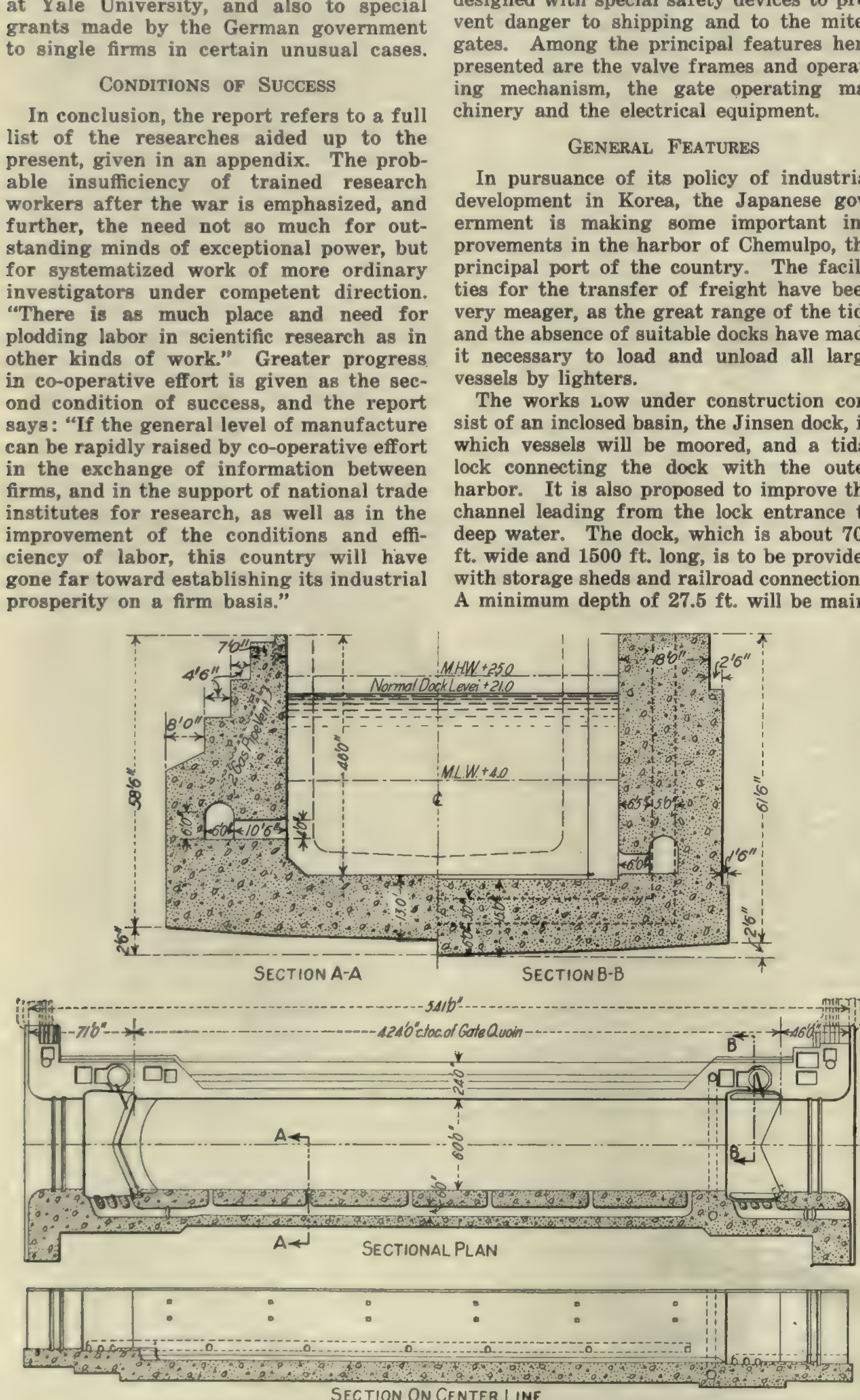
Consulting Engineer, New York City; Recently Designing Engineer, Panama Canal

A HUGE DOCK, 700 x 1500 ft. inside dimensions, provided with storage sheds and railroad connections, is being constructed by the Japanese government in the harbor of Chemulpo, Korea. Owing to the extreme range of tides at this port, the tidal locks and gates at the ocean end were designed with special safety devices to prevent danger to shipping and to the miter gates. Among the principal features here presented are the valve frames and operating mechanism, the gate operating machinery and the electrical equipment.

General Features

In pursuance of its policy of industrial development in Korea, the Japanese government is making some important improvements in the harbor of Chemulpo, the principal port of the country. The facilities for the transfer of freight have been very meager, as the great range of the tide and the absence of suitable docks have made it necessary to load and unload all large vessels by lighters.

The works now under construction consist of an inclosed basin, the Jinsen dock, in which vessels will be moored, and a tidal lock connecting the dock with the outer harbor. It is also proposed to improve the channel leading from the lock entrance to deep water. The dock, which is about 700 ft. wide and 1500 ft. long, is to be provided with storage sheds and railroad connections. A minimum depth of 27.5 ft. will be maintained at all times. When the tide falls below this normal dock level the gates will be closed and vessels locked in and out. At higher stages of the tide all the gates will be wide open and ships will pass freely from the outer harbor to the mooring basin.



SECTIONS OF LOCK BETWEEN DOCK AND OCEAN—NOTE CULVERTS AND OUTLETS

Details of Lock

The lock is shown in plan and elevation in one of the drawings. It has a clear width of 60 ft., a length of 424 ft. between the gates and a depth of 48 ft., giving a freeboard of 4 ft. above the high water of ordinary spring tides. The walls are of mass concrete, faced with granite at the gate quoins and sills and other important points, and there are heavy floors, from 10 to 15 ft. thick, reinforced with steel rails.

The filling system consists of a longitudinal culvert 6 ft. wide and 7½ ft. high in each side wall, with six horizontal 3 x 4-ft. outlets, the bottoms of which are 7 ft. above the lock floor. The culverts for emptying the lock are of the same size as the filling culverts, and discharge through outlets in the lower gate recesses. There are six valves in all, which are in the main culverts, four used in daily operation, the other two, at the ocean end, being utilized only when the lock is to be pumped out.

The steel lock gates are of the mitering type with air chambers, and, like the valves, are operated by electric motors. Four capstans, also driven by electricity, will be installed to assist in the handling of vessels.

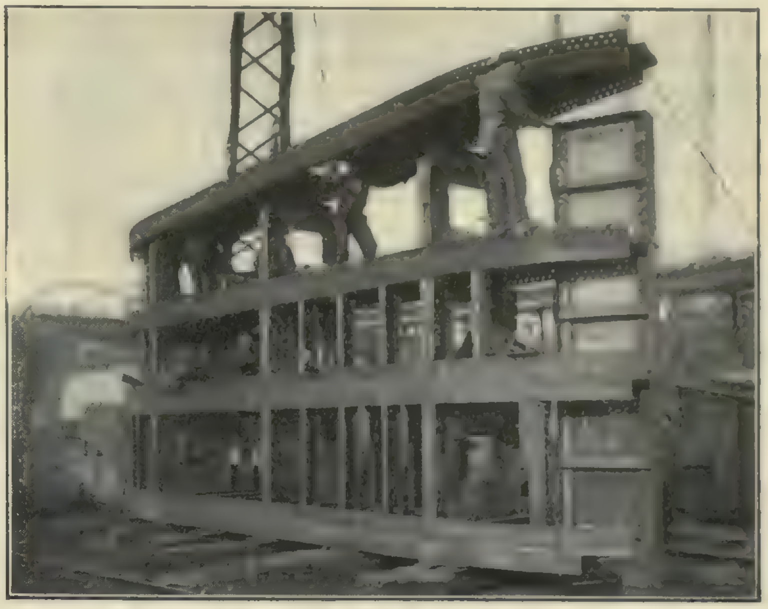
Details of Valves

The general plan of the valves at the upper end of the lock and the machinery for raising and lowering them is given in one of the drawings. The double valves at the lower end have a common operating mechanism with a single motor. One of the valves with its frame is seen in one of the photographs taken at the shops, where they were all assembled to guard against errors in fitting. It will be noticed that they are of the type known as "wagon-body" valves, which roll on four large wheels secured to the main casting. This form has been used extensively on Canadian canals and also in the United States, and was adopted for the large drydock at Panama just completed.

For openings of moderate size, wagon-body valves are simpler and cheaper than Stoney valves with loose trains of small rollers, and move quite as freely. They have generally been built of structural steel, though cast iron was preferred for the Jinsen dock in order to reduce the corrosion in salt water. Careful workmanship is necessary to insure an equal distribution of the hydrostatic load over the wheels, and their chilled treads should be accurately ground to size.

The design adopted for the fixed frames in the walls was the result of careful study and is believed to have special merits. Much trouble has been experienced with large valves in setting the frames correctly in the concrete, especially when the side

VALVE AND FRAME ASSEMBLED IN SHOP BEFORE SHIPMENT TO SITE



ASSEMBLING THE SECTIONS OF LOCK GATE IN CONTRACTOR'S YARD

castings are not rigidly connected. In many cases the main frame does not extend above the culvert opening, and small guide rails are used for the upper part of the gate travel, which it is almost impossible to set accurately. In some large locks recently built the great care required in placing the fixed frames interfered seriously with rapid and economical concreting. Nevertheless, it was afterward necessary to go to heavy expense in correcting errors in setting.

Advantages of These Frames

The frames here adopted are made long enough to guide the valves through their whole stroke, and have heavy cross-pieces at the top and bottom. These maintain the correct distance between the side pieces and permit the entire frame to be handled as a unit. Even if it should be slightly out of plumb, the valve would work properly, as the stem has a flexible connection at the top. All the frames were assembled in the shop to guard against errors. The joint between the valve and frame is made tight at the sides and top by rubber seals and at the bottom by a strip of babbitt metal on which the valve rests.

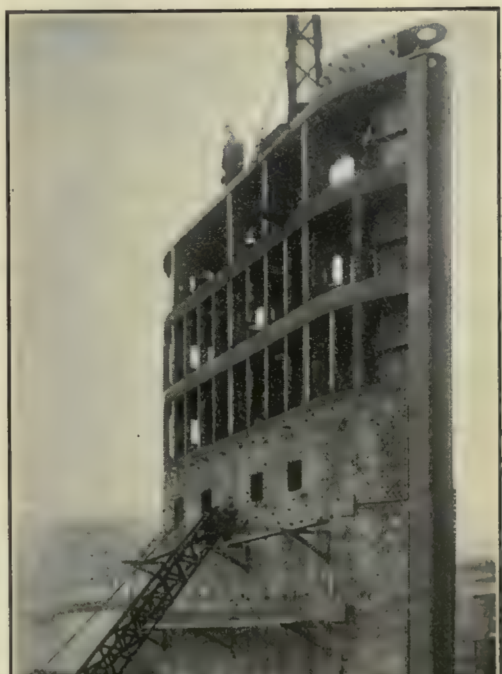
The valve is raised and lowered by a stem made of 6-in. double extra-heavy pipe, which is fastened to a pin at the bottom and screwed at the top into a crosshead nut of phosphor bronze. The latter is moved up and down by a revolving screw and comes to rest against springs at the top and bottom. It is guided by steel bars riveted to a suspended structural frame. There is a roller thrust bearing to resist the downward force, while the small upward reaction is taken by a shoulder in the casting. The screw is driven from the motor shaft by a gear-and-pinion reduction and two bevel gears. The small gears, motors and other electrical equipment are in a separate machinery room, the horizontal shaft passing through a stuffing box in the dividing wall so as to exclude water from the machinery.

Lock Gates

The lock gates are of the mitering type, with air and water chambers. Single-skin gates without flotation chambers have many advantages, even for fairly large locks, as all parts are more accessible for inspection, repainting and repair, while they are also lighter and less expensive. Plans for both types were submitted to the harbor authorities. They preferred the double-skin gate.

The gate leaves are horizontally framed, with girders 4 ft. deep, spaced about 5 ft. apart, so that the interior compartments are comparatively easy of access. Their shape is the same as that used at Panama and in the latest lock at Sault Ste. Marie, the lower face being straight throughout, the upper curved near the ends. Curved leaves, forming a circular arch from quoin to quoin, are still advocated by some engineers, but very seldom built, as a slight saving in weight is more than balanced by the greater cost of the shopwork. Straight leaves have also practical advantages, especially in avoiding deep recesses in the masonry.

The upper gates are 39 ft. and the lower 47 ft. high, the length of the leaf being 33 ft. and the rise of the sill equal to one-fifth of the lock width. There are three sets of vertical frames extending from the top to the bottom and channel intercostals, for stiffening the skin, at intervals of about 2 ft. At the quoin and miter posts heavy vertical-plate diaphragms distribute the end thrust.



LOCK GATE LEAF NEARLY ASSEMBLED

The gates rest on hemispherical pintles of nickel steel 14 in. in diameter, with carbon-steel pin caps, and turn at the top on 10-in. nickel-steel pins with phosphor-bronze bushings. The quoin and miter posts and the clapping sill attached to the gate are of greenheart timber, and the hollow quoins and fixed sills of polished granite. The air chamber in the lower part of the gate, which is not subdivided, is accessible at all times by a manshaft with ladders extending to the top; and there is also a manhole near the bottom. The upper part of the gate forms a water chamber. The entire weight is hung from the anchorage, as no rollers on the lock floor are used. There are two riveted anchor frames, triangular in shape, one at right angles to the lock wall, the other approximately parallel to it, which extend about 14 ft. into the concrete. The upper and lower gate leaves weigh 290,000 lb. and 240,000 lb. respectively. One of the larger leaves was completely assembled at the contractor's yard. Two photographs herewith show stages of the erection. The gates will be erected in the field by Japanese contractors.

Gate-Operating Machinery

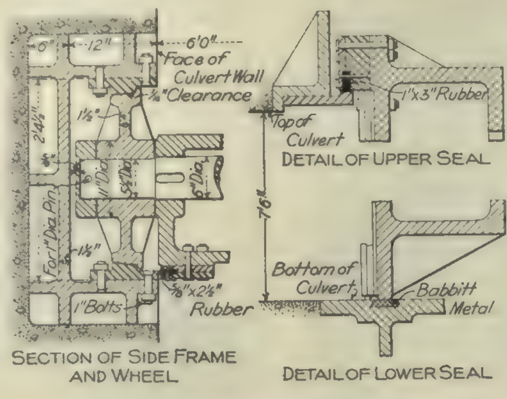
The mechanism for opening and closing the gates is of the bullwheel type devised by E. Schildhauer for the Panama Canal. The motor and the smaller gears are again placed in a watertight machinery room. Some interesting tests made in the Panama locks since their completion have shown that, under the conditions prevailing there, the resistance to the movement of the gates is greater when they are close to the sill than in any other part of their travel.

In the plans here adopted a slight change in the position of the bullwheel center was made, by which the speed of the gate when almost fully closed, and hence the maximum motor load, has been greatly reduced. A similar reduction in the resistance to the gate at the other end of its stroke was obtained by deepening the recesses in the walls.

The three-phase alternating current at 60 cycles and 220 volts is furnished by a central power house, which also serves other installations. All the sluice and lock gate motors are normally operated from a small central-control house at the middle of the lock wall, but each motor can also be controlled from a switchboard in its own machinery room. The main control switchboard is on the second floor of the control house, from which all parts of the lock are visible to the operator. All power and control cables are cambric-insulated and lead-sheathed, and drawn through iron conduits embedded in the concrete close to the top of the lock wall.

The motors are started and stopped by contactor panels in the several machinery rooms. There are two double-pole contactors for each motor, one for opening and the other for closing the gate, which carry the main current. The motors are ordinarily started by the operator in the control house, and stopped by a limit switch connected to the motor shaft when the gate or valve has reached the end of its travel. Indicators are installed both in the individual machinery rooms and the control house. There is a set of three lights for each machine. Red and blue lights indicate the open and closed positions respectively; the white lights show when a valve or gate is in motion.

All the motors for the gate and valve operation are interchangeable, being standard 22-hp. motors with a synchronous speed of 720 r.p.m. They are of the squirrel-cage form, designed for intermittent service, entirely inclosed and fitted with solenoid brakes mounted on extensions of the motor



DETAILS OF SIDE FRAME AND SEALS

shaft. As a safety provision against overloading the sluice-valve motors, there are mechanical friction cutoff couplings attached to the motor shafts. In the case of the lock gates, overload on the motor and excessive strains in the gate and machinery, due to accidental obstructions, are guarded against by an auxiliary cut-out switch fastened to the strut, which stops the motor when the compression of the springs in the strut exceeds proper limits.

Special Safety Devices Required by Tidal Conditions

The great range of the tides at Chemulpo and the character of the gate-operating machinery introduce some special dangers, which are absent in most other locks. The dangers in question are of two kinds:

The first would occur in case of failure to close the gates when the tide dropped to normal dock level. The depth of water would soon be insufficient to float vessels and serious damage might easily result. A neglect of this kind is not unlikely to occur, especially at night, when there may be only a single attendant on duty.

To meet this danger, it is proposed to install a simple telltale device. It consists of a float switch placed in a well in the dock wall, which will ring a signal bell when the water drops below any desired level. Connections are made with the operating circuits, so that the bell will continue to ring until the attendant has closed the proper switches and all the upper lock gates and valves have actually started to close. It was not thought safe to have the lock gates close automatically, as there would be some risk of collision with a passing vessel.

Danger From High Tides

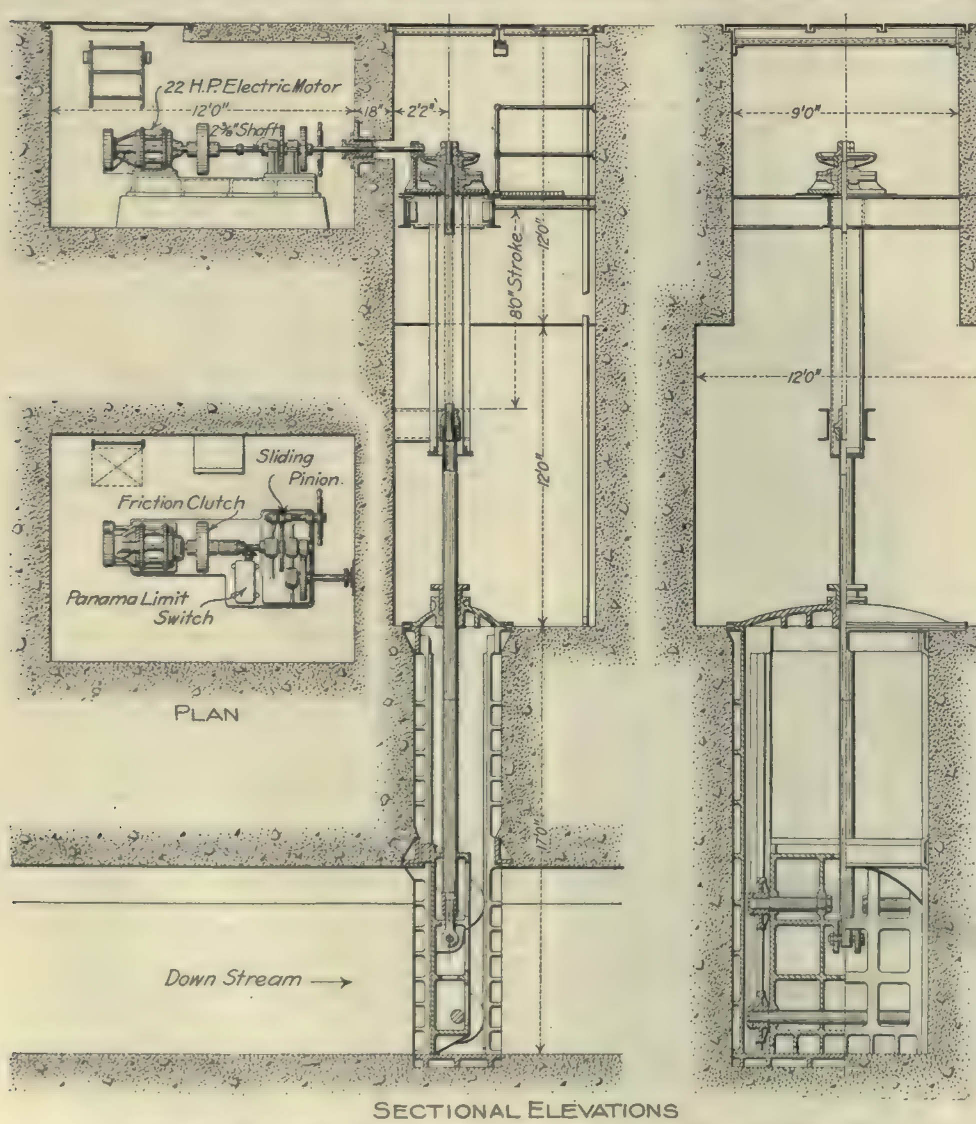
The second danger to be guarded against would arise from neglect to open a lock gate when the tide rose higher than the water level on the upper side of the gate. Where miter gates are operated by chains it is customary to leave the latter loose after the gates have been closed, so that a pressure on the downstream face merely opens the leaves. With the type of machinery in the Jinsen dock the strut holds the gates very rigidly and a reverse water pressure produces strains in the strut and the gate leaves. As the tidal rise at Chemulpo is very rapid, at times over 1 in. per minute, the stresses would become excessive within a very short time. It was therefore thought best to have the gates open automatically, especially as it is not easy at night to tell just when the levels balance.

The proposed protective device should be entirely effective. It consists of an electric switch similar to the cut-out switch mentioned, and is also fastened to the operating strut. When the reversed water pressure acts on the closed leaf, the strut shortens, and its two sections slide on each other. As soon as this movement has reached any desired amount the switch starts the motor and opens the gate. It is proposed to attach these switches to all the gate leaves, as the reversed head may occur at both ends of the lock.

Personnel

The general contract for the lock equipment was awarded through Mitsui & Company, Inc., to the McClintic-Marshall Company of Pittsburgh, which built the miter gates at its Rankin plant. The machinery was manufactured by the Fawcus Machine Company, and the electric equipment by the General Electric Company. Some of the heavier iron castings were made by the Davies & Thomas Company at Catasauqua, Pa.

The general and detailed plans were prepared by Henry and C. J. Goldmark, consulting engineers, of New York City, who also supervised the construction on behalf of the harbor authorities. N. Sakaide is the government engineer in charge.



SECTIONAL ELEVATIONS

DETAILS OF VALVES AND MECHANISM FOR RAISING AND LOWERING THEM

Cord Wood Shrinks 25 Per Cent in Sawing

Two students of the University of Washington, working under the direction of the College of Forestry, have found that a cord of full-length wood when sawed into short lengths and repiled in the ordinary stack shrinks on an average about 25 per cent. For close piling in which all the sticks are carefully fitted together the shrinkage is about 13 per cent.

Discuss Illinois Bridge Specifications

Chicago Association of Commerce Committee Gets Opinions of University Professors on Permissible Unit Stresses in Concrete Structures

THE adequacy and economy in the design of the concrete highway bridges of Illinois have been under investigation as a part of the work of the good-roads committee of the Chicago Association of Commerce. Founded on correspondence with various university bridge departments, the report indicates that the specifications are high grade, although they might be modified in a few instances. Points with reference to loading, stresses and use of high-carbon steel are given below.

An explanation of certain clauses in the specifications was furnished by W. W. Marr, state highway engineer. As to live loads for concrete bridges, he states that the expected life of concrete bridges is considered so much greater than that of steel bridges that the loads are assumed considerably higher than for steel structures. As an alternative to a live load of 125 lb. per square foot, the load diagram used is the approximate equivalent effect on a reinforced-concrete slab of a 24-ton steam-plow tractor, and is probably as satisfactory as any that may be devised for use, considering the heaviest motor trucks now known. Such loads are as yet unknown on county highways in Illinois. Prof. F. E. Turneaure, University of Wisconsin, stated that he did not consider this assumption excessive.

Concrete Arches

Illinois does not permit concrete arches unless founded on solid rock or unusually firm hardpan, except for paved culverts and very small paved bridges. Professor Turneaure called attention to the fact that a number of arches in Wisconsin have been built on pile foundations driven in good, firm soil, with entire success; also two arches on gravel foundations without piling.

With reference to concentrated loads on steel bridges, Mr. Marr said that with concrete floors the Illinois specifications call for a uniform live load of 1440 lb. per foot of floor slab on the concrete subfloor slab. In explanation he stated that this is the approximate equivalent to the heaviest concentrated motor-truck wheel load to be expected. It is based on the maximum stringer spacing allowed, which in turn has been found to represent the approximate economical maximum. This provides a floor slab having a total thickness of about 4 in., which is about the minimum thickness that can be constructed and cured satisfactorily without using extraordinary precautions.

"Just what assumptions," Professor Turneaure said, "should be made with regard to the load on the portion of the concrete floor under the drive wheel of the traction engine, particularly if the same has sharp lugs, is problematical. The writer does not believe that an assumption of 1440 lb. per square foot of floor slab is at all excessive."

High-Compression Unit Stresses Explained

For reinforced slab structures the Illinois and Wisconsin permissible stresses, in pounds per square inch, are as given in the table.

For reinforced-concrete girders the compression is 1000 lb. in Illinois and 700 lb. in Wisconsin. For plain and reinforced-concrete arches it is 800 lb. in both states.

Mr. Marr says: "Considering the length of span for which girders are used, the probability of the maximum load coming upon the structure is considerably more remote than in the case of simple-slab bridges. The uniform live load produces the greatest moment in the girders, except for the shortest girder spans. In short, for through-girder spans the girders are arbitrarily increased in depth and width beyond that theoretically required to afford protection to the traffic as side rails and for appearance.

"The only load which may now be anticipated which might approximate 125 lb. per square foot on a 16-ft. roadway bridge over a length as much as 50 ft. is that of a string of 7 cu. yd. trailers hauled by a steam tractor. Such an outfit was purchased by the State Highway Department some years ago and produced the equivalent load of about 110 lb. per square foot over a width of 16 ft. and a length of about 50 ft. The use of this outfit has been virtually abandoned because it has been found impracticable to provide road surfaces to accommodate the load. Should such loads occur in the future on county highways, they would undoubtedly be rare. The dead-load stress is under that recommended by the Joint Committee.

Through-Girder Bridge Tested

"A 40-ft. clear span, 18-ft. roadway, reinforced-concrete through-girder test bridge was built at the Southern Illinois penitentiary and was subjected to various test loads. A live load equivalent to thirteen times the live load used in designing was imposed for four days in an attempt to break the bridge. No failure occurred. A load equivalent to eleven and one-half times the designing load (1450 lb. per square foot) was left in place for more than one year and no failure occurred (see 'Test of a 40-Ft. Reinforced Concrete Highway Bridge' by D. A. Abrams, *Proceedings* of the American Society for Testing Materials, Vol. 13, 1913). The observed stress in the girder steel was only about one-half that computed by the usual formula, considering each girder as a unit independent of the floor. Loading the bridge to destruction has been abandoned.

"Considering the probable rare occurrence of the maximum load, the age of the concrete when such a load may be expected and the behavior of the test bridge above mentioned, the compressive stress allowed for concrete in girder bridges is not considered too high. In deck-girder bridges, on account of the floor slab forming a part of the area in compression, the concrete stress is low.

"Compression in arches is lower than for girder bridges because of uncertain temperature effects and on account of the effect of the possible nonrigidity of foundations.

"Extensive tests made under the direction of Prof. F. O. Du Four and the State Highway Department have indicated plainly that impact may be disregarded in the design of such bridges as are provided by these specifications.

"In general," said Professor Turneaure, "there is very little difference between the two sets of specifications. I think that the allowable stress of 80 lb. of the Illinois specifications is better than the 120 lb. of the Wisconsin specifications. Relative to girders I should say that the 1000 lb. allowable stress on concrete was high. I should prefer the Wisconsin rule."

PERMISSIBLE STRESSES FOR REINFORCED SLAB STRUCTURES

	Wisconsin	Illinois
Tension in concrete	None	None
Compression in concrete (Class A)	700	800
Shear (diagonal tension) in concrete when no shear reinforcement is provided	30	40
Shear (diagonal tension) in concrete when reinforcement is provided for shear in excess of 40 lb. per square inch	120	120
Bond between reinforcing steel and concrete (surface area)	120	80
Tension in reinforcing steel	16,000	12,000

Comments on Specifications

The comment of Prof. O. H. Basquin, Northwestern University, is as follows:

"The compressive stress in concrete girders seems too high, even in view of the explanation. Nothing is said as to the method of estimating these stresses; therefore these are the actual stresses. The explanation would rather indicate that the method of estimating the stresses in the bridges tested may be in error.

"The compressive stress in concrete seems too high for plain concrete arches and perhaps also for those that are reinforced."

N. B. Garver, instructor in highway bridge engineering, University of Illinois, wrote with reference to the specifications in general as follows:

"My opinion is that in the main the specifications depend primarily upon the loadings and unit stresses specified. In the light of experiments that have been made I believe these specifications to be safe and economical. My reasons for that belief are based on the evidence which appears in the following published articles." Ten references were given.

Prohibits High-Carbon Steel

"High-carbon steel is prohibited in the Illinois specifications," said Mr. Marr, "because the added cost of bending in scattered bridge work makes it uneconomical. In addition, much trouble has been experienced from breakage due to rough handling and during bending."

Professor Turneaure agreed with Mr. Marr on this point and added that the high-carbon steel was not so reliable as mild steel.

Geodetic Survey Party Adopts Auto-Truck Transport

Observations have just been completed by the U. S. Coast and Geodetic Survey on an arc of primary triangulation 630 miles long from northern Utah to northeastern Oregon and thence to Portland. For the first time on this class of work the surveying party was transported by automobile truck, and as a result of the experience with them all parties engaged on similar work are to be provided with this means of transportation. The truck carried the party to the bases of the peaks from which observations were made, the equipage and instruments being transported to the top by horses or members of the party. Most of the observations were made by night, using acetylene lamps for sights. Observations were made from end to end of one line 134 miles long in this way. The elevations of a large number of mountain peaks were determined accurately by triangulation for the first time by this survey. The party was in charge of C. V. Hodgson.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

George's Opportunity

SIR: I respectfully suggest that the American Society of Civil Engineers adopt as its motto for the coming year the familiar slogan, "Let George Do It," as the nominees for the ensuing year are: President, George Pegram; vice-presidents, George Kittredge and George Webster; and treasurer, George Tillson.

New York City. FREDERICK H. POND.

Information Wanted on Turnouts for Concrete Roads

SIR: Can you tell me where I can get some information on the omission of shoulders on single-track concrete roads and the use of turnouts? The turnouts are to be, say, 6 ft. in width and 40 ft. in length, and be placed at 500-ft. intervals on alternate sides of the road. If you can give me the names of any engineers or communities that have used this construction I would appreciate it.

Greenville, Miss. A. R. ALLING.

Cast-Iron Rocker Shoes Successful

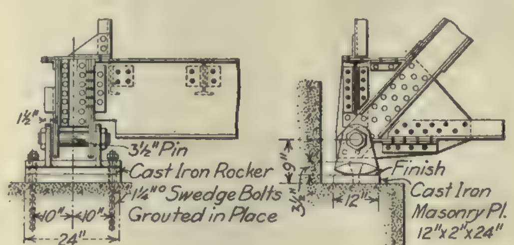
SIR: In an article on the steel-bridge standards of the Iowa Highway Commission in the Engineering Record of Dec. 12, 1914, page 631, the writer made brief mention of the rocker shoes used on truss spans 70 ft. or more in length. No details were given at that time. In view of the fact that this type of expansion bearing has been used successfully for several years, the accompanying details and photograph may be of some interest.

The usual type of roller bearing with rollers from 2 to 4 in. in diameter, in general use for highway bridges, is very unsatisfactory because it soon clogs with dirt and rust and is practically never cleaned. The rockers as shown were designed to overcome this objection. They were first suggested and used in some of the earlier designs of the commission by Prof. J. E. Kirkham of the Iowa State College, and, so far as the writer knows, the use of this type of expansion bearing for highway bridges is original with Professor Kirkham.

CAST-IRON ROCKER IN 110-FOOT SPAN

In the earlier designs the rockers varied considerably in dimensions and minor details, but the bridge designs have since been standardized, and for the past three years they have been built as shown in the accompanying details, which are for a standard 110-ft. through riveted truss span with 16-ft. roadway and concrete floor. The rockers have been used for bridges with concrete floors, and of span lengths up to 150 ft. For the longer and heavier spans the thickness of the vertical webs and of the masonry plate is increased. The masonry plates are made of such area that the pressure on the masonry is limited to 400 lb. per square inch. The rockers are anchored to the masonry with 1¼-in. swedged bolts passing through the rocker portion as shown. The wedge-shaped anchor bolt slots provide for the free expansion and contraction of the trusses.

It will be noted that the standard rockers are of cast iron rather than cast steel. The principal reasons for this are that good



DETAILS OF ROCKER AT EXPANSION END

iron castings are more easily obtainable in small shops than good steel castings, and the iron castings are the cheaper. The same type of rocker bearing is adapted to long-span plate girders by the use of an upper cast shoe bolted to the sole plate of the girder and connected to the rocker pin.

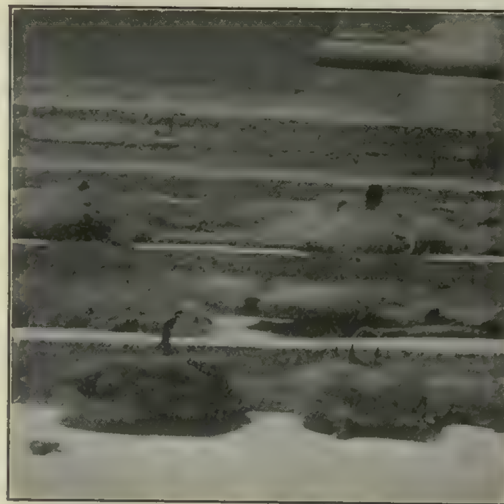
The cost of the cast-iron rockers compares favorably with that of roller bearings, and the results have been much more satisfactory than could have been expected with the latter type of expansion bearing.

E. F. KELLEY,
Assistant Bridge Engineer, Iowa State Highway Commission.
Ames, Iowa.

Roots Grow Rapidly in Sewer

SIR: In the accompanying illustration is shown a six months' growth of elm roots in a 12-in. storm sewer. All were taken from a length of about 30 ft. The section of storm sewer from which these roots were taken was thoroughly cleaned in December, 1915. Recently, after a heavy rain, it was noticed that the water did not get away from this section properly. Upon investigation the trouble proved to be roots, most of which were raked out. The remainder were removed by the machine.

This sewer, which was constructed about six years ago, was not laid to a true grade, there being a rise toward the outlet sufficient to hold water the full depth of pipe at the clogged section. This has been an exceptionally dry season and has caused the



ELM ROOTS GROW IN A 12-INCH STORM SEWER

roots to search the sewers more vigorously for water.

Fortunately there is another storm sewer across the street, low enough so that by laying a cross-connection the defective sewer can be thoroughly drained, thus removing the constant water supply which gave the roots such rapid growth.

C. E. HENDERSON,
St. Augustine, Fla. City Engineer.

Quality of Concrete—and of Engineering Supervision

SIR: Under the caption, "Quality of Concrete," you have an editorial in your issue of Nov. 11, page 577, commenting on the report of a bridge failure at Independence, Ore. This editorial brings to mind the old expression that "you cannot legislate efficiency"—and so it is with a specification, "you cannot legislate proper construction." You can suggest and direct that such and such things shall be used and performed, but the result depends, more than on this, on the man who is doing the directing; that is, the inspector, and on the engineer or other person delegated to supervise the construction. A set of plans and specifications can be ever so carefully drawn, but unless the work is delivered into the hands of competent and honest inspectors and competent and honest supervising officials, what is the use?

I do not believe I am exaggerating when I say that at least 50 per cent of our public improvements are improperly inspected. And why? Simply because we, as engineers, are content to sit tight at the critical time and criticise afterward. We do not bring the matter home with sufficient force to the political officeholder that competent inspection is one of the main essentials of successful work. We object probably in a weak sort of way, but not convincingly, and the result is that some political supporter or personal friend of the officeholder gets the job.

It is the general supposition of the layman that all that is necessary for successful inspection is to have somebody on the job; no matter who it is, just so he is on the job. The engineer will see to it that the work is being done right, that's his business. The job fails, and the engineer gets the blame. Why shouldn't he? If he is so timid as to tolerate such an organization for the carrying out of the work he has so carefully planned he deserves to get the blame.

You never see a lawyer delegating to an

incompetent the defense of an important case which he has gone to considerable trouble to prepare; nor a doctor a serious and complicated operation. They either go through with and dictate the policies of the procedure or else they do not act. And so it should be with engineers; they should hold out for the final say as to who shall supervise or inspect, or else refuse to act.

Nor can you always lay the blame for poor inspection on the political officeholder. How often do we see the engineer, who is given absolute authority for creating his construction organization, hire cheap help for the sake of saving a few dollars. Cheap help as a rule denotes incompetence. Low pay is conducive to dishonesty. In this age we usually get just what we pay for. Cheap help means cheap work; a cheap contract, trouble.

So I say it is up to the engineer to see, first, that he has competent assistants; second, that the contractor is to receive a reasonable price for his work, and, third, that the work is done properly. Every failure discredits not only the engineer who had charge of the work, but also the whole profession. The greater the number of failures, the greater is our discredit in the minds of the public.

Another matter which you refer to and in which I cannot concur is that of specifying the strength a concrete shall attain within a certain specified time. Theoretically this is good, but is it practical? I think not. If I get the correct impression, you would take samples of the concrete as it was being run, and then at the expiration of the required time, test it and find out if the job complied with the specifications. In the meantime the work has continued and possibly has been completed. I suppose the remedy would be to tear it down and try again.

This is exactly where most of our trouble comes under the present system. The error is committed but not discovered until some time later. To correct it would necessitate the removal of considerable other work which apparently is good, so we take a chance. Like all other forms of gambling, we win sometimes, and sometimes we do not. When we do not win, it is a failure.

It is my belief, and I think the majority of the profession will agree with me, that the proper time to stop faulty work is while it is being done, and that the time to catch faulty materials is when they are being delivered. If sufficient care were used at the time the specifications are drawn to obtain a correct knowledge of the materials available and draw the specifications accordingly, and if we would then see to it that the conditions during construction are carried out as they should be, we should have far fewer failures and far less criticism.

Summing the whole situation up, we come to the following conclusions: First, an engineer should not accept a commission until he has some assurance that suitable provisions will be made for carrying out the construction end; second, he should give careful consideration to the selection of the materials, the conditions under which they are to be used, and all local conditions likely to affect the quality of the work, then limit the requirements of the specifications to these conditions; and, third, he should not be found guilty of practising false economy or of having a philanthropic feeling for the contractor.

G. C. PRUETT,
City Engineer.
Miles City, Mont.

Derricks on Yadkin River Power Project

SIR: Referring to the article in your issue of Nov. 18, page 610, on the Yadkin River power project, we wish to call your attention to an omission in regard to the equipment. You speak of the American Hoist & Derrick Company's derricks being used on this work, but you do not mention the hoisting engines.

These derricks are operated by 9 x 10 double-cylinder tandem-drum Lidgerwood hoists, with their patent bullwheel swinging gear.

We designed a special derrick engine for the Hardaway Contracting Company, for use on its different contracts. The design is generally that of our standard derrick hoist, but made with larger-faced swinging drums, which necessitated heavier gears and heavier shafts. The hoisting drums are fitted with non-burn Autobesto lined brakes, two on each drum. Mr. Hardaway's desire was to have a hoist that would withstand every abuse.

LOCATION OF HOISTING DERRICKS DURING THE JULY FLOOD

Mr. Hardaway has so far as possible standardized all his equipment, as this simplifies the matter of repairs, and also his men when shifted from one work to another are familiar with the apparatus they have to handle. This is an important advantage where comparatively unskilled labor is used.

We have sold to the Hardaway Contracting Company 127 hoists, steam, electric and air-driven, since it commenced standardizing its equipment, and are building twelve more for that company at the present time.

We inclose a photograph taken during the floods, showing the location of these derricks.

LIDGERWOOD MANUFACTURING COMPANY,
John Sinclair,
Manager Advertising Department.

Experts Overnight

SIR: I read with much interest the editorial in your issue of Nov. 18, page 607, entitled "Experts Overnight." I beg to suggest, however, that there may be another side to the story.

As no detailed information is given as to the exact conditions surrounding the junket in question, I will speak only in general terms. Men occupying the positions mentioned are mostly men of the world, of mature age, possessed of tact and common sense and under no illusions as to their own ability to become expert sewage-disposal engineers overnight. The majority of them, the country over, are honest men, anxious to do their best for the community. It is not uncommon for them to go, individually, at their own expense, to examine work similar to some that may be proposed in their own town. Very frequently they do the same thing while on business or pleasure trips to other towns in the country, or even abroad. Their work in connection with a sewage-disposal plant is fully as important as, and often much more difficult than, that of the engineer, and they are seldom paid for it except with abuse.

Sewage-disposal plants cost large sums of money, which usually means a bond issue authorized by popular vote. In other words, the voters must be convinced of the wisdom and desirability of the expense. This often requires years of hard work. Experienced public officials understand perfectly that they are not by any means their own masters; they must convince their constituents of the wisdom of their acts. They have to deal with the hostile press, the reptile press, the conservative press, the unwise friendly press and the technical press—although few read the latter; they are all mouthpieces of appropriate elements in the community. Property owners, who are usually influential people, dread the increased taxes, while other important groups of people would prefer to have the money spent for civic centers, school houses, parks, playgrounds, waterworks, street cleaning or hospitals. Successful politicians realize that they must lead public opinion, but must never advance so rapidly as to get out of touch with it; otherwise all their projects will be wrecked.

Whenever a sewage-disposal proposition is agitated every politician, public official and prominent citizen who is supposed to have any say in the matter is besieged by a multitude of engineers, contractors, patentees, etc., every one of whom presents a proposition which he insists is the very thing and the only thing. These propositions differ widely in character and estimated cost. Some of the proposers are honest and capable and some are not. The officials are well aware that an engineer must be selected, but whom shall they select? Their information on that subject is by no means as extensive as yours, Mr. Editor.

Many patentees maintain competent staffs of engineers who have made a specialty of that work. Their experience is wider than that of anybody else except a few famous experts, and they are usually willing to do the engineering work and take their pay in

the form of a royalty. Many contracting companies also maintain competent staffs of engineers, and they have the advantage in that they can be held responsible for their preliminary estimates and for the successful operation of the plant, as well as for patent infringements. A competent independent engineer is best of all, but many engineers have a personal equation in the form of a percentage which must be added to their preliminary estimates to cover the total cost of the work. This percentage varies from 10 to 50 or more. Appropriations and bond issues for public works must generally be sufficient to complete the work, in order to make the contracts legal, and if a supplementary appropriation is required the public officials are subjected to a great deal of very awkward questioning.

An agitation for an important public work can hardly get far until the public is reliably informed as to the roughly approximate total cost of the proposition. A competent engineer would hardly risk his reputation on a preliminary estimate without an investigation which might cost thousands of dollars. There are no funds available. What more natural thing is to be done than to send a delegation of prominent citizens or responsible officials to other cities where sewage-disposal plants are in operation and ascertain how successful they are, under whose patents, if any, they were built, who were the engineers in charge of design and construction, and what was the cost.

Besides, if the project is in the agitation stage the average voter will listen much more attentively to a man who has seen the thing with his own eyes than to the man who has obtained his information at second or third hand, and the officials and politicians are the ones who have to do most of the talking to the public. True, they might have sent the city engineer just as well, but he might be a candidate for sewage-disposal engineer. If an expert, however famous, delivers public addresses as an advocate of the project, the ordinary citizen assumes at once that he is looking for a job.

Harrisburg, Pa. WILLIS WHITED.

Gas Companies Not Opposed to Heat-Unit Standard

SIR: In the editorial entitled "A Profit-Sharing Plan for a Gas Company," published in the Engineering Record of Nov. 18, page 609, there is an inference that the general adoption of the heat-unit standard for gas quality has been delayed in this country due to the gas companies' attitude. This is directly the opposite to the true state of affairs. It is doubtful if there is a gas company in this country which would not cheerfully adopt the heat-unit standard if the utilities commissions permitted it. In fact, at the recent annual meeting of the American Gas Institute a resolution was adopted recommending the total heating value as the only standard basis of rating the quality of all manufactured gas distributed in the United States.

There are various reasons why the artificial-gas industry desires to make its gas to a heat-unit standard. Modern gas illumination, as typified by the gas mantle, depends on the heat value rather than on the candlepower for its efficiency. Long-distance transmission, which has enabled gas companies to extend their services to outlying communities, whose populations in themselves would not justify the investment represented in a gas plant, requires high-pressure distribution. Such a system of distribution is impossible under a candlepower requirement for quality.

The cost of manufacture of heat-unit gas is less than that of candlepower gas, due to the fact that oil has to be introduced in the manufacture of the latter to give it the proper illuminating value. In this connection there is another advantage in that the smoking up of ceilings, walls, etc., is very largely reduced to the point, in fact, where it becomes negligible.

So desirable is the heat-unit standard to the gas company that the company to which you allude, the Peoples Gas Light & Coke Company of Chicago, has spent great sums of money in publicity matter to educate the people of that city up to the point where it might make its proposition for a change in standards. It was not, and is not a case of the company hanging back, but of the public not being educated up to the point where sentiment would not be adverse to the change.

Your editorial would also leave the impression that the adoption of the heat-unit standard is not so general as it is. In addition to Wisconsin, Massachusetts and New York (Second District), New Hampshire, Connecticut, Pennsylvania, New Jersey, Maryland and other states and the District of Columbia have adopted this standard, which is already in effect in Great Britain and Continental Europe. In 1915 Canada also adopted a heat-unit standard on much the same basis as Great Britain's.

Your allusion to the plan to build a byproduct coke-oven plant may lead to some confusion in the minds of your readers. Byproduct coke-oven plants, though large producers of gas, can by no means be substituted for the usual city gas plant. Their principal product is not gas, and in consequence their operation must depend to a large extent on industrial conditions. If the market were glutted with coke, for example, it is quite likely that many would curtail their operations.

During the past few years many of these plants have been constructed and a considerable number are now under construction. Several of them sell their surplus gas to city gas companies, but they in nowise lessen the responsibility of the city companies to have sufficient plant available to supply the demand.

The gas plant in the strict sense of the word is in existence to meet the current demand for gas, and must meet it. It cannot reduce its output at will, dependent upon whether there is a good market for its coke or tar products, as the byproduct company can. These latter companies have come into great prominence as gas producers. It is likely that they will increase in number and output at a rapid rate in the future, especially if proper tariff legislation is passed for the protection of the dyestuffs industry, but they are not gas plants, as the gas industry understands the term.

The editorial on the whole is, in my opinion, extremely valuable, and carefully considered. The facts as presented reveal a good general knowledge of the existing conditions in the gas industry, and it cannot but have the effect of directing your readers' attention to an industry they should know a great deal about, concerning which, nevertheless, they in reality know very little.

EUGENE C. MILES,
Editor, American Gas Light Journal.
New York City.

Warehouse Footings Rest on Concrete and Sand Piles

SIR: The following piece of construction may be of interest to the readers of the Engineering Record. It was interesting to the writer, as it is new in his experience.

Our company built a five-story reinforced-concrete warehouse for the Kansas Ice & Storage Company of Salina. The building was completed this summer and is now in use. All footings rest on 9-in. concrete and sand piles, the accompanying illustrations showing a typical interior footing.

The following tests were made on this type of pile by R. H. Short, manager of the plant and designer of the building:

SAND PILE 6 INCHES IN DIAMETER

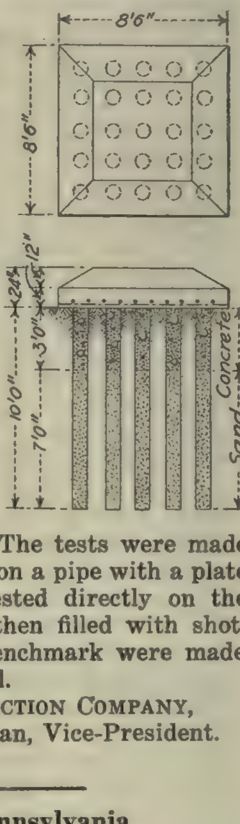
Load, lb.	Settlement in 24 hours, in.
7,600	⅛
11,100	*¼
14,420	*1

SAND PILE 9 INCHES IN DIAMETER

Load, lb.	Settlement in 24 hours, in.
4,520	⅛
7,950	*¼
11,170	*1

*Total settlement.

The variation in the result of two piles was probably due to variation in the soil, which is a sandy loam. The test piles were



TYPICAL INTERIOR FOOTING OF WAREHOUSE

Holes drilled with post-hole auger, filled with sand and tamped as filled. Cap and top of pile poured at same time.

about 100 ft. apart. The tests were made by setting a large box on a pipe with a plate on the end, which rested directly on the sand. The box was then filled with shot. Readings from the benchmark were made with an ordinary level.

EBERHARDT CONSTRUCTION COMPANY,
D. B. Duncan, Vice-President.
Salina, Kan.

Dams in Pennsylvania

Fifty-one applications for the construction of new dams were received or considered by the Water Supply Commission of Pennsylvania during the year 1915 and forty-three permits were issued. This information is contained in the commission's latest annual report. Three of the proposed dams exceeded 40 ft. in height, the maximum height being 68 ft. Twenty-nine applications for permission to make changes or repairs to existing dams were received and twenty-three approved. Construction work was continued on thirty-two projects under permits issued prior to 1915. The number of existing dams examined was 348, and repairs or alterations were ordered on 121 of these. The total number of field examinations made in connection with dams was 626.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Tripod Used to Swing Ram on Pipe-Laying Job

IN LAYING the 18-in. pipe for the Lindsay-Strathmore irrigation project in California the plan of using a 200-lb. ram for driving the pipe into place was tried out instead of employing hand sledges in

SWINGING RAM DRIVES PIPE HOME

the ordinary way. The ram was swung by block and tackle from a tripod made up, as shown in the illustration, of 2-in. pipe.

Working with machine-banded pipe in 12-ft. lengths and with slip joints fitting into couplings, it was found that on this work the crew of five men and foremen completed in the trench an average of 1100 ft. to 1200 ft. in a nine-hour day.

This is about an average rate of progress whether the pipe is driven home by means of sledges or by the device shown. The Redwood Manufacturing Company, which holds the contract on this work, pointed out that although the time required in shifting the apparatus almost offset the time saving which its use effected, the use of the tripod made the work much easier for the men.

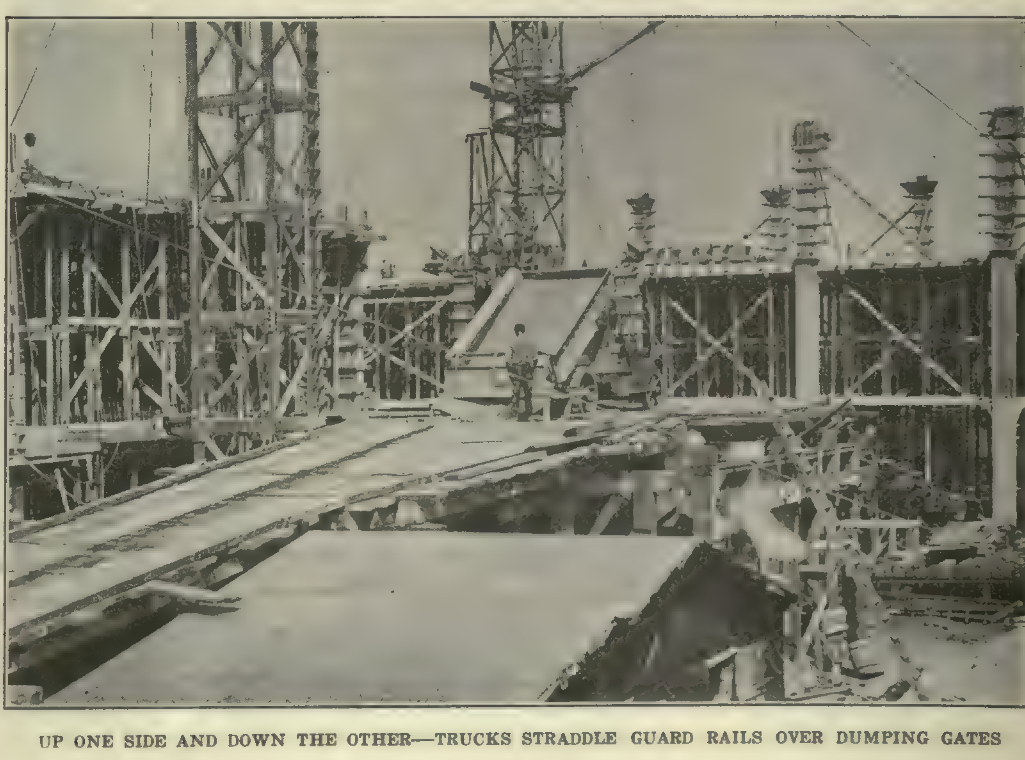
Lime Used to "Blast" Old Foundations Between Running Machines

SEVERAL hard brick foundations for large blowing engines were taken out a number of years ago at the Edgar Thomson Steel Works of the Carnegie Steel Company, at Braddock, Pa., by loading holes drilled in them with lumps of freshly slaked lime. The foundations were located between other blowing engines which it was necessary to keep in operation, and blasting was considered dangerous, while chipping the old foundations out by hand would have been very expensive and slow.

The old foundations were about 12 x 20 ft. in plan and 12 ft. high. Holes were drilled into the top face 3 ft. apart each way. Each of these holes, 3 in. in diameter and 3 ft. deep, was first filled to a depth of 1 ft. with 1½-in. to ½-in. lumps of freshly slaked lime, and sufficient water was poured in to cover the lime. Then another foot of lime and more water was added, filling the hole within 6 in. of the top, after which the top of the hole was filled with brick drillings rammed tightly. The holes were filled this way one at a time, in order. After about 10 minutes, cracks would start in all directions from the first holes filled, and in a short time after all the holes were loaded the entire top of the foundation would be broken into pieces approximating 3-ft. cubes. This was the largest size that could conveniently be removed by hand, but the foundation might have been broken into chunks of any size by varying the depth and spacing of the holes. The holes had to be loaded rapidly, and the workmen were kept off the top of the foundation after the loading was finished, as on one occasion the tamping blew out of a hole. The method made no dirt and no noise, and involved no danger of damage to the moving machinery less than 10 ft. away.

Ramps on Both Sides of Dumping Platform Save Time

A DUMPING platform with inclines on both sides is being used to unload motor trucks of the Cleveland Builders' Supply Company in constructing the $500,000 reinforced-concrete building of the Richman Brothers Company in Cleveland. With this arrangement the trucks do not have to turn around or back away after dumping, but drive straight across the bins and down on the other side. The nine back-dumping White trucks employed on the job discharge their loads through holes over the bins in the plank roadway. The truck wheels are kept from going into these holes by timber guard rails which the trucks straddle. Plank "splash" boards resting on short posts and on these guard rails are placed behind the truck by the dumpman to keep material from spilling over the wheel tracks. The trucks follow each other very closely, as concrete is mixed and placed at a rapid rate, and the double runway is said to save considerable time in dumping.



UP ONE SIDE AND DOWN THE OTHER—TRUCKS STRADDLE GUARD RAILS OVER DUMPING GATES

Release Valve Maintains Pressure in Highway Water-Supply Line

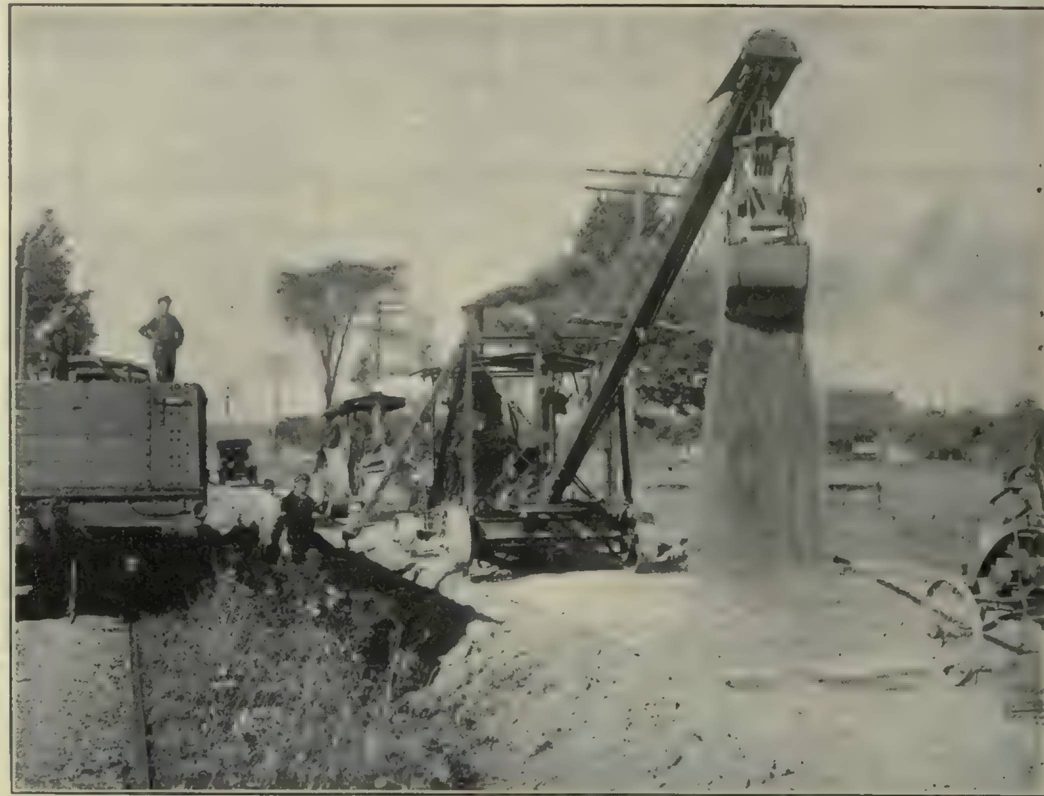
By HARLAN H. EDWARDS
Urbana, Illinois

IN ORDER to maintain a uniform pressure in the discharge line of a piston pump a simple weighted pressure-release valve is being used by an Illinois highway contractor. The valve is in a pipe line supplying water for a concrete mixer on the thin-base monolithic brick-pavement construction of Bishop and Liddell, near Milford, Iroquois County, Ill. A T was inserted in the discharge line, to which were fitted a nipple and a valve. A waste pipe was run from the valve to a ditch near by. In operation the pump is run continuously by a gasoline engine, and the pressure is regulated by placing the weight at any desired point along the lever arm. In this way the pressure at the mixer, wherever it may be along the road, can be maintained constant by a small movement of the weight.

The use of such a valve insures a continuous supply of water in reliable volume and smooth running of the pump without constant attention.

Light Crane Unloads Stone and Hauls Scraper to Spread It

THE Harrison Engineering & Construction Company in resurfacing a road near Buffalo, N. Y., has taken advantage of a parallel electric-railway line to develop the novel method of unloading and spreading road metal shown in the photograph. The stone is delivered in gondola cars on the electric road, unloaded by a Byers Auto-Crane and dumped in the center of the road in front of a wheeled scraper. The scraper is hitched to the crane, and as the latter piles up stone in the roadway it backs away, drawing the scraper after it and spreading the stone. The car of stone is kept within reach of the crane by the electric locomotive. It can readily be seen that work done in this way progresses much more rapidly than with hand unloading and spreading, to say nothing of the great reduction in the size of the crew required.



SCRAPER HITCHED TO CRANE SPREADS STONE UNLOADED AS LATTER BACKS DOWN ROAD

Light-Wood Spouting Plant Saves on Small Remote Job

By JOHN A. HAMILTON
Monongahela Valley Water Company, Elizabeth, Pa.

THE PLANT shown in the photograph was used by the writer to distribute the 1100 yd. of concrete in building a 1,000,000-gal. clear-water basin, and should prove economical on other comparatively small jobs where steel spouting equipment is not available. The main tower was 54 ft. high. The three light movable towers, made entirely of 2 x 4-in. lumber, were 36, 26 and 16 ft. high respectively. They were spaced 30 ft. apart, giving the chutes a slope of 1 on 3, on which the concrete ran smoothly. Each section of chute was 32 ft. long and was constructed of 16-ft. 2 x 10-in. plank, with a 2 x 10-in. rib 16 ft. long spiked to the bottom. The ends of the chutes were held together by a single vertical bolt at the towers, which made a swing joint. Handles were spiked to these light wood towers, and it was possible to move the end of the chute line to any point of the 85 x 130-ft. basin in 20 minutes. As steel equipment would have been expensive for this job, the nearest point at which it could have been purchased being several hundred miles away, the wood construction used represented a considerable saving in the cost of the concrete plant.

WOOD CHUTE LINE ON LIGHT TOWERS MOVED TO ANY PART OF BASIN IN 20 MINUTES

Permanently Straighten Drill Rod That Persisted in Bending

By H. S. CARPENTER
Cobleskill, N. Y.

A WELL-DRILL rod which persisted in bending after it had twice been straightened by the manufacturer of the drill was straightened by the writer for the third time last June by compressing the metal at the bend, and has since been giving satisfactory service. The well drill is in service making blast holes. .

Since steel can be deformed more easily in tension than in compression, it is likely that the first time this rod was bent the elastic limit of the steel was passed on the convex side of the bend, resulting in permanent displacement of the molecules. When the rod was straightened the first time it was evidently bent back by hammering on the end, or by other means which applied the force to the heated bend in a way that did not recompress the displaced molecules on the convex side, but merely stretched the concave side beyond the elastic limit, resulting in permanent distortion of the rod by increasing its length without reducing its cross-section at the bend. This produced a weak spot in the rod, and it bent at the same point again soon after it was put in service. It seems to have been given the same treatment the second time, which did not improve it, as it bent in the same place for the third time on being put back in service. This time, instead of sending it back to the manufacturer, it was straightened on the job.

Three light rails were laid parallel on the ground and leveled. The stem, heated, was laid across these rails with the convex side of the bend down and the middle of the bend over the center rail. The rod was then hammered on top directly in the concave side of the bend until it was straightened. The hammering was done lightly with an 8-lb. sledge. Striking was continued till the rod could roll completely over and remain in contact with all three rails. In this way the "grain" of the metal at the bend was worked closer instead of being stretched still further, and was restored to something like its original condition. The rod has been in service for several months since and has given no further trouble.

Mechanical Engineers in War Service

Nearly 900 members of the Institute of Mechanical Engineers are known to be in active service, and many others are engaged on munition or other war work.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Massachusetts Commission Issues Bridge Order

As Result of Accident in Which Fifty Lives Were Lost—Bridge Inoperative Until All Gates Are Closed

The Massachusetts Public Service Commission, after an extensive investigation by its inspection department of the accident on Nov. 7, resulting in the loss of nearly fifty lives when an electric car plunged into the Fort Point Channel in Boston after going through the gate at the open Summer Street drawbridge, has issued its finding and also announced its orders for preventing such accidents in the future. The report of the inspection department was made by its chief, George W. Bishop, and is quoted in full in the finding. The orders resulting from the investigation are as follows:

"Every street railway in Massachusetts operating cars or trains over drawbridges on surface lines shall at once establish positive stops at a reasonable braking distance from each drawbridge, subject to the approval of the commission, to protect traffic going in either direction, and shall erect at each stopping place a stop sign visible both by day and night, the type of sign and rules governing its use to be approved by the commission.

"Every such company shall make seasonable application to the proper municipal authorities for the location or relocation, at a reasonable braking distance from each end of each drawbridge, of suitable gates, painted with alternate white and black diagonal stripes and provided at night with red lights located at reasonable intervals on the upper portion, such gates to be properly illuminated and interlocked with the bridge machinery so that the latter cannot be operated unless all the gates are closed.

"Wherever, for any reason, it is found impracticable to secure such location or relocation of drawbridge gates, every such company, provided the necessary consent is obtained from the proper municipal authorities, shall install and maintain, at a reasonable braking distance from each end of each drawbridge, a smashboard signal or similar device so interlocked with the operating mechanism of the draw span as to make it impossible for the drawtender to open the draw before the smashboard is in proper position."

Coroner Calls on Engineers to Propose Safeguards for Bridges

Several prominent people in Chicago recently plunged to their death in an automobile which fell into the Chicago River at the Twelfth Street bridge. Peter Hoffman, coroner, appointed a commission on bridge-safety equipment headed by I. F. Stern, consulting engineer, to make recommendations which could be submitted to the city council for incorporation into a city ordinance. Other members of the commission are John E. Ericson, city engineer; Isham Randolph, L. E. Ritter and W. B. Jackson, consulting engineers; W. R. Morehouse, commissioner of public works, and Charles M. Hayes, president of the Public Safety Commission.

The recommendations call for more illumination, double safety gates, additional signal lights, louder bells and gongs, more clearly defined operation of bridges and interlocking, details for street-car tracks and better police protection.

Of the two gates recommended for each approach, the first is a two-armed light signal gate rotating vertically across the street to be placed 25 ft. back of the break in the roadway. The second heavy barrier gate, capable of stopping automobiles, is to descend in a vertical plane and to be yielding so as to absorb the shock gradually. It is to be placed 5 ft. in front of the signal gate. The apparatus is to be interlocked so that the bridge cannot be opened until these gates are in position.

To keep the matter alive the coroner's commission has been taken over by the Public Safety Commission as a "bridge safety committee." As a memorial to Hugo J. Warner, one of the most prominent of the persons killed, the family proposes, instead of entering suit against the city, "to work untiringly to the end that there may be no repetition of such an accident."

Lower Court Declares Adamson Law Unconstitutional

The so-called eight-hour law was declared unconstitutional by Judge William C. Hook of the U. S. Circuit Court of Appeals, in a decision rendered Nov. 22 at Kansas City in the suit brought by the receivers of the Missouri, Oklahoma & Gulf Railway. This is the first decision in any of the numerous suits brought by various railroads to prove the Adamson law unconstitutional. Judge Hook made it clear that the decision was not based on a careful study of the merits of the case, but was rendered to allow the matter to go at once as a test case to the U. S. Supreme Court.

Trip Through New Sewer in Autos Has Its Joys and Dangers

Inspection of the new south-side storm sewer of Columbus, Ohio, was recently made in Ford automobiles with attendant pleasures and perils—mostly perils, if the account given to the Engineering Record is correct. About twenty automobiles were lowered 20 ft. down the steep approach to the mouth of the passage near Parsons Avenue, and one by one they disappeared into the darkness of the concrete tunnel. Difficulty in negotiating the sharp turns furnished the only thrills during the first part of the journey. Farther along one of the leading cars developed engine trouble, which resulted in a twenty-minute delay. As some of the drivers refused to shut off their motors, the air soon became filled with gas fumes, which caused several members of the expedition to make hasty exits through manholes.

This information was furnished by Charles E. Cannell, of J. C. Carland & Company, Columbus.

Broken Stone Not Permanent Improvement

The local court at York, Pa., rendered a decision Nov. 24 in a case brought by the city against a resident to collect the cost of permanent paving installed on streets upon which broken stone had previously been placed. In deciding for the city, the court ruled that the evidence did not show that piking the highway in 1874 and 1903 was intended as a permanent improvement, and that residents are liable for assessments for improved pavement laid upon such thoroughfares. The action was a test case, establishing a basis for similar actions, where required, against other property owners assessed for paving improvements.

California City Wants Manager

A city manager at $5,000 a year, reports state, is wanted by Marysville, Cal. Experience, honesty and no local friends or relatives are said to be the requirements to be demanded of the applicant.

City Managers Discuss Their Problems at Convention

Delegates from Fifteen Cities Recite Experiences in Municipal Administration—Executive Ability Put Before Technical Training

Qualifications needed in men aspiring to positions as city managers, and methods of training best suited to develop candidates for this specialized branch of public service, formed the main topics of discussion at the annual convention of the City Managers' Association, held at Springfield, Mass., Nov. 21 to 23. Fifteen cities were represented by their managers at the convention, which was only one of ten similar meetings of civic organizations held in Springfield last week. The consensus of opinion semed to be that executive ability, rather than engineering training, was the prime requisite for a city manager. Technical training, it was admitted, was an exceedingly desirable qualification in a city manager, but by no means an essential for his success. A feature of the meeting was the elimination of the formal paper and the substitution of general discussion for it. Specific subjects for discussion were arranged for in advance, and in the program definite time was assigned to each topic, so that the business of the convention proceeded in an orderly, efficient way. There were no postponements or omissions of subjects scheduled in the program. President Henry M. Waite, city manager of Dayton, Ohio, presided at the sessions of the convention.

As a preliminary to their business and technical sessions, the city managers, on Nov. 20, made an inspection of the municipal activities of New York City, proceeding to Springfield in time for the opening of the convention in the latter city on Nov. 21. The first day was given over to reports of officers and committees and to general discussion of such subjects as legal difficulties, budgets, politics, cost records and publicity methods.

Publicity for Bids

There was some difference of opinion as to whether bids for the purchase of city supplies should be made public. It was pointed out that better prices on small purchases can generally be secured when a bidder's figures are not made public. A salesman who puts in a low price does not want his competitor to know about it. Under such conditions, of course, the city is the gainer, but, as Henry M. Waite pointed out, public affairs should be open, and an opportunity should be given to any one who wishes to examine the city manager's books. In Dayton, the city manager is authorized to make purchases amounting to $500 or less without the authority of the commission. Card indexes of current prices are kept, and while these are not given to the press they are open and available at all times. One instance was cited where, after bids had been received, one manufacturer was induced to lower his price. There is danger in this procedure, it was pointed out. If unsatisfactory prices are received, it is best, according to Mr. Waite, to reject all bids and call for new ones.

Understudies for City Managers

One of the subjects which elicited considerable discussion was the training of understudies for city managers. Mr. Waite pointed out that the principle of an understudy for each position is the basis upon which a successful organization must be built up. Men should not be brought in from the outside for these posts, but should be developed out of the exist-

ing personnel. Unless this is done, the morale of the organization is destroyed.

Mr. Waite made a forceful plea for the development of men according to their natural bents. Speaking of university courses for the training of city managers, it was held that the tendency of such training is to give the student so many things to think of that he becomes bewildered. "You can't create executive ability in a college course," said Mr. Waite. "It is latent in the individual, and there is no rule for finding out whether it is there or not unless a man is put to work at a job in which he can show whether or not he possesses administrative ability. The final training of the city manager must be in the field and not in the classroom."

A great mistake is being made, according to Mr. Waite, by heralding the commission-manager form of government as a panacea for the troubles of municipal government. This form of government should be suggested only when the people are ready for it. "American people," said Mr. Waite, "don't want to be reformed. They want to reform themselves."

Training for Public Service

In the discussion of the training of city managers, G. C. Cummin of Jackson, Mich., pointed out that the hardest thing for executives to get is a man who will do his own work and at the same time train himself for the job ahead. O. E. Carr of Niagara Falls said that executive ability should come first and technical knowledge second in determining the qualifications of a city manager for his work. Mr. Waite believes that a city manager need not be an engineer. In small towns, he said, engineering training is an advantage, but any good executive, whether he has had engineering training or not, can be a good city manager. C. A. Bingham supported this view, but added that while a city manager need not be an engineer, engineering experience is exceedingly useful.

Dr. W. H. Allen director of the Institute for Public Service, New York City, spoke upon the subject of education for service. His contention was that a man must be developed by placing an actual load upon him; in other words, give him his instruction, not exclusively in the classroom but in some city department. Real experience is necessary. There is to be a future demand for city-manager material, according to Dr. Allen, and it is time now to train men to meet this demand. Apprenticeship in the offices of city managers was spoken of as a desirable form of training, but Mr. Waite pointed out that there should be some clearing house established before raw recruits possessing no particular qualifications for the job are dumped into the laps of city managers for instruction.

The statement is sometimes made that the city-manager plan is applicable only to the small or medium-sized town. The opinion prevailed at the convention that this was not so, and that the city-manager form of government could be successful in a city of 1,000,000 population or more. In a large town the form of organization would involve a division of the work into units, with department heads reporting to a central authority.

Prof. A. R. Hatton spoke of the advantages of broad general training for municipal executives. In addition to this broad training he believes that from 30 to 50 per cent of a candidate's time should be spent in actual practical work in city offices. Then, too, he would exclude from a training course for city service men who do not exhibit characteristics which indicate their fitness for this kind of work. Only picked men should be admitted to preliminary training, according to Profesor Hatton.

Complaints

It has been the practice of a number of city managers to set aside a certain time for hearing complaints. The discussion at the convention developed the fact that this practice has not very much to commend it. It was pointed out that people will offer objections whether or not any specific time is set for them, and that the mere scheduling of a certain night for hearing complaints tends to make people complain who would not otherwise do so.

E. P. Goodrich of New York City spoke of the qualifications for higher executives in municipal administration. Specialization is necessary, according to him. He would combine a university education with technical training and five years in municipal employ. Municipal executives should be grounded in practical politics and know what vote-getting means. It is not only necessary, according to Mr. Goodrich, to report that a certain thing is desirable, but to keep at it until some real working results have been accomplished.

City-Manager Accomplishments

One of the chief advantages of the city-manager form of government, according to the opinions expressed at the convention, was the opportunity it offered to cities to live within their incomes. An interesting feature of the convention was the report by the city managers of their most important accomplishment during the year. For Dayton, Ohio, Mr. Waite reported living within the municipal income. For Jackson, Mich., Mr. Cummin pointed to governmental harmony. For Sandusky, Ohio, K. B. Ward believed that the maintenance of the city-manager form of government was the big feature of the year. C. A. Bingham of Norwood, Mass., placed emphasis upon co-operation of citizens in civic affairs For Winnetka, Ill., R. L. Fitzgerald believed that the establishment of an accounting system was the best thing done in 1916. For Winchester, Va., Arthur N. Field pointed to reduced operating expenses of the city. Elimination of politics was the big accomplishment at Beaufort, S. C., according to H. G. Otis. Rock Hill, S. C., lived within its income last year, according to J. G. Barnwell. According to W. L. Miller, St. Augustine, Fla., under the city-manager form of government, had been placed on a sound financial basis and the debt was decreased 30 per cent. A large reduction in the tax rate was the accomplishment of Niagara Falls, according to O. E. Carr.

The election of officers of the City Managers' Association for the ensuing year resulted as follows: President, O. E. Carr of Niagara Falls, N. Y.; vice-president, Kenneth B. Ward of Sandusky, Ohio; secretary-treasurer, W. L. Miller of St. Augustine, Fla. The next place of meeting was not decided upon, but it will probably be in some city of the Middle West.

To Introduce Bill for Improving Timber Land in Washington

A bill has been designed for consideration at the forthcoming session of the Washington state legislature, covering the development of logged-off or stump lands for agricultural operations. The measure is intended to make available extensive timber properties of the state which are now unworked because of the inability of the owners to finance the clearing. The proposed act provides for the establishment of agricultural-development districts, with limits to be co-extensive with the limits of the respective counties. These districts will be organized by the county commissioners upon the application of fifty or more landowners resident in the county, and will be under the jurisdiction of a commission composed of the county engineer, the county agriculturist and the county auditor.

This commission, or board, will have the power to acquire lands by purchase; to manufacture or purchase powder, caps, fuses and necessary land-clearing equipment, and to operate for the improvement of the land. It will also be empowered to sell powder, caps and fuses to any landowner to an amount not to exceed $1,000, and to lease the land-clearing equipment; to borrow funds and issue bonds to an amount of $250,000 outstanding at one time and to raise revenue by levying an annual tax not exceeding one-fourth of a mill, as well as employ any necessary labor. To carry out the provisions of the act, agricultural development bonds are to be issued, payable not later than two years after date and bearing annual interest not in excess of 6 per cent. The bonds will be considered as preferential investment for the permanent school fund and for all state, county, municipal or other public funds.

Hole Through First of New Subway Tunnels Under East River

The first of the new subway tunnels under the East River in New York City was holed through on the morning of Nov. 28, the final shot being fired from the Brooklyn side. The tube, which met in rock, is one of the pair which cross from Old Slip, Manhattan, to Clark Street, Brooklyn, and which will be operated in connection with the Seventh Avenue line by the Interborough Rapid Transit Company.

The headings of the other tube of this pair are yet about 300 ft. apart. The headings of the second pair of tunnels at this point, which are being built by the same contractor, the Flinn-O'Rourke Company, Inc., from Broad Street, Manhattan, to Montague Street, Brooklyn, and will be operated in connection with the new Broadway line by the Brooklyn Rapid Transit Company, are still some distance apart. Work on them has been delayed by blasting in the channel recently undertaken by the War Department.

In addition to these tunnels the new dual rapid transit system provides for double-track crossings under the East River at Fourteenth Street and at Sixtieth Street, work on both of which is under way. All of these tunnels are in charge of Clifford M. Holland, division engineer for the Public Service Commission, under the direction of Robert Ridgway, chief engineer of subway construction.

City-Planning Engineer Recommended by Milwaukee Council

The first step toward definite city planning, which would set aside certain sections of Milwaukee for residence purposes and others for business and factory sites, was taken at a recent meeting of the council finance committee. It was recommended that the Bogk ordinance to engage a city-planning engineer at a salary of $2,500 per year be passed.

The committee also recommended the adoption of the Bogk resolution to set aside the sum of $18,000 in the 1917 budget as the city's share for rebuilding the floor of the auditorium. The floor rests upon the ground which has been sinking ever since the building was erected. The floor is from 12 to 16 in. out of level. The present rebuilding plans contemplate the removal of the ground underneath the floor and supporting it by piles. This plan would give a firmer support and considerably more exhibition space in the basement. The entire work will cost approximately $36,000.

Consideration was deferred for two weeks on the Bohn and Bulder resolutions to set aside $50,000 and $15,000 for bathing facilities in some of the inland parks.

Property Owners Not Liable for Street Improvement

The Superior Court of Pennsylvania recently handed down an important decision in favor of property owners on Market Street, Pottsville. The court rules that the city cannot collect from owners the cost of installing a second paving on that thoroughfare. The street was improved with wood block pavement, and an assessment of $50,000 made against the property owners to cover the cost of the work. The court says that as this street was macadamized before being paved with wood blocks such must be considered an original paving. The city therefore cannot collect from the property owners the cost of a second paving. This decision affects every third-class city in the state.

Appreciation of Civil Service Examiner

At a recent meeting of the New Jersey Civil Service Commission it was resolved "that this commission express to James H. MacDonald of New Haven, Conn., its gratification on the able and efficient methods employed by him in the recent examination for road inspectors, and its belief that this examination and the one previously conducted by him have set a standard which will greatly aid in an efficient and thorough plan of road inspection in the state of New Jersey."

Stevens Dedicates New Gymnasium

Stevens Institute of Technology recently dedicated its new gymnasium, which was erected at a cost of $125,000. The structure, thought to be the first of its kind to be built elliptical in plan, is the gift of William Hall Walker of New York City.

University of Illinois Will Dedicate New Building December 6 and 7

Formal dedication of the new $250,000 ceramic engineering building of the University of Illinois will take place next Wednesday and Thursday. The list of speakers at the celebration includes Governor Dunn, W. L. Abbott, president of the board of trustees, and S. W. Stratton, director of the U. S. Bureau of Standards. The three-story structure is 67 x 189 ft. in plan, and was made of materials representative of the ceramic arts. Its laboratories are equipped with the latest types of apparatus. Ceramic materials, their development and their uses in highway and structural work, will be the subject of most of the addresses. The formal dedication will take place Dec. 7.

NEW CERAMIC ENGINEERING BUILDING OF UNIVERSITY OF ILLINOIS, WHICH COST $250,000, WILL BE DEDICATED NEXT WEDNESDAY AND THURSDAY

Sanitary District of Chicago to Build Activated-Sludge Plant

Activated-sludge treatment of the sewage of the villages along the Des Plaines River is in the definite program decided upon Nov. 23 by the trustees of the Sanitary District of Chicago. For the 22-square mile area tributary to the Thirty-ninth Street pumping station on the lakefront, settling basins or activated-sludge treatment is recommended. A narrow strip of land along the lakefront is to be acquired for such works. This project is to prevent deposits from being precipitated in the stockyards slip and Bubbly Creek. Likewise, to prevent deposits in the Calumet-Sag channel, sewage originating in the Calumet region is to be treated by sedimentation or otherwise. Evanston's sewage, that from the north shore cities and from the area along the North Branch of the Chicago River, is to be treated. All of these plants are to abate local nuisances and are supplementary to the dilution method.

The definite order passed authorized the chief engineer, George M. Wisner, to prepare plans and specifications for these plants and to present them, with detailed estimates of cost, at an early date.

Engineering Society Activities

British Columbia Division of the Canadian Society of Civil Engineers will hold its annual meeting Dec. 9 in Victoria, B. C.

Engineers Club of St. Louis, at its meeting last Wednesday evening, was entertained with an illustrated description of the Chouteau Avenue viaduct being constructed in St. Louis to eliminate what has been the most dangerous grade crossing in that city since the completion of the Tower Grove viaduct. L. R. Bowen, C. W. Martin and W. R. Crecelius, of the bridge department of St. Louis, conducted the lecture.

Engineers' Society of Western Pennsylvania recently took a "personally conducted" tour, via moving pictures, through the Koppers byproduct coke and gas plant of the La Clede Gas Company, St. Louis. C. J. Ramsburg, vice-president of H. Koppers Company, explained the pictures at the meeting held in the Oliver Building, Pittsburgh.

Detroit Engineering Society met last night to hear John W. Batten, engineer of the Detroit Gas Company, discuss the manufacture and distribution of gas. At the Dec. 15 meeting L. W. Spring of the Crane Company will present a paper on the metallurgy and properties of common alloys.

Detroit Chemists will Dec. 21 hear R. Winthrop Pratt, consulting engineer, of Cleveland, and Dr. Hippolyte Greuner, professor of chemistry, Western Reserve University, discuss the proposed method of water purification at Cleveland. The meeting will be held in the Stevens Building, Detroit.

What Engineers and Contractors Are Doing

MANLEY OSGOOD, formerly city engineer of Ann Arbor, Mich., has opened consulting offices in that city in the First National Bank Building, as president of the Washtenaw Engineering Company.

R. E. MOHR, formerly engineer for F. J. Hughes & Company, architects and engineers, of Dayton, Ohio, has joined the forces of the Concrete Steel Construction Company, with office at Springfield, Ohio.

DR. RICHARD C. MACLAURIN, president of Massachusetts Institute of Technology, has been made a director of the Equitable Life Assurance Society, of New York.

ROBERT C. TERRELL, formerly commissioner of roads for Kentucky, is now a member of the faculty of the civil-engineering department of the University of Oklahoma. During his last term of office with Kentucky—1912 to 1916—the state-aid laws were enacted and about $6,455,000 was voted in bonds for the construction of state roads. After graduation from the State University of Kentucky in 1906 Mr. Terrell spent two years on the instruction staff of his alma mater. He was appointed commissioner of public roads for Kentucky in 1908 and reappointed in 1912.

ARTHUR F. SHUEY has resigned from the employ of the Cornell (Wis.) Wood Products Company to become assistant engineer of the Florida State Board of Health. He will report to George W. Simons, Jr., sanitary engineer of the board. Mr. Shuey is a 1916 graduate of Massachusetts Institute of Technology.

W. M. IMBRIE, JR., recently resigned as superintendent of the Chattanooga Chemical Company to become engineer in charge of construction for the Atlantic Pulp & Paper Company, Savannah, Ga.

LOUIS C. KELSEY, consulting engineer, of Portland, Ore., has opened a branch office in the Twin Falls Trust Building, Twin Falls, Idaho.

GEORGE T. GROVE has been transferred from the engineering department of the United Fuel Gas Company to the gasoline department, a recently created division devoted to the study of increasing the production of gasoline.

L. O. MARDEN has resigned as chief draftsman for Oklahoma City to take a similar position in the Highway Department of the State of Oklahoma. Mr. Marden is a graduate of Tufts College.

HARRY J. TURNER, in the service of the New York State Highway Department, has been appointed junior assistant engineer in the department of the state engineer and surveyor. He is at present located near Buffalo.

A. B. DEPUY, JR., assistant engineer for Remington & Vosbury, civil engineers, of Camden, N. J., has been made resident engineer for the firm on the construction of a sewerage system and disposal plant at Bay Head, N. J.

NICHOLAS P. MELNIKOFF, chief engineer of the cabinet of the Czar of Russia, is visiting the larger cities of the Pacific Coast and will soon be in the eastern business centers. He states that he came to America to collect data and to interest Americans in large investment opportunities in Russia, as well as to study industrial methods and plants in the United States.

WILLARD T. CHEVALIER, formerly with the Atlantic, Gulf & Pacific Company, has just been appointed sales manager of the James Hermiston Manufacturing Company, Inc., New York City (formerly the American Bitumastic Enamels Company). Mr. Chevalier studied engineering at the Pratt Institute, Cooper Union, and Polytechnic Institute of Brooklyn. In 1903 he went with Arbuckle Brothers, coffee merchants, where for a little more than two years he worked in the mechanical department. In 1905 he joined the engineering staff of the Consolidated Telegraph & Electrical Subway Company, New York City. Mr. Chevalier was with the New York Public Service Commission for about two and one-half years as assistant on subsurface structures. His next work was for the Atlantic, Gulf & Pacific Company, for one year on New York Barge Canal work and then on the development of Mill Basin, on Jamaica Bay, Long Island.

Civil Service Examinations

United States—Examinations will be made of eligibles to fill positions in the Navy Department as structural-steel draftsmen, salary $3.52 to $4 per day. Date not stated. Education, training and physical ability are subjects on which applicants will be rated. Examinations will be made Jan. 3, 1917, of applicants for laboratorian qualified in strength of materials, salary $3.04 per day, and Dec. 26 for petroleum economist, salary $1,800 to $2,500. Form 1312 should be filled in for the first two examinations, form 2118 for the last one.

Short-Wheel-Base Trenchers Have All Operations Reversible

In the four new sizes of short-wheel-base trenchers put on the market recently the machines have a reversible action on each operation of traction, digging and conveying. These machines cut a trench from 9 to 48 in. wide and from 6 to 18 ft. deep. Booms on the two larger machines are of the box-girder type, smaller in section at the end, as shown in the photograph. The smaller machines have trussed I-beam booms. Some of the new features claimed are bevel gears and worm drives with ball-bearing thrust joints, a spiral-spring cushion support for the front axle and an automobile type of steering mechanism.

The range in width of trench is obtained on the larger machines by using two sets of self-cleaning buckets and side cutters, the latter being placed on the digging chain in intermediate positions between the buckets. On the smaller machines two sets of buckets are used, the extra width being obtained by side cutters. The larger machines are equipped with steam or gas power and the smaller ones with Minneapolis Steel & Machinery Company gasoline engines using two-thirds kerosene and one-third gasoline. The machines are made by the Parsons Company, Newton, Iowa.

SHORT-WHEEL-BASE TRENCHER DIGS TRENCH 4 FEET WIDE AND 18 FEET DEEP

Steel Company Enlarges

The Midwest Forge & Steel Company, St. Louis, has purchased the Heller Forge Works and the Western Forge Company, which were founded 25 years ago. The Midwest company will continue to produce forged-steel balls, crusher plates and shafts, guard-rail clamps, dipper teeth and similar articles.

For Making Changes on Blueprints

A white water-color fluid used in ruling and lettering pens by means of which changes can be made on blueprints is offered by J. O. Johnston of Rochester, N. Y. "Snow White," as the fluid is known, can also be used in correcting black lines on white paper.

Heat Mixing Water in Salamander

A portable water heater for supplying a concrete or mortar mixer consists of a heavy galvanized-iron salamander in which is placed a coil of 100 ft. of 1-in. pipe. The fire is built on top of the bottom series of coils. Fifty cents' worth of coke will do a day's work, the maker states, which reports a test during an outside temperature of 10 deg. Fahr. in which the water was raised from 36 to 130 deg. Fahr. at the rate of 300 gal. per hour. To give added water or increased heat several heaters may be coupled up in series. The heaters are made by the Londelius & Sons Company, Chicago.

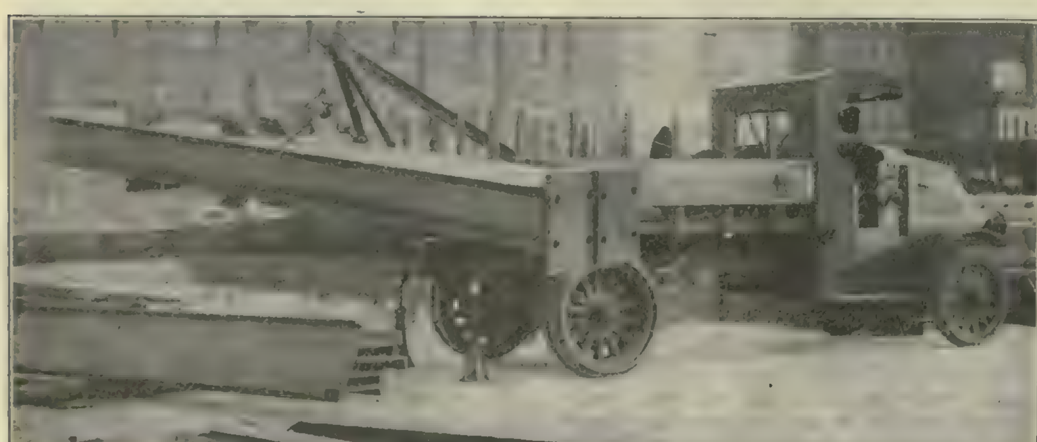
Five-Ton Bucket Holds 200 Cubic Feet

The 5-ton bucket shown in the picture is 15 ft. 3⅝ in. high, 4 ft. 9 in. wide, has a spread of 15 ft. 1¾ in. when open and holds 200 cu. ft. It was made by the Mead-Morrison Manufacturing Company, Boston, for handling ore. The firm is now building a 10-ton bucket which will be 19 ft. 3 in. high when open and 18 ft. high when closed. It will have a spread of 19 ft. 6 in. when open, and its width will be 6 ft. 6 in. The wire rope used on the 5-ton bucket is 1 in. in diameter.

New 3½-Ton Emergency Truck for Boston Fire Department

A 3½-ton Mack emergency and wrecking truck has just been installed by the Boston fire department. The machine is equipped with a power winch, 250 ft. of ⅝-in. cable, removable derrick, drawbar for towing purposes, jacks, skids and all sorts of wrecking apparatus and tools. The equipment can tear down walls, move freight cars in the event of a yard fire, replace derailed cars, pull out trucks stalled in public highways and remove all sorts of débris.

The use of this truck is not confined, it is said, to fire-department service. The construction is thought to make it a practical piece of machinery for the contractor, as the winch can be utilized for hoisting the truck's load to upper floors and for lowering or removing material to and from excavations.



TRUCK WITH ATTACHMENT WELL ADAPTED TO CONTRACTORS' NEEDS

Trade Publications

The following companies have recently issued trade literature:

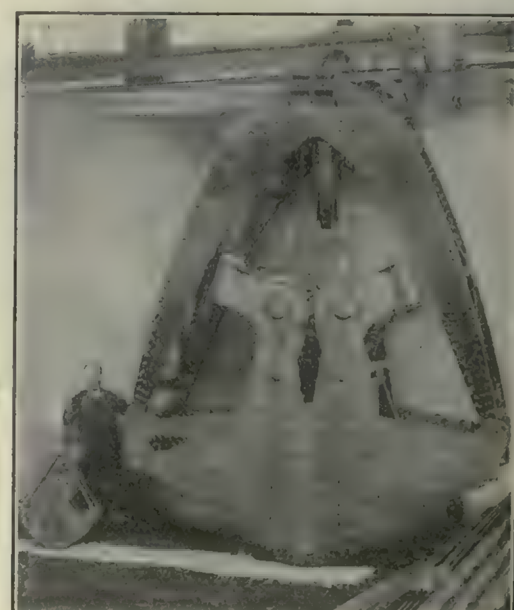
The Holt Manufacturing Company, Peoria, Ill. Circulars showing the Holt "caterpillar" in use on highways and on farms.

American Sheet & Tin Plate Company, Pittsburgh. Booklet, 8 x 11 in.; 20 pages; illustrated. Picturizes uses of "Apollo Best Bloom" and "Apollo-Keystone" copper steel galvanized sheets. Contains tables of standard sizes, showing weights per square foot, per sheet and per bundle, and number of sheets in one bundle.

Buffalo Municipal Equipment Company, Buffalo. Catalogue E. B. listing that company's compressed air hand sprinkler, combined trap and emergency outlet, portable pipe-line street flusher and other products.

Allis-Chalmers Manufacturing Company, Milwaukee. Bulletin 1810, 8 x 10½ in.; 12 pages; illustrated. Describes all-steel jaw crushers for reducing rock.

Wallace & Tiernan Company, Inc., New York. Booklet entitled "Protecting the Water Supply of Greater New York." Size 6¾ x 9¾; 24 pages; illustrated. Describes chlorine-control apparatus for purification of water supply.



200-CUBIC FOOT BUCKET FOR HANDLING ORE

Searchlight Company, Chicago. Booklet, 6 x 9 in., 32 pages. Information on welding and cutting of metals by oxyacetylene process, and equipment.

American Lava Company, Chattanooga, Tenn. Catalog 19, 6 x 9 in.; 24 pages. Describes and illustrates various styles of acetylene-gas tips and burners. Description in French, Spanish and English.

Stow Manufacturing Company, Binghamton, N. Y. Bulletin 100, 6 x 9 in.; 20 pages. Catalogs and illustrates electric motors. Also Bulletins 101 and 102, describing electrically driven drills, grinders and buffers and flexible shafts.

Clarage Fan Company, Kalamazoo, Mich. Folder, 6 x 9 in., 24 pages, illustrated. Describes multiblade fan for heating and ventilating installations.

National Transit Pump & Machine Company, Oil City, Pa. Bulletin 201, 6 x 9 in.; 20 pages; illustrated. Lists National Transit horizontal duplex piston power pumps.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

PUBLISHED BY MCGRAW PUBLISHING COMPANY INC.

Volume 74 NEW YORK, SATURDAY, DECEMBER 9, 1916 Number 24

A Report That Registered

SOME caustic things are being printed in the Chicago papers about a college professor's report on paving conditions. When an engineer with two trained eyes—trained as Prof. Ira O. Baker's have been for more than forty years—sees skimped pavements and broken specifications, his clear, concise, logical presentation of his observations is likely to make the impression intended. Lest the impression be given that Professor Baker's report, the recommendations of which are printed elsewhere in this issue, was simply the result of his three-day automobile trip around Chicago, it should be emphasized that what he portrays is the result of an exhaustive investigation, covering several months, by the technical staff of the finance committee, which is in reality the old efficiency division of the Civil Service Commission, with F. H. Cenfield as the staff engineer and James Miles as chief. Professor Baker is not given to taking anything for granted, so he checked up the work of the staff by personal examination, which convinced him of the "discrimination and trustworthiness of the observations of the staff." The whole report is illuminating reading for the citizen of Chicago as well as for paving engineers in other municipalities.

Thought Stimulants

"SOME of you probably thought that the last lecture, on 'Synthetic Resins,' would be a dry, technical, chemical paper. You may be interested to know that the attendance was 246, that the speaker made his subject intensely interesting to everyone present and that every man there must have gone home with a new realization of how closely scientific research and engineering are related and how interdependent they are. You cannot tell when a meeting may give you something you really need. The talks are purposely on widely different subjects to be as broadening as possible. More likely than not the paper you think may not interest you will be the one you should not have, on any account, missed."

These words taken from the bulletin of the Detroit Engineering Society bring home a truth that thoughtful men must frequently realize. Collateral subjects, even subjects entirely foreign to one's principal pursuit, often are thought-provoking. They shed light from different angles on our own specialty. Experiences in one line, having little direct relation to our own work, are seen to be applicable to our task. Principles that have been discovered in one field may be the touchstone that will convert our own failures into successes, that will point the way to a solution of a hitherto baffling problem. The Detroit Engineering Society is well advised in diversifying its program. Its members may thereby get little information that they can apply directly in their every-day work, but they will gain instead that which is far more important—a broad vision and a contact with the world at large.

If the Job Were Done Over

FAR TOO FEW are the confessions of engineers, in print at least, that if they had it to do over again they would build this or that differently. All the more commendable, therefore, is that paragraph headed "If the Job Were Done Over Again," in the article by Mr. Rands (page 700) on the Oregon City pipe line. Here Mr. Rands tells frankly wherein the plans would be changed if they could be—and by so doing he has perhaps saved other engineers from the same pitfalls. And these confessions do not condemn his work in any measure. Before laymen it may be best to be guarded in admissions that there was a chance for improvement, lest they be misconstrued as acknowledgment of incompetence. But we as engineers know that we must do pioneering, and that there is no stigma attached to failure to find the shortest and best route the first time. Any worth-while advance in the art must be worked out by a series of modifications of the first idea. There should be more engineers willing, like Mr. Rands, to tell the profession what better ways have been indicated by the experiences with their installations.

The Rejected First Plans

ALONG with more confessions of how the completed job could have been improved, the engineering profession could profit by more analyses of adopted plans, particularly of general plans of large projects. Frequently we read that the adopted plan was one of perhaps five considered. Occasionally we are allowed to know in a general way what was contemplated in the other four, and why the fifth was selected. More often we are not. Seldom are we given the benefit of a thorough analysis of all five. Yet if the first four were given extended engineering study are there not lessons to be learned from them? Might they not embody features that for another project, with different governing conditions, would be preferable to the corresponding details in the adopted plan? The Engineering Record is not putting forth a new idea in suggesting that there be more analyses of this sort published; but it desires to emphasize again the proneness of discussions of engineering structures to confine themselves to the designs and construction methods used, to the neglect of the efforts and problems of those who labored with the now despised forerunners of the adopted plans.

Trite but Still True

NEARLY every week brings an editorial wail from some newspaper about a deadly grade crossing and the greed of the soulless railroad in continuing it. Seldom, however, is there the slightest suggestion that the public should contribute to the expense of removing the danger. None of the more enlightened railroad managers will defend the grade crossing as a permanent institution. But they contend, as the Engineering Record has persistently contended, that grade crossings are joint affairs, that they were fully justified when the railroads were built, that the elimination of them now is costing and will cost a vast sum of money and that the public should in all fairness assume a share of the financial burden. The Engineering Record has pointed out how under the rational percentage basis of the New York law a comparatively satisfactory program of grade separation is being carried out, in spite of defects in the law and mistakes in its administration. Until the public and the press in less enlightened—less enlightened in this respect—sections of the country recognize their moral obligations in the matter of grade crossings they need not expect the railroads to do other than fight each grade-separation project to the last ditch.

Civil Engineers' Conventions

SOME TIME AGO it was proposed that the annual conventions of the American Society of Civil Engineers move from one district to the other according to a permanent schedule. Such a schedule having been reported to the board of direction at its meeting on Oct. 10, it was approved and the conventions are therefore set by districts up to and including the year 1928. Presumably, if the society is not redistricted by that time, the same schedule will prevail for another cycle. Incidental to the adoption of this routing for the annual conventions, the board considered the advisability of holding a second meeting annually outside of New York City. It will be remembered that such a second meeting has been frequently advocated and that one of that type, at New Orleans, proved to be very successful. The board is of the opinion that if such a meeting be given a distinctly technical character, the plan could be carried out without having a prejudicial effect on the attendance at other meetings. Moreover, if the preparation of a social program were not regarded as obligatory, no addi-

tional burden would be placed on the membership of the district. The board, therefore, adopted a schedule for this second meeting each year outside of New York City, leaving it optional with the designated district, however, to say whether this second meeting should be held. The board has taken an excellent step. It seems hardly likely that the districts will fail to avail themselves of the privilege of having within their boundaries such a second meeting, particularly when it is distinctly stated that the meeting is to be of a technical character and that the districts are not to consider the arrangement of a social program obligatory. One of the great needs of the society has been a closer contact between the members. Such contact would be promoted by the additional general meeting every year. New Orleans has already demonstrated that such a meeting can be carried through successfully. With the board's plain endorsement of the plan, it is hoped that the districts will do their part toward knitting the organization more closely together.

Definiteness in Specifications

THE fundamental qualifications of a good set of specifications were well stated by R. Fleming, of the American Bridge Company, in his article reviewing one thousand steel specifications in the issue of June 24, page 838, when he said that "a specification should be clear, consistent, complete and fair. Explanations of its meaning should not be necessary." In the article on page 708 of this issue Mr. Fleming presents specifications for steelwork of buildings which admirably illustrate the type of specification which he earlier described.

It was suggested in the editorial commenting on Mr. Fleming's previous article that the American Society of Civil Engineers, through a committee, should prepare an authoritative set of standard specifications for the steelwork of buildings. Mr. Fleming's proposed specifications would well serve as a basis for the work. There would probably be disagreement on certain clauses covering most questions. For example, the relatively high limit for the allowable slenderness ratio l/r might be questioned, and there would undoubtedly be debate over the clause allowing part of the area of a column to be disregarded in the computation of the radius of gyration, provided the area is considered not to carry load. This virtually amounts to an increase in the permissible length ratio.

Other vital points in which Mr. Fleming has endeavored to make general practice and the proposed specifications agree are found in the provisions for allowable stresses for countersunk and flattened rivets and the exception of webs of rolled sections from the ¼-in. minimum thickness clause. One noteworthy requirement is found, forbidding the use of rivets in tension, turned bolts being specified for all such cases. If this means that all brackets on the face of columns where some rivets are in tension must be bolted, there may well be raised the old question of the actual strength of rivets subjected to combined tension and shear. Indeed, it is hoped that this will be made the subject of extensive investigation. It is one of the weakest points in our knowledge of the behavior of structural frames, and a really comprehensive series of tests of riveted joints, in which the rivets are subjected to combined shearing and tensile stress, is needed.

Many other details are definitely fixed by Mr. Fleming's specifications. It is hoped that structural engineers will freely discuss them, to the end that our ideas may be crystallized on the general standards that make for safe, rapid and economical construction.

Technical Societies and Advertising

THE American Society of Mechanical Engineers has recently asked its members to express their attitude toward the publication of the book known as *Condensed Catalogs*. The volume is nothing more than a collection of advertisements and has as its sole reason for existence the revenue that results to the society. In other words, the American Society of Mechanical Engineers has gone into a commercial venture.

Originally *Condensed Catalogs* was an offshoot of the advertising carried in the *Journal*. Possibly it might have been called a sop, for it was used to get more advertising into the *Journal* by offering free space in the collection of advertisements in the catalog book. Now all pretense of a relationship between the two publications has been dropped.

The criticism that applies to the publication by the society of *Condensed Catalogs* applies also to the advertising carried in the *Journal*, though the catalog publication is the more flagrant case because of its absolute separation from the engineering papers of the society. The advertising in both publications, however, is a commercial activity and is as much out of harmony with the spirit that should actuate a great society as would be the selling of mechanical supplies or machine parts.

The excuse given for this activity is the revenue it yields for the support of the society's work. As the Engineering Record reads the latest financial statement of the organization, however, the income from advertising is not (at present at least) needed for the support of the society's work, but is purely a means of augmenting the surplus. The audit of books for the year ended Sept. 30, 1916, shows a revenue from advertising of $51,855.26 and an advertising cost of $26,703.23, leaving a net advertising income of $25,152.03. The statement also shows that income exceeded expenses in the same fiscal year by $24,118.41, which is within $1,000 of the net advertising revenue. Presumably this excess will be thrown into the surplus. The surplus and reserve accounts, by the way, now amount to $74,166.20, exclusive of the $24,118.41 excess income over expenses for the last fiscal year, above noted.

It is patent, then, that whatever excuse there may have been in the past, in the way of financial weakness and the need for revenue from sources other than the members, has now disappeared. Moreover, the advertising revenues have for some years been unnecessary in order that the society might meet its ordinary operating expenses.

The need of revenue is, of course, a poor excuse to plead for this means of raising funds. The end does not justify the means. However, since those who support the commercial activities of the society do so because of the revenue which it brings, the passing of the condition they desired to meet should be cited against them in their advocacy of a continuance of the practice. In any event, it was an unfortunate move. The engineering profession as a whole, we believe, will commend the society when it ceases its advertising activities.

The Fruits of Uncertainty

SIX weeks ago, when it was announced that Alfred Craven would retire on Nov. 1 as chief engineer of the Public Service Commission of the First District, New York, the Engineering Record asked editorially, "Does the commission intend to appoint to this post the man who is the logical candidate for it? If not, why not?"

To these questions, the commission has made no adequate answer, though one of its members has protested to this journal that the logical candidate was not passed over, but was given due consideration for the post before his subordinate was promoted over his head and made acting chief engineer. This commissioner believed that Mr. Ridgway's construction experience made him invaluable in his present position.

Meanwhile the uncertainty due to the failure to fill Mr. Craven's position by a permanent appointment is demoralizing the ranks. Competent men, in doubt as to the future, are speculating as to employment elsewhere instead of concentrating on their work.

One hears of this designer who is seeking a new position, of that section engineer who expects to be let out. The reorganization of one of the divisions has substantiated to some extent these rumors. Meanwhile contractors are growing impatient when their work is held up because of delays on the part of the commission's engineering staff in giving them lines and grades. Much of the work is reaching the final estimate stage. If there is to be any wholesale shake-up in the organization the important task of making up the final estimates will be placed in the hands of new men, instead of old employees.

Will not the commission hasten to explain its intentions? If it does not, and sees fit to postpone still longer the appointment of a permanent successor to Mr. Craven, the city's very important subway work is bound to suffer. Already certain newspapers are criticising the delay in the work. The present indefinite status certainly cannot help to rectify conditions. The best interests of the city of New York and of the engineering department of the Public Service Commission demand that the present uncertainty be quickly removed.

Engineers' Salaries and the High Cost of Living

INCREASES of wages are now of regular occurrence. The high cost of living has made an impression on employers throughout the country, and there is a widespread response, in industries which can stand additional wages, to the demand put on the purses of the employees.

As always in an era of high prices, the employers and the wage earners, generally speaking, are able to protect themselves. The one by increasing the price of his product is not only able to keep his margin of profit unimpaired, but is able, at the same time, to increase the compensation of those on a wage basis. We do not mean that the pay increases are always voluntary. They usually are granted because labor is organized or because it will flow to those establishments paying higher rates.

The increases, however, seldom apply to the salaried man. He is not organized. He does not readily shift from company to company. Consequently, there is no pressure upon those who hold the purse strings to take care of him. The engineer, by and large, comes in the salaried class and generally proves a sufferer under these conditions.

Realizing their condition, the engineering employees of the City of Chicago have just addressed to the Mayor and the City Council a dignified petition for salary increases. The document presents briefly the arguments for the increase. It sets forth that the present salaries were established in 1910 and that they are not materially different from that prevailing between 1897 and 1910. The compensation of the employees in the city's engineering service, therefore, has practically remained stationary for 20 years. In the meantime the cost of the necessities of life has increased approximately 50 per cent. The petition well says, "It is self-evident that if the salaries fixed in 1910 were fair at that time, they cannot be considered just compensation under present conditions."

But the employees advance a further argument, and that argument is based on the very solid ground that large increases have been granted the skilled and the common labor employed by the city. The average compensation of common labor has increased 220 per cent since 1897, of skilled labor 83 per cent and of foremen, 51½ per cent. When the actual figures are examined, the astonishing fact is brought out that the average salary in the lowest engineering grade is actually equal only to the *minimum* compensation of common labor. The average salary in the second engineering grade is equaled by the *minimum* wages of skilled labor, while the average foreman receives only slightly less than the average employee in the maximum engineering grade. In consequence, engineers in charge of work and responsible for its proper execution are frequently paid less than the foreman, and even less than some of the mechanics working under their direction. This naturally does not make for efficiency. Competent engineers will constantly seek to leave the service, while workmen, conscious that their superiors receive a lower compensation, are less amenable to the authority of those over them.

If the Mayor and City Council of Chicago will look at the subject from these two angles alone, we believe that they will agree to very substantial increases in the compensation of the city's engineering employees.

But there is a third reason, touched on also in the petition, which we believe deserves the very strongest emphasis. The engineering employees of the City of Chicago almost without exception do not do purely individualistic work. Whatever is intrusted to them goes far beyond the particular activities of the man in question. The designing engineer lays out structures whose cost runs into the thousands, and even into the hundreds of thousands, of dollars. The superintendent of construction works not by himself, but directs large expenditures in labor and in materials. Manifestly, men in these capacities must have superior judgment, must carry responsibilities far exceeding those of the average type of city employee. If the Chicago city officials will assent to the principle that men should be paid in accordance with the responsibility imposed upon them, there will be little further need for argument by the engineering employees of the city.

The petition is a dignified one. It presents only facts. It deserves, and we trust will receive, the careful and favorable consideration of the authorities to whom it is addressed.

Is Uniformity Possible in State Motor-Truck Legislation?

WITH New York State committed to legislation, effective Jan. 1, 1917, governing the weight, size and speed of motor trucks, and with other states, notably Pennsylvania, New Jersey, Maryland, Connecticut and Michigan, contemplating new or revised statutes along similar lines, it is clear that the control of motor-driven traffic on public highways is developing into a problem of more than local significance.

If this view is correct, it is time to consider a plan by which at least some degree of uniformity may be introduced into the forthcoming laws. Highway engineers have before them, as an example, the hodgepodge of road legislation developed by uncoordinated efforts of individual states. Is the same condition of disorder to be repeated in the case of motor-truck laws? Unless an attempt is made to standardize the regulatory measures for motor trucks we will have as many different sets of rules and regulations as there are states in the Union. To users and manufacturers of motor trucks, and to engineers who must build and maintain highways to carry the traffic of the future, this prospect is not encouraging. Motor-truck men have already expressed the fear that they may be legislated out of existence in certain localities.

Motor trucks doing interstate business may soon be governed by two or more independent, and possibly conflicting, sets of state requirements. A contractor with a fleet of trucks and trailers who has just finished a job in New Jersey may have his equipment ruled off the roads in New York State. He would have to purchase trucks and trailers of different design or alter the ones he has to make them conform to New York State requirements. In either case he would be saddled with an expense.

Motor-truck manufacturers are, naturally, opposed to any restrictions of the use of highways. Nevertheless, if such laws are inevitable, it is needless to point out to them the advantages of uniform statutes. Under them, manufacturers would be able to standardize their machines instead of making different types for each state. Uniform laws would result in lower truck production costs and, it is fair to assume, in a correspondingly reduced price to purchasers.

It may be argued that types of road vary in different states, and that in one locality the highways are capable of sustaining heavier loads than in others. This is undoubtedly true, but it is conceivable that a general code would take such factors into account. If merely the framework of a sane and reasonable code of regulations for motor trucks could be constructed, it would save a vast amount of needless work in states contemplating the enactment of such measures.

The general procedure preliminary to the passage of a motor-truck bill is first to appoint a commission to investigate the subject, then hold a number of hearings at which those interested may express their views. Finally, after many changes the regulations go to the legislature in the form of a bill. Why is it necessary to repeat this routine for every state that is to have a motor-truck law? Why cannot the work be done once and for all, in its principal features at least, by a committee representing national highway and motor-truck interests? If it be conceded that motor-truck legislation is coming—and every indication points that way—it is time for such organizations as the American Highway Association, the American Road Builders Association, the Motor Truck Club of America, the National Automobile Chamber of Commerce, the newly formed Association of Trailer Manufacturers, and other bodies, to inquire into the possibilities of co-operation in drafting what might be termed a model motor-truck law.

To be sure there is some degree of co-operation among states at present. New York, for example, has the benefit of the tentative set of rules and regulations proposed for New Jersey. Massachusetts, also, has contributed valuable information, but the co-operation has taken the form rather of finding out what the other states have done than of joining with them in reaching some degree of standardization in regulatory measures. Useful as this practice is, the full benefits will never be secured until efforts are centralized in a committee of national scope representing the builders of highways, the users of highways and the manufacturers of motor trucks and trailers and their accessories.

Bids Asked Before Bonds Were Voted to Show That Estimate Represented Real Cost of Pipe Line

Even Then $25,000 Was Refunded to the Water Department of Oregon City When Job Was Completed—High-Pressure Service Without Pumps or Elevated Tank—Cost $350,000

By H. A. RANDS
Of Rands & White, Civil and Hydraulic Engineers, Portland, Ore.

ONE OF THE ADVANTAGES afforded many of the cities of the Pacific Northwest is the possibility, through the proximity of the mountains and the protection afforded by the Forest Reserve, to secure an abundance of pure water at a nominal cost. Portland was the first to construct any considerable pipe line when in 1893 it brought in from the Cascade Mountains its now famous Bull Run supply. Seattle, shortly afterward, through a somewhat longer line, secured its supply from the Cedar River. Since then many smaller cities have followed the example of these larger ones. Probably the most notable of the projects undertaken by the smaller cities is that financed by Oregon City, Ore.

Source of Present Supply

The present source of the Oregon City water supply is the South Fork of the Clackamas River, a clear swift mountain stream having a catchment area of 27 square miles and a low water discharge, taken at the end of the 71-day record dry spell in the summer of 1914, of 13,500,000 gal. in 24 hours. At the intake the elevation is 820 ft., while the head of the stream is 5000 ft. above sea level. Samples of the water taken during the ordinary rainy weather of winter gave counts of 2 per cubic centimeter after 72 hours' incubation. The highest count so far obtained from the intake was near the end of the 71-day dry spell already mentioned, when a count of 25 per cubic centimeter was found.

To meet the arguments of those who contend that a project invariably costs from one and one-half to two times what the engineer estimates, the commission resorted to the rather novel expedient of calling for bids before the bond election. As a result thirteen bids were received, and the contract was tentatively awarded pending the result of the bond election. After the citizens had voted in favor of the project the contract was signed and both the commission and the low bidder lived up to their pre-election agreements.

PIPE LINE SHOWN ON COVER, AT EARLIER STAGE OF CONSTRUCTION

Bids were called for on machine-banded wood pipe, lap-welded steel pipe and riveted steel pipe. After opening the bids there occurred the usual controversy as to the best material. The wood pipe was cheapest. Riveted pipe was more expensive and lap-welded pipe the highest priced. The commission at one time voted to award the contract for riveted pipe. This was done despite the recommendation of the engineers, who contended that to build a line of the character and size of the one in question, having thousands of degrees of curvature, both horizontal and vertical, with inflexible riveted joints to be laid out and cut in advance, would be a long and tedious job. Later the vote was reconsidered and the job was awarded to the same bidder for Matheson pipe construction.

Several conditions affected the price at which the pipe was furnished, with the result that an extremely low figure was obtained. One of these reasons was the great calm which hung over the steel trade during the early months of the European war. Another was the fact that this line was being built almost within earshot of the whistles of the great wood-pipe factories of Oregon and Washington.

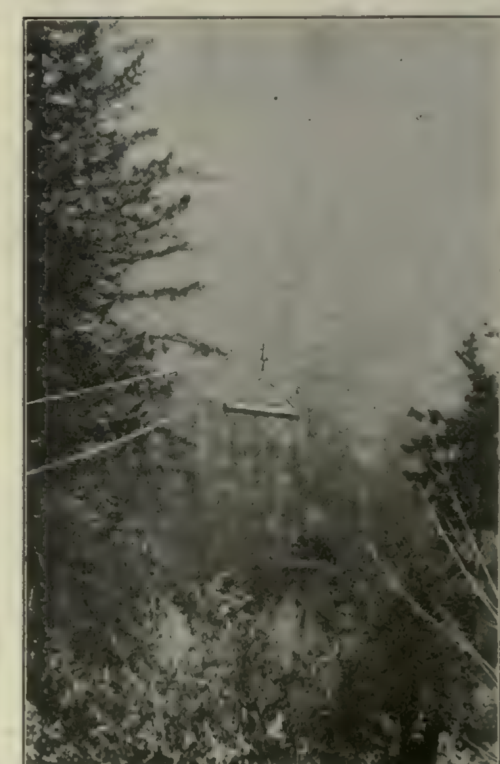
Description of Line

The pipe on the upper 13 miles has a diameter of 18 in.; on the lower $11\frac{1}{2}$ miles 16-in. pipe was used. The larger size has a thickness of 0.245 in. and the smaller 0.234 in. The preservative used was the usual dipped coating made by the National Tube Company. For 10 miles from the intake the line follows the gorge of the Clackamas River, where there was much rock work. Several tunnels, having an aggregate length of 1212 ft., were also necessary. Along much of this upper 10 miles the pipe had to be carried across the river from the road on the north bank by means of aerial lines and donkey engines. For this the huge trees were used for cableway towers, and they served the purpose admirably even when the span was as great as 1000 ft. To the credit of the contractor, it may be said that this difficult work was accomplished without a single accident to a workman and with the loss of only one length of pipe.

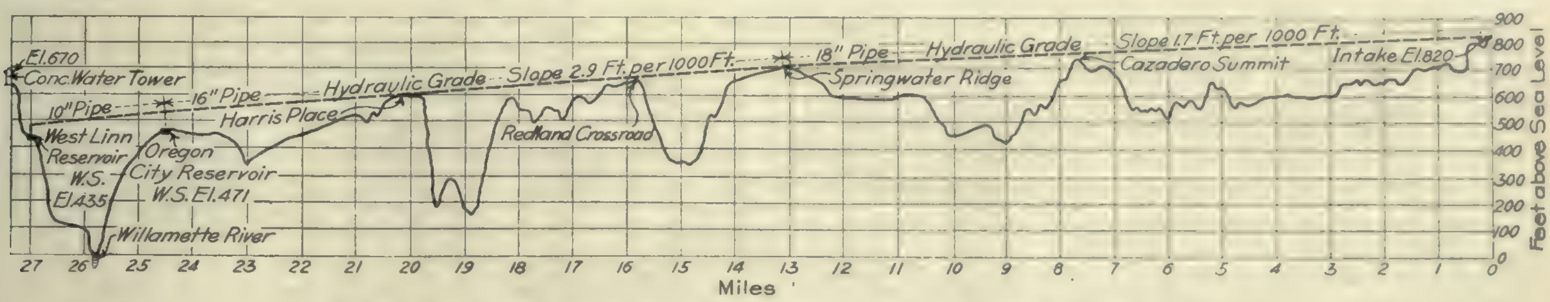
Four-inch blowoff valves are placed in all the principal depressions. These were set in double bell-end castings 13 in. in length, with the blowoff branch tangent to the bottom. In several places in sharp draws these blowoff branches were cast integral with the ells used to make the required vertical curve. To relieve the line of air in filling and to take care of any vacuum in the event of the breaking of the line, vent pipes were placed on the principal summits near the hydraulic grade. On the principal lower summits 2-in. Chabot air and vacuum valves are used for the same purpose. Several of these are twin set, and in one instance three are set in one battery. To relieve the line of any air which may accumulate during operation, a $\frac{3}{4}$-in. corporation cock is placed on every lesser summit. By carrying a piece of $\frac{1}{2}$-in. pipe 3 ft. long with a $\frac{3}{4}$-in. reducer on the lower end and an ell and nipple on the upper end to turn the stream to one side, the patrolman is able to open these corporation cocks easily, without getting wet. On a few summits air-relief valves of the lever-and-foot type were also used.

If the Job Were Done Over Again

At the end of every job there are always a few things which, if it was being done over again, would be handled differently. First among them would be the use of the National burlap coating in place of the dipped coating now on the pipe. Another change would be the exclusion of a few elbows used to negotiate sharp summits. Two of these lifted when the line was filled. They were taken out and the profile was revised to eliminate them. Two of the three still in use are anchored in rock; the third is heavily loaded. For negotiating sharp



TREES WERE USED WITH GREAT SUCCESS AS CABLEWAY TOWERS IN MOVING PIPE



PROFILE OF OREGON CITY PIPE LINE, SHOWING LOCATION OF RESERVOIR AND TANK

depressions elbows are desirable; on sharp summits they are likely to give trouble. Another change would be the elimination of several 16-in. gates put in the 18-in. pipe and several 14-in. gates in the 16-in. line. We have never had occasion to close these gates since filling the line, and except for convenience in testing they are of little use. The reason why this is so may be deduced from an examination of the profile.

The line as far as Harris Place, where the last gate is located, is made up of four great inverted siphons. Should any of these need repair the others will remain nearly full even when the water is shut off at the intake. In practice, too, it has been found that as much of the line is far below the hydraulic grade it is possible, when making repairs, to keep the water right behind the men by opening one or two blowoffs. When the repairs are completed the blowoff is closed and the water sent on its way.

No Pumps or Tanks Used

Oregon City has a high-pressure zone. Water is supplied to that district without resorting to pumps or to an elevated tank. By reference to the profile it will be seen that from the Springwater ridge to Harris Place the hydraulic grade has a drop of 2.9 ft. in 1000. From Harris Place west to the reservoir the drop amounts to 5.5 ft. in 1000. Instead of reducing the diameter of the pipe, and losing the head in friction, the 16-in. tube was continued to the reservoir, at the entrance to which was placed a regulating gate. By partly closing this gate the head on the high-pressure side is raised to the hydraulic gradient for a 16-in. pipe. This gives the high-pressure zone a minimum pressure of about 37 lb. To prevent subjecting the line to the full hydrostatic head (in the event of an inadvertent closing of the regulating gate), a concrete overflow basin with waste pipe has been placed in the line at Harris Place. The following paragraph explains how this holding up of the hydraulic grade makes it possible to serve the high-service zone in West Linn.

West Linn System

By the terms of an agreement entered into before the construction of the line was begun, West Linn, located directly across the Wilamette River from Oregon City, had purchased a one-third interest in the water-supply system. As that city had no distributing system, plans were prepared and a contract was let soon after work was begun on the main line. The West Linn distributing system was built by the same firm that had the contract for the larger job. Matheson double-wrapped National coated pipe of 4, 6, 8 and 10-in. sizes were used. West Linn, like Oregon City, has a high-pressure service zone. To supply it, the 2,500,000-gal. reservoir included in the system was so located that the water in discharging into it from the pipe line would turn a Pelton wheel geared to a triplex pump. This lifts the water for the high-service zone through a 1700-ft. pipe line to a reinforced concrete water tower 50 ft. high and of 14-ft. internal diameter, located on the highest point.

Actual construction was started April 12, 1915. The first water reached the reservoir Oct. 7 of the same year. Notwithstanding the fact that the bonds sold at $95.56, after all right-of-way, engineering and other charges were paid, $25,500 of the original bond issue was turned back to the water department. The rated capacity of the line is 3,000,000 gal. in 24 hours, although no capacity tests have been made. The entire distributing system cost about $65,000 and was completed in December, 1915.

The principal quantities, with unit and total prices, are given in the accompanying table.

COST OF OREGON CITY PIPE LINE

Item	Quantity		Unit price	Total price
Clearing right-of-way	43.54	acres	$200.00	$8,708.00
Solid rock (in trench)	4,380	cu. yd.	4.50	19,710.00
Solid rock (side cut)...	1,324	cu. yd.	1.50	1,986.00
Loose rock....	13,604	cu. yd.	1.00	13,604.00
Cement gravel.	5,392	cu. yd.	.75	4,044.00
Common gravel.	38,364	cu. yd.	.40	15,345.00
Tunnels (4 x 6 ft.).......	1,212	ft.	6.50	7,878.00
Matheson pipe:				
18-in. f. o. b. job	69,940	ft.	1.37½	96,167.50
16-in. f. o. b. job	61,797.5	ft.	1.17	72,303.10
18-in. distributing and laying ...	68,680	ft.	.40½	27,815.40
16-in. distributing and laying ...	60,680	ft.	.31	18,848.00
Cast-iron specials	21,810	lb.	.07	1,526.70
Miscellaneous				4,870.18
Extra work				3,115.53
Total				$295,921.41

Personnel

D. C. Henny and J. L. Stannard of Portland were consulted on the work. S. A. Cobb of Oregon City was the engineer for the West Linn system, the reinforced-concrete standpipe for which was designed by W. G. Kirchoffer of Madison, Wis. The Oregon Engineering & Construction Company, of Oregon City, had both contracts, and the writer was engineer for the main pipe line and consulting engineer for West Linn.

ABOUT 1200 FEET OF TUNNEL WAS NECESSARY IN THE FIRST 10 MILES FROM THE INTAKE

To Decolorize Tar Streaks in Concrete Road Crack Repairs

Studies are being made, according to the latest annual report of the Board of Wayne County (Mich.) Road Commissioners, to develop a preparation which will accomplish, in the repair of concrete road cracks, what Tarvia mixtures accomplish, yet which will have a color so nearly like that of concrete that repaired spots will not be noticeable. Present methods of repairing cracks necessarily draw attention to the location of the cracks because of the black streak left by the tar after the required maintenance work has been performed. This objection, according to the Wayne County report, does not come from road users or property owners, but from engineers, road builders, and salesmen.

New Reservoir to Be Built Inside Old One That Failed

Designs Completed for Reconstruction at Cleveland Filter Plant, Where Concrete Basin Roof Collapsed When Finished

UTILIZING as an outside form the filtered-water reservoir at Cleveland, Ohio, which partly collapsed last July just when it had been completed, a new reinforced-concrete basin will be built within the old one in accordance with designs upon which bids for construction were received this week. The work will involve about 14,000 cu. yd. of concrete, 760 tons of steel reinforcement and 10,000 cu. yd. of backfill.

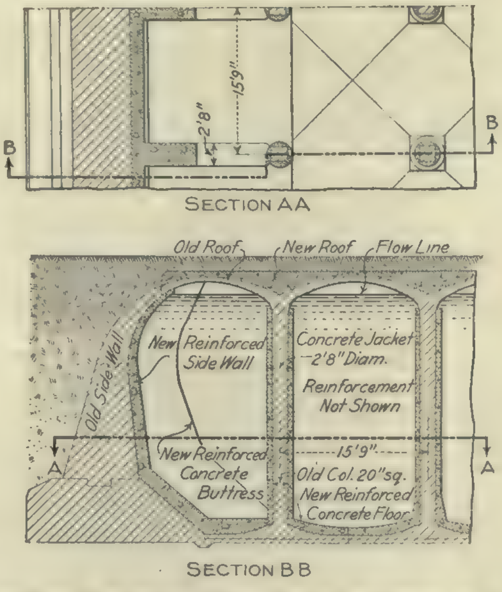
While this summer's accident, which was described in the Engineering Record of July 29, page 151, involved the failure of only four columns of the existing structure, together with the section of the groined arch vaulting which they supported, extensive investigations of the quality of the concrete in the remainder of the reservoir cast suspicion upon the entire structure and led to the conclusion that it was unfit for use. The alternatives therefore were (1) to demolish the damaged basin and replace it with a new one on the same site; (2) to choose a new site and build a new structure; (3) to construct a new reservoir inside of the old one. In the first case the cost of demolition would have been excessive and, in the second, no other site was available for the new structure. These considerations therefore led to the adoption of the third scheme, a new basin inside of the old one, as the most economical and practical one.

Old Walls as Forms

The original filtered-water reservoir has over-all dimensions of about 936 x 195 ft. and is about 28 ft. deep from floor to roof inside. It is separated into two sections by a concrete division wall. In the designs for the reconstruction, which were prepared by Nathan C. Johnson and Frederic C. Noble, both of New York City, acting as consulting engineers to the city of Cleveland, no reliance whatever was placed on the strength of the existing basin. The walls were considered merely as convenient outside forms against which the new concrete could be poured, while the columns were regarded as so much sand—material which, the designers point out, can be depended upon to carry loads if adequately confined. The repair scheme for the columns therefore involved the jacketing of those now standing with spiral steel reinforcement and enveloping the whole with a cylinder of concrete. The new column jacketing is carried up to the groined arch vaulting and extends above the old column heads. The original columns were square, measuring 1 ft. 8 in. on a side, while the jacket will convert them into cylinders 2 ft. 8 in. in diameter, except at the base, which will flare out to a diameter of 3 ft. 8 in.

Buttresses at Side Walls

The accompanying drawings, in which the reinforcement details are largely omitted, show the main features of the new work. The new side walls are reinforced in both directions and act as slabs supported by reinforced-concrete buttresses at 15-ft. 9-in. intervals (the spacing of columns center to center). These



THE OLD RESERVOIR WILL SERVE MERELY AS A FORM AGAINST WHICH TO PLACE THE NEW CONCRETE—OLD COLUMNS WILL BE JACKETED

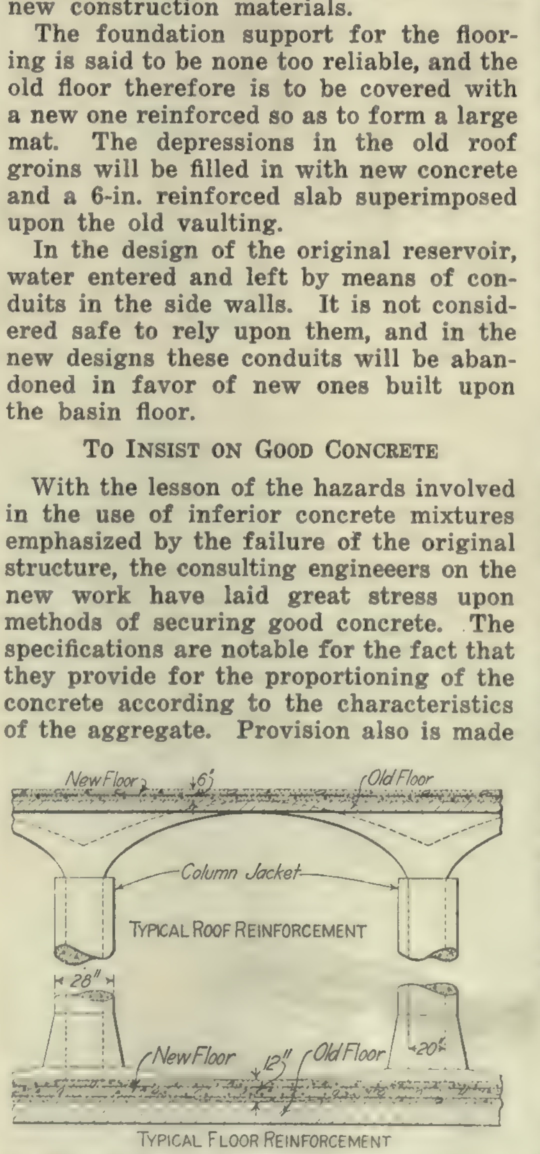
buttresses serve also to tie the flooring and roof together. Acting as beams, they transmit pressure on the side walls—either internal, due to a head of water, or external, due to earth pressure—to the roof and floor, which are both heavily reinforced. Thus, the type of construction resolves itself into a huge reinforced-concrete box, to be built within the present basin by piercing holes in the vaulting of the latter for the introduction of the new construction materials.

The foundation support for the flooring is said to be none too reliable, and the old floor therefore is to be covered with a new one reinforced so as to form a large mat. The depressions in the old roof groins will be filled in with new concrete and a 6-in. reinforced slab superimposed upon the old vaulting.

In the design of the original reservoir, water entered and left by means of conduits in the side walls. It is not considered safe to rely upon them, and in the new designs these conduits will be abandoned in favor of new ones built upon the basin floor.

To Insist on Good Concrete

With the lesson of the hazards involved in the use of inferior concrete mixtures emphasized by the failure of the original structure, the consulting engineeers on the new work have laid great stress upon methods of securing good concrete. The specifications are notable for the fact that they provide for the proportioning of the concrete according to the characteristics of the aggregate. Provision also is made



TYPICAL REINFORCEMENT OF NEW FLOOR ON TOP OF OLD AND NEW REINFORCED ROOF

to control the quantity of water going into the mixture, so as to prevent over-wet concrete. The consulting engineers took steps to have the proper amount of cement introduced into the mixtures by providing, in the bids, that cement be paid for as a separate item. Thus there would be no inducement for the contractor to skimp on the amount of cement going into his mixers.

To Test Old Concrete

An aftermath of the failure of last July is an extensive investigation of the quality of concrete in the old filtered-water reservoir, supplementing examinations already made. This investigation, which is being conducted by Nathan C. Johnson, consulting engineer, of New York, involves the taking of about 2 miles of 6-in. cores from the old concrete to serve as a basis for a thorough study of its quality. The cores, taken by means of a shot drill, are to be used to verify the conclusions of the examining engineers.

Avers Chicago Can Improve Its Paving Methods

Professor Ira O. Baker Recommends Better Specifications and Inspections—Suggests School for Inspectors

ASIDE from the sensational charges of skimping on materials, depths of foundations and inefficient inspection in the paving of Chicago streets by the Board of Local Improvements, Prof. Ira O. Baker in his report to the finance committee of the city council makes several recommendations that are applicable to many other cities. These recommendations were written following (1) a three-day inspection of paving and asphalt plants, (2) a study of current specifications, (3) a half-day discussion with the chief engineer, and (4) an examination of an analysis made by the staff of the finance committee.

To Improve Specifications

As to specifications, Professor Baker suggests that they be changed so as to secure clear language, logical arrangement and good typographical form. Unless these conditions are fulfilled the specifications do not make the intended impression on either the contractor or inspector. They should have no deadwood—only those requirements which it is intended to enforce. The requirements should be definite enough to secure good work. It should be seen that the clauses governing the business relations of the parties are clear and defined, and that they properly safeguard the interested parties. Particular attention should be paid to the technical clauses, to the end that the resulting work may be in accordance with the best state of the art. Too dry concrete and few real expansion joints were found in curb and gutters. Concrete base for asphalt was found left sleek instead of rough, and the thickness was skimped to an estimated extent of $200,000 on the season's work.

Establish Inspectors' School

To improve the inspection, which he found lax in many cases, he makes the following suggestions: Prepare clear and comprehensive instructions to the inspectors. Establish a school for the instruction

of inspectors to teach them the technical points necessary for the discharge of their duties. Establish a system of checks and inspection to determine whether the inspectors are doing their duty and are observing the requirements of the specifications. It would probably be wise, he said, to provide the inspection engineers with automobiles in order that they may appear at unexpected times in widely different parts of their territory. Provide some system of penalties for lax inspection.

WHAT SHALL BE FUTURE POLICY?

As to the future policy to be settled, the following questions were asked: Should the Board of Local Improvements buy hydraulic cement and furnish it to the contractor? Is it wise to reduce the number of brands of asphalt that may be used? Should the board buy asphalt and furnish it to the contractor? Should the contractors' guarantee be eliminated? Should not cement filler be substituted for the pitch filler now used in brick pavements, and also in granite block pavements?

The advisability, Professor Baker said, of having the inspector present during the preparation of the subgrade should be considered. Closer co-ordination should be established between the Board of Local Improvements and the Bureau of Streets in the Department of Public Works. The Bureau of Streets might otherwise continue to repair streets when it is cheaper to lay a new one. Closer co-operation would also give to the Board of Local Improvements a knowledge of the cost of maintaining and cleaning which would be of inestimable value in determining the relative economy of the different forms of construction.

KEEP INSPECTORS BUSY ALL YEAR

Investigations by the board's corps of inspectors during the period when construction is not in progress is one of the constructive recommendations. So much work, 150 to 200 miles per year, is done that any small improvement would result in a greater saving than the cost of the investigation. It is suggested that the following matters are proper subjects: The proper proportions in concrete; tests of sand in concrete (cement is now tested, but the variation in strength due to the sand may be sixteen times as great as the variation in the cement); elaboration of field tests; census of travel to determine proper types of pavement to use on certain streets; a thorough study of the cost of maintenance and of cleaning of different types of pavements under traffic of different amounts and character. Of prime importance, he thinks, is the effect of motor traffic on street pavements, and the board should know whether certain types of pavements will be adequate to meet such motor traffic as is likely to come on the through-traffic streets in the future.

With reference to the personnel of the inspectors, the report indicates that out of 114 inspectors employed, 66 were civil-service men and 48 were appointed on temporary authority. Professor Baker is of the opinion that all these men should be technically trained, but the records indicate that they are from all walks of life. He would reorganize the department so that these inspectors could work up through and become division engineers. He would abolish the position of general inspector and substitute that of junior engineer with technical training.

Byproduct Coke Ovens on Jersey Meadows Built Inside Temporary Steel Sheds

Large Quantity of Materials Handled Over Soft Ground—Work Developed So as to Keep Two Concrete Plants Busy—75-Foot Tower Mounted on Flat Car

ON GROUND so soft that it is difficult to maintain construction tracks, a two-and-a-half-million-dollar byproduct coke plant is being built at a rapid rate on the meadows west of the Hackensack River and north of the Lackawanna Railroad. Begun May 1, this plant is expected to produce coke early in 1917. About 20,000 round piles 45 to 70 ft. long are required to support the various structures, and the 110 coke ovens will contain approximately 320,000 cu. ft. of brick work. The construction work has been planned so that concrete materials were received by water and piling and other construction materials by rail, so that most of the concrete work could be carried on without interfering with the distribution of piles, brick and other materials over the construction tracks. Steel concrete towers 75 ft. high have been mounted on flat cars and moved, without accident, over soft track. For the construction of the ovens themselves silica brick, which are easily injured by the weather, are used and steel-frame sheds the size of mill buildings are employed to inclose the two batteries of ovens during construction.

COKE PRODUCTION FIRST CONSIDERATION

The first consideration governing the planning of the construction work was the production of coke at the earliest possible date. The entire plant is founded on piles in the soft mud underlying the meadows, and it is planned to fill in the entire site with 10 or 12 ft. of cinders. Therefore very heavy cellular concrete footings surmounting the piles were required to bring the floor level of the structure up to the proper grade. The concrete below final ground level under the brick ovens alone amounts to 15 000 yd., and 8000 yd. is required under the byproduct building. This building, the second largest piece of construction, was the second undertaken, and the third unit on which work was begun was the boiler house, requiring about 5000 yd. of concrete. The quenching track, purifiers and coal and coke handling apparatus were undertaken next, and the benzol plant, which is not essential to the early operation of the plant, will be constructed last.

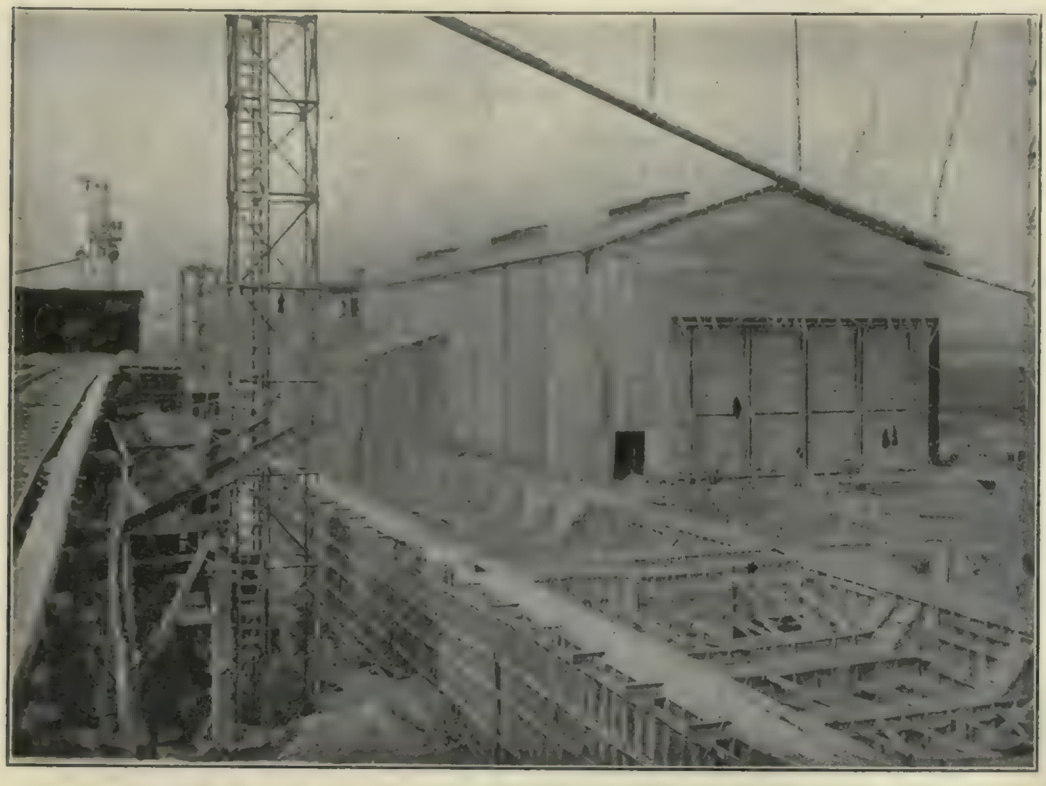
The pile driving proceeds very rapidly, the majority of the 20,000 piles required having been placed by five drivers this summer. The rigs are operated by drop hammers, with which quite as rapid driving can be done in the soft mud as with steam hammers. The drivers were handled on skids over the meadow, and on this account the piles had to be driven before any excavation could be made. It was at first thought that cofferdamming would be required for the footing excavations around the top of the piles to exclude water and prevent caving of the soil. The mud, however, filled with grass roots at the surface, proved almost impervious and stood with a vertical face. No trouble was experienced in excavating the 4 or 5 ft. required and in cutting off the piles, and very little pumping was necessary. The dirt was disposed of by dumping it near the sides of the excavations, where it will become part of the permanent filling of the site.

LOOKING TOWARD RIVER—COKE OVENS IN CENTER, BYPRODUCT BUILDING AT RIGHT

Construction siding shown makes loop around far end of ovens, returning on left side. It is used to deliver all materials except concrete aggregate, which is received by water at point marked by pile driver to the left of locomotive crane.

TRACKS LAID ON SOFT GROUND

At the beginning of the work a siding was laid out on the north side of the Lackawanna Railroad, which passes through a material and storage yard to the site of the plant, where it forks, one branch going to the north side of the ovens and the other passing between the south side of the ovens and the byproducts building and power plant. Three or 4 ft. of cinders brought in over the railroad had to be dumped along this entire line before anything like a solid foundation could be secured for the track. The brick have been stored near the buildings for which they are required, so that rehandling them by rail is not necessary. The piling has generally been distributed to the drivers in the cars in which it was received. The structural steel, however, together with the tanks, piping and such



STEEL-FRAME SHEDS 40 FEET HIGH SHELTER BRICK OVENS DURING CONSTRUCTION

Main concrete plant at left, track foundation for machine that unloads ovens in foreground. Shed covers west battery of ovens, the other battery being to right of view, with foundation for coal bins shown between.

of the mechanical equipment as has been received, has been unloaded in the yard and will be rehandled to place on work cars. One 55-ton locomotive and two dinkeys take care of the switching, except for that necessary to supply the track mixing plant with aggregate, which is done by one of the locomotive cranes.

MAIN MIXING PLANT SUPPLIED BY WATER

A stationary tower at the foot of which is the main mixing plant was erected near the middle of the south side of the foundation for the ovens. Opposite it on the north side of the ovens was located a tail tower. The plant at the foot of the first tower consisted of a ¾-yd. mixer erected under material bins which were supplied by cars running on an overhead trestle to the material dock on the Hackensack River. These cars could also be tripped to unload at any point along the trestle, the space underneath which was reserved for storage. The cars were loaded from a hopper located over the track at the dock, this hopper being fed by derrick direct from the barges. The material in the storage piles is rehandled by being loaded into gondola cars with one of the cranes and from these cars conveyed to the desired point in the same way.

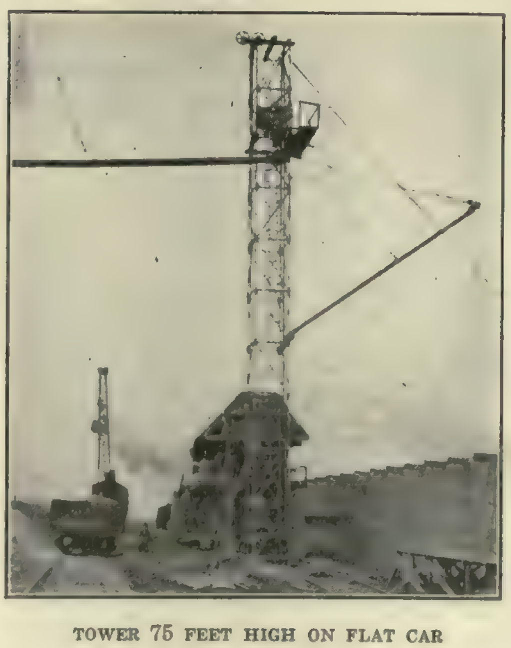
This plant was used to concrete the cellular foundation for the ovens and also that for the boiler house and purifiers. When the latter is completed, it will be taken down and mounted on a flat car.

75-FOOT TOWER MOUNTED ON FLAT CAR

The track plant, which is used to concrete the foundation for the byproduct building, consists of a 75-ft. steel tower mounted on a standard flat car. The tower extends nearly to the track, and is hung in front of the car. On the car over the mixer are small bins, which are supplied by a locomotive crane. A cement car is coupled behind the mixer car in use, and a belt conveyor hung at the side of the latter is used to transfer cement from the door of the box car to the charging platform. This conveyor, made on the job, consists of two chains between the links of which are fastened crosswise narrow pieces of plank about 2 ft. long. The chains run over sprockets, and the belt is driven by a small motor at the end nearest the mixer.

The tower is of course guyed when in use. The rig has been moved successfully a number of times, however, without the use of any guys, by emptying the bins and lashing to the tower the boom of the locomotive crane, which does the switching, to keep the tower from swaying. This plant, like the stationary one, is provided with a ¾-yd. mixer. All the concrete equipment is of Lakewood manufacture. The plant mounted on the flat car has made a maximum run of 406 yd. in 12 hours, while the stationary plant has placed 360 yd. in 10 hours.

The forms are of wood, and as the concrete work is all low, the exterior forms are braced directly to the ground. The interior forms are secured with the Universal clamps. The carpenter shop, equipped with power saws, is located, with the machine and blacksmith shops, at the southwest corner of the work. All the equipment is run electrically except the cranes and locomotives. Power is received from the New Jersey Public Service Corporation at 2200 volts alternating current, transformed by a Westinghouse motor-generator set to direct current at 220 volts and distributed over the job in insulated cables laid along the surface of the ground.



TOWER 75 FEET HIGH ON FLAT CAR

STEEL SHEDS FOR BRICKWORK

The silica brick used in building the ovens must be protected from the weather during laying, and for this purpose steel-frame sheds are used. Being 40 x 200 ft. and about 40 ft. high, these sheds are of unusual size for temporary structures. Accommodating in width a standard oven of 12¼ tons capacity, the sheds may be built to any length by joining on additional bays. They were built with the intention of using them repeatedly on successive contracts.

The silica brick are laid in mortar made with hydrated lime. About 120 bricklayers are required in building the ovens and carrying on the brickwork for the other buildings, which are steel frame above the foundation. The erection of this steelwork was begun on Oct. 1.

The plant is being constructed for the Seaboard Byproduct Coke Company by the H. Koppers Company of Pittsburgh, for whom T. S. Fillebrown, erecting engineer, is in charge at the work. The Linde & Griffith Company is contractor for the pile driving, while the steelwork is furnished and erected by the McClintic-Marshall Company.

How to Get Best Results with Tile Drainage

W. C. Curd of Missouri Pacific Gives Conclusions from Experiences of Six Years—Not a Panacea for All Wet Cuts

WHEN and how to use vitrified tile in the drainage of railroad subgrades is discussed by W. C. Curd, drainage engineer of the Missouri Pacific Railway, in a recent *Bulletin* of the American Railway Engineering Association. From 1905 to 1911 tile was applied at 714 locations to remedy water pockets or wet cuts. Eleven per cent were reported as failing to give benefits because the tile was either insufficiently deep or not placed in the proper location. On this account and to determine the value of tile drainage for roadbed an investigation was made. The investigation showed a remarkable benefit, states Mr. Curd, where the drains had been properly installed. He estimates a return of from 50 to 200 per cent per year in decreased cost of maintaining line and surface.

His conclusions as to how to secure the greatest permanency and benefit with tile drains are substantially as follows:

LAYING THE DRAINS

Drains should be laid with bell-end vitrified salt-glazed sewer pipe of a minimum diameter of 6 in., with unsealed joints. The top of the tile should be placed 1 ft. below frost line and a minimum distance of 1 ft. below unstable or moving material. The depth in each case should be carefully determined by test holes or by inspecting the excavation.

The tile should be laid to a grade established by level and with all the fall obtain-

able. The location of the center line of the tile should be parallel to and from 4 ft. 6 in. to 7 ft. from the center line of the track. The tile should be placed directly on the bottom of the trench. After it is laid to line and grade, and before backfilling, it should be covered with straw, grass or some such material to prevent loose particles in backfilling from entering the joints.

The trenches should be backfilled with cinders, with coarse material placed directly around and over the tile. Where the walls of the trench show signs of distortion from passing loads, a sufficient quantity of riprap or coarse stone should be mixed with the cinders to brace the walls.

LATERALS AND OUTLETS

Pockets under the track should be tapped with cinder-filled lateral trenches, and connected into the tile drain trench, but without connection with the tile drain except through the unsealed joints.

All surface water should be removed from cuts by intercepting and side ditches, otherwise the tile drain may be overtaxed and eventually fail entirely.

After the drains have been installed it is essential to maintain free outlets to prevent water backing into the tile. The ends of the drains should be surrounded and supported by concrete or dry masonry to guard against underwash. To prevent small animals from entering the tile the outlet should be protected by rods or grating.

CAUSES OF FAILURE

Failures of drains come from the following causes: Insufficient depth below moving material; shifting grade or alignment, causing joints to open; insufficient grade to provide proper flow; location of drain in impervious material without providing adequate means for tapping saturated material with lateral drains or cross-trenches, or distortion of walls of trenches.

Tile drainage, concludes Mr. Curd, is not a panacea for all wet cuts and its use is not recommended without a complete knowledge of the conditions to be corrected. When these are known and proper methods of installation are applied, much benefit is reasonably sure to follow.

Scarcity of Pebbles Forces Concrete-Road Change

Owing to inability to secure sufficient quantities of pebbles up to the quality of its specifications, the Board of County Road Commissioners of Wayne County, Michigan, according to its annual report for 1915-16, has been forced to revert to the former two-course specifications, using either pebbles or a local stone for the base and traprock or Wisconsin granite for the wearing surface. In building a two-course road the Wayne County method has been to make the lower course of a 1:2:4 mix, with a 3-in. traprock or granite wearing surface of a 1:1½:2½ mix. As traprock and granite cost about $1.35 a ton more than pebbles, and as there is an extra labor charge in handling two-course work, the Wayne County engineers report an additional factor in rising costs. It is believed, however, that over a long period of time the increased quality of the work due to the better quality of the wearing surface through using a harder, tougher and more uniform stone will offset the increased cost of the road by adding materially to its life and usefulness.

Settlers with Small Farms Most Successful on United States Reclamation Projects

Secretary Lane Gives Increases in Areas Irrigated, Value of Crops and Number of Homes—Settlers' Success Depends on Cost of Capital

IN his annual report made public Dec. 7 Franklin K. Lane, Secretary of the Interior, summarizes the activities of the Reclamation Service for the fiscal year ended June 30, 1916. Increases in areas irrigated and cropped, and in crop values, as well as the difficulties confronting the settlers, are pointed out. In discussing the latter subject, lack of sufficient capital and its effect on the welfare of the settler are given a prominent place. The following paragraphs and tables are taken from the report.

During the last year the operation of the reclamation laws has continued to advance their objects, as shown by the increases in the area for which the service could supply water, in the areas actually irrigated and cropped, in the value of crops produced and the increase in the actual number of settlers and of homes. The progressive increase in these elements is shown in Table 1.

In summarizing the construction results accomplished during the year, increases of 230,349 acres to which the Reclamation Service was prepared to supply water, 81,328 acres for which water rights are under contract and 138,479 acres in rental contracts are mentioned. Reservoir capacity has been increased from 6,500,360 to 9,035,160 acre-feet—a gain of 2,534,800 acre-feet during the year.

DIFFICULTIES OF THE SETTLERS

Practically every annual report of the Reclamation Service has stated that the principal difficulty with which the average settler has to contend is the lack of sufficient capital. In some cases the settler may originally have had considerable capital, but his lack of experience, or other misfortune, has operated to his disadvantage until his funds have been practically exhausted. After he has acquired the necessary experience he is often unable to recover his standing for the lack of the necessary funds.

This lack of capital is felt more acutely as the area acquired or under attempted cultivation increases. The instances of success with small capital, especially in the case of inexperienced settlers, are confined almost entirely to small holdings of 40 acres or less, and perhaps no one circumstance has operated so strongly to handicap settlers in making a success upon government projects as the attempt to hold and improve too much land.

The Huntley project in Montana is conspicuously successful so far as individual prosperity is concerned. This project was handicapped by the cold climate, the usual drawbacks of refractory soil, and the characteristic desert difficulties; but it was

TABLE 1—RESULTS OF RECLAMATION, EXCLUSIVE OF INDIAN PROJECTS BUILT FOR INDIAN SERVICE

Year	Irrigable acreage*	Irrigated acreage	Irrigated farms	Cropped acreage	Crop value
1909..	730,000	382,000	9,000	....	....
1910..	880,000	475,000	12,000	415,000	$12,500,000
1911..	1,015,000	560,000	14,000	470,000	13,000,000
1912..	1,160,000	645,000	15,000	590,000	14,500,000
1913..	1,200,000	700,000	16,000	650,000	16,000,000
1914..	1,250,000	770,000	18,000	700,000	16,500,000
1915..	1,500,000	857,000	20,000	800,000	19,000,000

*Area Reclamation Service was prepared to supply water

opened under a special law which gave the secretary wide discretion, and policies were adopted which could not be applied to other projects owng to legal requirements. The size of the farm unit was in general made 40 acres. Settlers were not permitted upon the land until the water was ready for delivery, and when settlement was invited each settler was obliged to pay $1 per acre to the Indian tribe as partial payment for the land and also 10 per cent of the water charge at time of entry.

These substantial payments eliminated

TABLE 2—IRRIGATION AND CROP RESULTS ON GOVERNMENT PROJECTS, 1915*

Project	Irrigable acreage	Irrigated acreage	Cropped acreage	Value of crops: Total	Value of crops: Per acre cropped
Salt River	219,691	179,350	171,832	$3,661,769	$21.31
Yuma	72,440	27,857	25,101	873,721	34.81
Orland	20,320	8,928	6,930	220,422	31.81
Uncompahgre Valley	65,000	41,463	40,553	1,044,915	25.76
Boise	150,000	76,705	69,818	1,526,873	21.87
Minidoka	120,000	83,562	77,008	1,725,515	22.41
Huntley	30,813	18,203	18,185	535,363	29.41
Milk River	22,200	4,192	3,887	51,249	13.18
Sun River	16,326	4,261	4,243	†80,000	†19.00
Lower Yellowstone	42,329	12,656	11,990	194,011	16.18
North Platte	129,714	70,007	68,130	1,263,617	18.55
Truckee-Carson	65,000	40,295	38,495	592,523	15.39
Carlsbad	24,796	13,470	11,322	245,684	21.70
Hondo	3,330	1,294	1,287	17,778	13.81
Rio Grande	45,000	33,876	32,246	1,103,389	34.22
Umatilla	17,000	5,306	3,603	104,653	29.04
Klamath	38,000	27,254	27,254	377,488	13.85
Belle Fourche	78,591	44,067	43,063	462,050	10.72
Okanogan	10,099	7,800	4,814	254,425	52.60
Yakima:					
Sunnyside unit	82,757	66,607	54,919	2,750,326	50.08
Tieton unit	34,440	22,000	18,100	668,650	37.00
Shoshone	42,816	25,753	24,833	410,031	16.51
Totals for irrigated areas covered by crop reports	1,330,222	814,906	757,613	$18,164,452	$24.00
Additional irrigated areas not covered by crop reports:					
Boise	80,000	20,422	......	....	....
Uncompahgre Valley	4,500	4,500	......	....	....
North Platte	8,050	8,050	......	....	....
Strawberry Valley	50,000	8,900	......	....	....
Totals, reclamation projects	1,472,772	856,778	......	....	....

*Data are for calendar year (irrigation season) except on Salt River project, Ariz., data are for corresponding "agricultural year," October, 1914, to September, 1915.
†Estimated.

the impecunious speculator. The settler was not compelled to live for years upon an arid homestead without water and thus dissipate his means and his patience, and he was not permitted to take more land than was necessary for his livelihood. Thus were eliminated the three principal causes of failure upon other projects.

The Shoshone project and many other projects illustrate strikingly the contrast between large and small holdings. On those projects, homesteads near railroad stations are generally made 40 acres, while farther out they contain 80 acres of irrigable land and sometimes more, up to a limit of 160 acres. In general, the individuals with the small holdings, having less tax upon their resources for improvements and water charges, have been successful. Their neighbors, similarly situated, but with larger holdings, have been unable with their means to cultivate any larger area of land during the first few years when the struggle is on, and have had the additional burden of double the water charges and heavier costs for fencing and other improvements. The results have shown a larger percentage of success and general prosperity upon the small unit.

Results of Reclamation

The usual data were collected at the close of the irrigation season of 1915 regarding the results being attained by the irrigators. These figures show the annual advance in the settlement and development of the government's reclamation projects. In 1915 over 1000 farms and 50,000 acres were added to the cultivation area of the various projects and irrigation water was served to 18,600 producing farms. Over 800,000 acres were irrigated and crops were harvested from over 750,000 acres.

The new lands brought into production do not reach their full yield the first year, including young orchards just coming into bearing, new alfalfa stands giving a single cutting of hay, and other fields first brought into cultivation during the season and giving partial yields while being better prepared for full production. But in spite of the large addition to the producing area in 1915 there was an increase in the average returns per acre over the preceding year. During 1915 the average for all reclamation projects in value of crops per acre was $24—an increase of 50 cents per acre in comparison with the statistics for 1914. At the same time the total production increased to more than $18,000,000.

Gain in 1915

The year 1915 was the first since crop statistics have been gathered on the government projects that the average crop value per acre shows a gain over the preceding year. That is, beginning with the figures for 1908 or 1909 there was a gradual reduction each year in the average reported crop value per acre until 1915, when there was a gain over 1914. This may be partially explained by the fact that the Reclamation Service began water service with a number of old irrigated tracts under canals acquired in connection with the Salt River, Uncompahgre Valley, and other projects, and each year diluted this with added raw land not giving full production, tending to step down the general average return per acre. Acting in the other direction, the raw land addition of each year has gradually reached more intensive production, so that in 1914 this factor may have balanced the other, and in 1915 the statistics have begun a trend in the other direction. It is also true that the early figures of crop production were roughly estimated, with the error naturally on the side of greater returns. There is now well established a relatively inexpensive system of collecting these data, but one probably more accurate than an ordinary census. Such data are available for the last three or four years. In these the average return is fairly constant, but has decreased slightly and now increased, with a change in any year small enough to be attributable to the many factors always affecting the business of farming.

Two Projects Added in 1915

In 1915 two projects were added to those producing annual crops worth over a million dollars, the Uncompahgre Valley (Colo.), and the North Platte (Neb.-Wyo.). The Salt River project, Arizona, continues to lead in total returns with crops worth $3,660,000, closely followed by the Yakima project, Washington, producing from less than half as large an area crops estimated at $3,418,000.

TABLE 3—CROP RESULTS ON RECLAMATION PROJECTS IN 1915

Figures are limited to irrigated areas covered by crop reports, excluding about 40,000 acres irrigated but not covered by crop reports, and small areas cropped by dry farming on a few projects.

Crop	Acreage cropped: Total	Acreage cropped: Per cent	Yields, average per acre, bu.	Crop value, average per acre
Cereals:				
Barley	37,474	4.6	25	$15
Corn	39,785	5.3	31	20
Oats	49,514	6.5	30	13
Rye	780	0.1	14	11
Wheat	84,052	11.4	21	18
Total	211,605	27.9	.....	$17
Other grain and seed:				
Alfalfa seed ..	14,517	1.9	4.0	$32
Clover seed ...	5,537	0.7	3.6	37
Sorghum (grain) ...	7,216	1.0	35	22
Flaxseed	330	....	*11	20
Millet seed ...	244	....	9	11
Total	27,844	3.6	....	$30
Hay and forage:			Tons	
Alfalfa hay ...	335,161	44.3	2.9	$19
Clover hay ...	6,726	0.9	1.9	11
Other hay	12,484	1.6	1.4	12
Corn fodder ..	33,529	4.4	1.8	20
Peas	927	0.1	*18	31
Other forage..	870	0.1	....	....
Pasture	98,128	12.9	....	9
Total	487,825	64.3	....	$17
Vegetables and truck:			Bu.	
Beans	2,610	0.4	12	$31
Onions	324	....	204	122
Potatoes, white	17,269	2.3	165	74
Potatoes, sweet	279	....	70	41
Truck	11,481	1.5	....	67
Total	31,963	4.2	....	$68
Fruit and nuts:			Lb.	
Apples	16,502	2.2	2,500	$52
Peaches	2,326	0.3	4,600	54
Pears	1,755	0.2	5,250	89
Prunes	302	....	10,000	235
Citrus fruit...	1,167	0.2	1,850	68
Small fruit....	1,577	0.2	1,850	113
Other fruit and nuts	2,212	0.3	....	75
Total	25,927	3.4	....	$63
Miscellaneous:			Tons	
Sugar beets...	20,848	2.7	11	$59
Cotton	3,325	0.4	†385	62
Hops	545	0.1	†1,800	188
Cane	1,411	0.2	5.3	24
Other crops....	1,335	0.2	....	....
Total	27,464	3.6	....	....
Duplication ...	55,015	7.0	....	....
All crops	757,613	100.0	....	$24

*Bushels.
†Pounds.

The foregoing figures are restricted to areas covered by the water-user census or crop reports, which in general cover lands under canals operated by the Reclamation Service. On several of the projects additional areas received water developed by the project works, but delivered through canals not operated by the government. This was the case of the Strawberry Valley project, Utah, where water was delivered for the first time from the government works. In this way an additional 40,000 acres were served by the government projects, bringing the total irrigated area to about 850,000 acres. At the same time the works were capable of serving nearly 1,500,000 acres.

The areas in use and estimated returns for the separate projects are shown in Table 2.

Crops of 1915

The figures for 1915 (see Table 3) show no marked change in the character of crops grown or their relative areas. More than half the total cropped area is devoted to hay and forage crops, slightly less than one-third to grains, and less than 5 per cent each to fruit, vegetables, and sugar beets. The depression in the cotton market that followed the outbreak of war in Europe was reflected in a large reduction of area utilized for this crop. The later recovery in prices is not yet reflected in the statistics.

Alfalfa continues to dominate the crop statistics from the irrigated areas. In 1915 it occupied nearly half the cropped acreage and yielded more than one-third the total crop value. Its many virtues readily explain this popularity. Once established it is a hardy plant and continues almost indefinitely to furnish good annual yields without reseeding. It gives several cuttings each year. It is a legume with the peculiar power of drawing from the atmosphere the nitrogen in which the soils of the arid region are often deficient, and leaves behind more than it found of this valuable plant requirement. It is the deepest of subsoilers, penetrating with its many roots to a remarkable depth for the other essential elements of plant growth and improving the physical condition of the soil. It furnishes a hay of superior quality for conditioning and fattening stock, so effective in fact that it is now being utilized medicinally for humans.

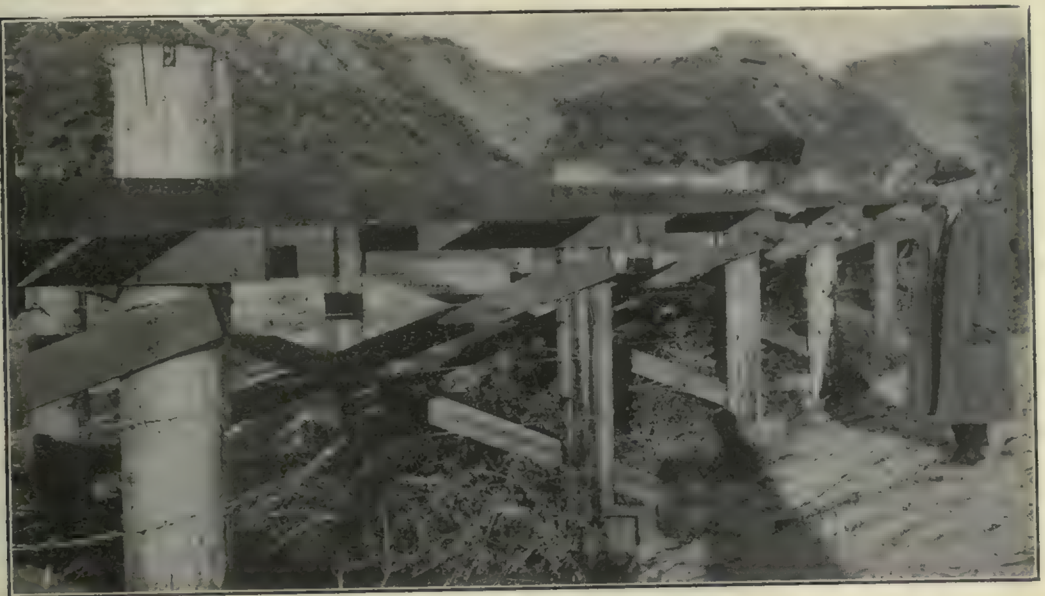
Success on Small Farms

A summary of 18,624 irrigated farms shows the average farm contains 54 acres of irrigable land, 44 acres of which are actually watered, leaving 10 acres for fields not yet utilized, buildings, private roads, etc. On this average farm 20 acres are in alfalfa, 13 in grain, with small areas of other crops. The farmer crops a total of 41 acres. His total crop as harvested is worth a little less than $1,000, but he has three or four work animals to feed and by feeding the rest of his crop its value can be greatly increased. For this purpose he has cows, sheep, and hogs—in all about 25 animals. These are worth about $1,000. Adding the price of his land and water-right payments, this average farmer is using a capital investment of $6,000. His success depends largely on what he pays for the use of this capital. If he is indebted for a large share of it at a high interest rate, he is likely to fail; if his capital is clear of indebtedness and interest is low, his chance is excellent.

Barbed Wire Helps Build River Embankments

Collects Sand Quickly on Three Miles of Pile Jetties Along Santa Maria and Santa Ynez Rivers in California

THE Santa Maria River in the southern part of California has a flood discharge in excess of 100,000 sec.-ft. It flows through a light sandy plain with a slope of 10 or 15 ft. per mile, and the conditions are such that a deep channel has never formed. The average channel depth below the natural bank is from 10 to 20 ft. In recent years the development of areas adjacent to this stream has made it desirable to fix the location of the channel at certain points by means of some type of jetty suitable for use in sandy formation. After some study of conditions Haviland & Tibbetts, civil engineers, of San Francisco, designed a jetty consisting of piles and barbed wire calculated to collect enough drift and detritus to build up the solid structure desired.



ROWS OF PILING WOUND WITH BARBED WIRE FOR CATCHING DÉBRIS AND FORMING JETTY

The piles were placed in a double row 10 ft. apart and each pair was spaced 12 ft. apart longitudinally. After the piles were driven about 20 ft. in the sandy bottom they were tied together by means of 2 x 6-in. cross-braces. Four of these braces were placed transversely between each pair of piles, two being horizontal and the other two inclined. Longitudinally four lines of 2 x 6s were run along each row of piles, two at the tops, and two where the piles entered the ground. With this wood framing in place, a brush mat about 3 ft. deep was placed between the rows of piling, and barb wire was then strung diagonally from pile to pile and also longitudinally along the outside of the piles, the wires being spaced about 1 ft. apart vertically.

About 3 miles of jetties of this type were built on the Santa Maria and Santa Ynez Rivers at an average cost of about $4 per linear foot in place. The barb wire quickly catches floating débris, which has the effect of increasing the height of the brush mattress, and this increases the tendency to collect and hold flood detritus.

This type of construction is reported to be giving very satisfactory service. In fact some of these jetties projecting about 6 ft. above ground have been completely buried in sand during the first few hours submerged.

Girders Act as Railing in Overhead Crossing

Arlington Avenue Bridge, Indianapolis, Economically Designed to Carry Street Loading Without Sidewalks or Car Tracks

UTILIZING the main girders for railings, with recessed panels on the outside, an economical form of reinforced-concrete overhead highway viaduct has been designed for the Arlington Avenue crossing over the Pittsburgh, Cincinnati, Chicago & St. Louis Railway (Pennsylvania Lines West of Pittsburgh) in Indianapolis, Ind. Eight spans 37 ft. center to center of columns, with girders, beams and piers exactly alike except at the ends and at the central expansion joint, are used for the 296-ft. total length of the structure. No end abutments are provided; the earthfill approach is carried right up to the end piers and around them on a 1½:1 slope, reaching beyond the next intermediate piers. At the center line of the symmetrical structure an expansion joint is furnished by double columns and roadway beams with 1-in. clearance between them. These details are illustrated in the drawing at the bottom of the page.

A roadway 24 ft. 7 in. wide between girders and 23 ft. 6 in. between curbs, with no sidewalks, is provided by using outside main girders and columns spaced 26 ft. on centers. As shown in the drawing, these main girders are carried above the 8-in. roadway slab a distance of 4 ft. to act as a side rail. On the outside a paneled effect is produced by 3-in. recesses. Intermediate transverse 15 x 28-in. floorbeams spaced 4 ft. 7 in. on centers are detailed with their lower faces flush with the bottom of the main girders. The floorbeams at the columns are made 2 ft. deeper, with curved brackets at their end connections to add transverse rigidity to the structure.

The bridge is designed for a uniform live load of 125 lb. per square foot of roadway and for a 20-ton road roller. No provision is made for electric railway loading. The main girders are designed as continuous beams. The column foundations are carried to hardpan by ordinary spread footings.

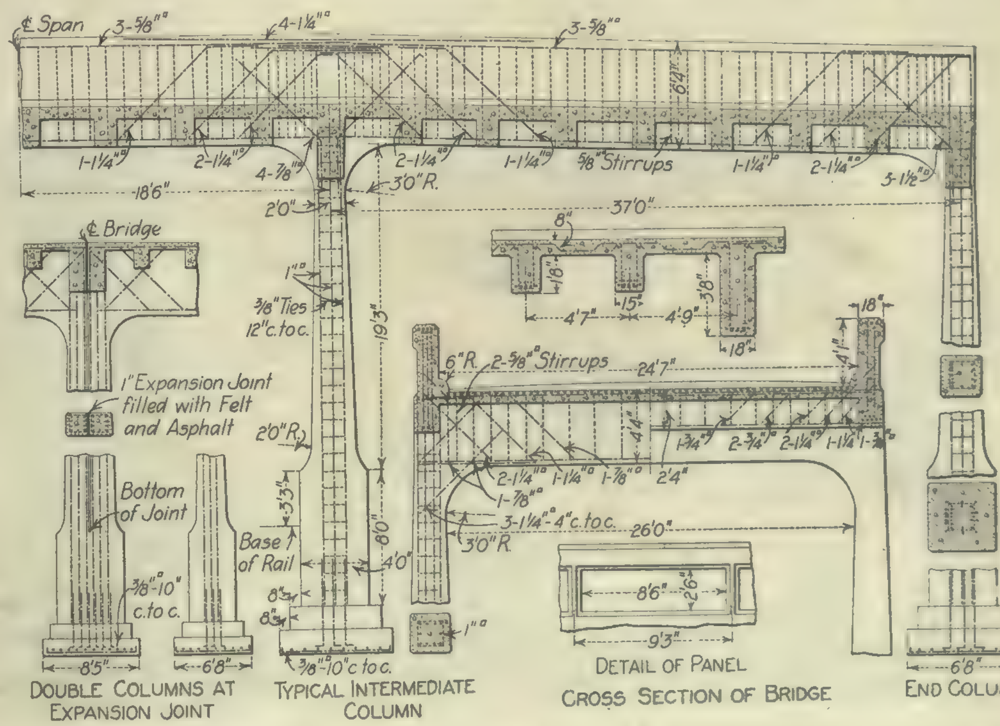
DOUBLE COLUMNS AT EXPANSION JOINT

On the center line of the structure a 1-in. expansion joint is provided by double columns and transverse beams, as shown on the drawing, the column joint above the piers to be filled with felt and asphalt. The floorbeams at this point are each made 18 in. wide, and the amount of steel reduced, since less strength is required. A single foundation is used for the double column, as indicated on the drawing.

This economical overhead crossing was designed under the direction of J. C. Bland, engineer of bridges, Pennsylvania Lines West of Pittsburgh. The contractor is the Dunn-McCarthy Company, of Chicago.

Granite Curbing Replaced by Concrete

Granite curbing is gradually being replaced in San Francisco by armored concrete curbing, according to the latest report of the city engineer, who states that the change effects a reduction in cost of about 50 per cent and a distinctive gain in general appearance.



SECTIONAL ELEVATION AND TYPICAL DETAILS OF 37-FOOT SPANS—GIRDERS USED AS RAILINGS

Build Monolithic Brick Road on One-Inch Base

Narrow Country Road Needs Small-Sized Equipment and Minimum of Aggregate for Thin, Granular, Easily Shaped Base

IN ACCORDANCE with the theory that a dry, compacted earth roadbed without any material depth of foundation will, by itself, sustain country traffic, Stockland Township, Iroquois County, Illinois, is building 5 miles of monolithic brick road 9 ft. wide, on a concrete base 1 in. thick. Carried to the limit from the structural standpoint, no base would be used, for the compacted soil is counted upon to take the load, and the brick is to act simply as a surfacing material, keeping the earth foundation dry. This means extraordinary pains

CONSISTENCY OF THIN GRANULAR BASE MOST IMPORTANT

to insure deep side ditches. The purpose of the thin layer of concrete, which can hardly be termed a base or foundation, is not to hold the brick nor to bear weight, but to make a smooth surface on which to lay the brick and one on which the grout will stop.

As in the Vermilion County brick roads, described in the Engineering Record of Sept. 30, page 400, and in which article the Stockland road is noted, wire-cut-lug brick are laid directly on the wet concrete within 20 ft. of the mixer. A 1:2½:4 mixture is used, the large material being roofing gravel passing a ½-in. screen and remaining on a ¼-in. screen. The moisture consistency is considered of the greatest importance. It is such that the mix will just run down a 30-deg. grade of the Boss mixer spout. It is then struck off with a hand template which is cut back 8 to 10 in. to permit a zigzag motion, as illustrated in one of the photographs. The base is so thin and the mixture so granular that if the water content is right the bricks are easily sustained, thus giving a smooth surface.

An Anyweight water roller weighing 25 lb. to the linear inch is used within 6 to 8 ft. of the brick layers to take out any small irregularities. The roller is pushed transversely across the brick rather than lengthwise, because it is considered that the sidewise rolling is like sliding two straightedges together to produce a straight line. In other words, as the roller approaches the end of one row of bricks it rests on the center of adjacent rows. In the lengthwise rolling the roller jumps over the joints from one row of bricks to another, thus tending to rock the individual brick.

The grouting was done with a small Marsh-Capron mixer, using practically the same procedure as was followed in the Vermilion County work. A 1:1 mix of cement, fine plaster and sand, of the consistency of cream, is spread directly from the mixer into the joints with a brush. The second coat is applied from wheelbarrows as soon as the first coat is settled but not set up. The third coat should be the filler left on top of the bricks from the other two coats and squeezed into the joints to fill them flush with the top. It is the aim to keep the grouting operation within from 100 to 200 ft. of the brick layers.

Some of the construction advantages noted on this work are the small mixer required for the foundation work and the small amount of aggregate needed, the latter materially reducing the teaming item.

The work is being carried out for the township by Bishop & Liddell, contractors, Danville, Ill.

ABSENCE OF LARGE AGGREGATE PILES IS CONSPICUOUS

Proposes Complete Specifications for the Structural-Steel Work of Buildings

Clauses Are Included to Cover the Often-Ignored Details Which Are the Usual Source of Difficulties and Misunderstandings

By R. FLEMING
New York City

WHILE it is possible to present a form which can be used as a guide in writing specifications for the structural-steel work of buildings, it is not practicable to draw up a specification that will apply to all cases. Modifications should be made to suit the specific building under consideration. For instance, a few lines headed "Description" should be given in place of the "Classification" included in the specifications here proposed. For an office building, that which relates solely to mill buildings should be omitted, and vice versa; in fact, all that is irrelevant to the particular building in question should be left out.

The terms of payment, dates of delivery, and method of settling questions arising between purchaser and contractor belong to the contract proper, and need not be repeated in the specifications.

Great care should be given to the preparation of Clause 3, on "Scope of Work." This section should be clear and complete. It should be definitely stated whether stacks, tanks, elevator framing, stairs, and similar items are included or excluded. Any special feature to be emphasized should be stated. It may seem to some that sections relating to design might be omitted in specifications for the contractor. This is often done when design drawings are furnished, but the practice is not to be commended. When making detail drawings it is an advantage to know the loads, stresses and other data upon which the design is based. In structures of unusual importance Clauses 51 and 53, on details and workmanship, should be elaborated.

Specifications for the steelwork of buildings are seldom written without drawing upon the work of others, and the following are not exceptions. In fact, they are largely a matter of selection, with such additions and modifications as the writer deems advisable. Values have been assigned to bolts acting in tension and to countersunk and flattened rivets. The last sentence of Clause 43 meets the case of replacing the lacing of four-angle latticed columns with web plates without violating a building code because of increased slenderness ratio l/r. In Clause 47 the limits of deflection are given as 1/24 and 1/32, instead of the usual 1/20 and 1/30. This allows 8-in. I-floorbeams and 6-in. channel purlins for 16-ft. bays—a very common practice, regardless of specifications. Similar modifications are made throughout, the object being a set of specifications that can and must be followed.

GENERAL REQUIREMENTS

1. *Drawings*—The drawings forming a part of these specifications are (giving number, maker, title and date of each drawing).

2. *Classification*—For the purpose of classification buildings are divided into two classes—(1) mill buildings; (2) office buildings.

Under Class 1 are included manufacturing plants, machine shops, power houses, train and pier sheds, electric-light stations.

armories, and buildings of similar character.

Under Class 2 are included office buildings, hotels, apartment houses, stores, warehouses, places of public assembly, and buildings of similar character.

3. *Scope of Work*—It is intended that these specifications and drawings cover the structural-steel work complete for the building. Cast-iron bases are included with the structural steel. The steel erector shall erect in place the steel framework on foundations furnished by others. Anchor bolts and loose lintels are to be delivered at the site, but put in place by other contractors.

MATERIALS TO BE FURNISHED

4. The materials to be furnished for buildings of Class 1 include steel trusses, columns, purlins, bracing, floor framing, crane girders with rails, trolley beams, lintels, girts, framing around door and window openings, beams supporting tanks, elevator framing, stair framing, floor plates, bunker framing and steel lining, stairs and railings unless of an ornamental character, cast-iron bases, grillage beams and anchor bolts.

The materials not furnished include ornamental iron and steelwork, mason's anchors, carpenter's anchors and irons, elevator sheave beams, switches for trolley beams, steel stacks, steel tanks, and reinforcing rods and bars for concrete.

5. The materials to be furnished for buildings of Class 2 include steel columns, cast-iron bases, rolled and cast-steel slabs, grillage beams, anchor bolts, floor framing, roof and ceiling framing, purlins, cornice supports, supports for tanks, penthouse framing, bracing and lintels.

The materials not furnished include ornamental iron and steelwork, mason's anchors, terra-cotta anchors, carpenter's anchors and irons, stair work, elevator framing, elevator sheave beams, steel stacks, steel tanks, light shapes supporting metal ceiling lath, cast-iron sills, and similar work, and reinforcing rods and bars for concrete.

6. Rivets and bolts for fastening steel to steel (but not for connecting the work of other trades) shall be furnished by the steel contractor. Fitting-up bolts for erection are to be considered a part of the erector's equipment, and need not be furnished by the steel contractor.

COLUMN-FOOTING PLAN

7. As soon as possible a column-footing plan shall be sent to the purchaser, showing the location, elevation and dimensions of all column bases, with the location, elevation, size and length of all anchor bolts The loads coming upon the column footings from the columns shall also be given.

8. Crane-clearance diagrams showing the clearances assumed for traveling cranes shall be furnished the purchaser at an early date.

9. *Substitution of Material*—If the contractor wishes to substitute other shapes or sizes for those called for on the drawings he may do so, subject to the approval of the engineer, provided the architectural features are maintained and proposed sections are sufficient to carry the required loads.

10. *Work of Other Trades*—Holes conforming to the usual standards of fabrication shall be punched in the steel for attaching the work of other trades, provided their location is given while the working drawings are being made.

11. *Working Drawings*—Working or shop drawings shall be made by the steel contractor, and prints in duplicate sent to the purchaser or his engineer for approval. The engineer's approval of drawings shall cover general design, strength and type of details. The engineer shall not be held responsible for the fit of work at the site. If, to expedite delivery, or for any other reason, he waives the approval of drawings, the contractor will not be relieved of responsibility for errors or omissions due to neglect or oversight on his (the contractor's) part.

12. All work must conform to local or state ordinances and regulations.

LOADS FOR ROOFS

13. Unless governed by a local building code the following loads shall be used:

Roof trusses and columns shall be designed to carry a uniform load per square foot of exposed roof surface, applied vertically. This load includes the weight of the structure, the snow, and the wind. For spans up to and including 80 ft., and in climates corresponding to that of New York, the total minimum uniform load per square foot of roof surface for different kinds of covering shall be taken as follows:

	Lb.
Corrugated metal	40
Gravel or composition roofing on wood sheathing	50
Slate on boards	50
Tile on steel purlins	55
Tar and gravel on cinder concrete	60
Slate or tile on cinder concrete	65

14. For roof spans over 80 ft. the above-cited loads shall be increased 1 per cent for every foot increase of span.

15. For roofs in climates where snow is excessive 5 to 10 lb. shall be added, and in climates where no snow is liable to occur 10 lb. may be deducted from the foregoing loads.

16. If a ceiling is carried by the lower chord, the ceiling load shall be assumed at not less than 10 lb. per square foot.

17. If shafting is carried by the lower chord, the load at the shaft shall be assumed at not less than 2000 lb. for light shafting, 4000 lb. for ordinary shafting, and 6000 lb. for heavy shafting. Unless the shafting is definitely located these loads shall be considered as liable to be concentrated at any point of the lower chord.

18. In designing purlins carrying roof covering only, the loads in Clauses 13 and 15 may be decreased 5 lb. and considered normal to the roof. When the pitch of the roof is more than 2½ in. to 1 ft., tie rods shall be used between the purlins.

19. Special loadings, such as tanks or elevator supports above the roof and hoists or trolleys on the lower chord, shall be taken into consideration.

20. The stresses obtained from concentrated loads shall be added to those due to uniform load.

21. Flat roofs used as places of public assembly shall be considered as floors.

FLOOR LOADS

22. *Floors*—Floor loads consist of dead load and live load. The dead load is composed of the weight of the floor construction and of any permanent wall resting upon it. In designing floorbeams and girders for fireproof construction the dead load shall be assumed at not less than 70 lb. per square foot. Partitions of wood studding or hollow tile not more than 6 in. thick may be considered as part of the live load.

23. Buildings of Class 1 shall be designed for minimum live loads per square foot of floor area, as follows:

	Lb.
Mold lofts, pattern and template shops	60
Machine shops	120 to 175
Factories	120 to 250
Warehouses	200 to 500
Foundries—charging floor	300
Power houses	200

24. Provision shall be made for the support of machinery, engines, boilers, tanks, and other concentrated loads when carried by the steel construction.

25. Stresses due to traveling cranes and machines tending to cause vibration shall be increased 25 per cent. (For hand-power cranes, impact may be taken at 10 per cent.)

26. Buildings of Class 2 shall be designed for minimum live loads per square foot of floor area as follows:

	Lb.
Dwelling and apartment houses	40
Hotels and offices—first floor	75
Hotels and offices—upper floors	50
School rooms and churches	75
Places of public assembly, where floors are used for drilling or dancing	100
Where not so used	80
Retail stores—ordinary	100
Public garages	100

27. Concentrated loads, such as heavy safes, special fixtures, machinery, auto trucks, shall be taken into consideration. Every steel beam in any floor used for business purposes shall be capable of sustaining a live load concentrated at its center of not less than 4000 lb.

COLUMN LOADS

28. *Columns*—Every column, post, or other vertical support, shall be of sufficient strength to carry the combined live and dead loads transmitted to it. In buildings of five or more stories in height where all the floors are not liable to be loaded at the same time it shall be permissible in designing columns to assume the live load on the floor next below the top floor at 95 per cent of the allowable live load, on the next lower floor at 90 per cent, and on each succeeding lower floor at correspondingly decreasing percentages until 50 per cent is reached, which reduced load shall be used for all remaining floors.

29. In calculating column loads no reduction of floor area shall be made for stair wells.

30. In proportioning columns provision shall be made for eccentric loading.

31. *Wind Pressure*—All steel buildings shall be designed to carry wind pressure to the ground by steel framework.

Buildings of Class 1 not over 25 ft. to the eave line shall be designed to resist a horizontal wind pressure of 15 lb. per square foot on the sides of the building, and the corresponding normal component on the roof according to the Duchemin formula for wind pressure on inclined surfaces,

$$p = P \frac{2 \sin A}{1 + \sin^2 A}$$

Where buildings are more than 25 ft. to the eave line the horizontal pressure shall be taken at 20 lb. per square foot and the

corresponding normal component on the roof.

Buildings of Class 2 in which the height is more than three times the minimum horizontal dimension shall be designed to resist a horizontal wind pressure of 20 lb. per square foot on the sides of the building and the corresponding normal component on the roof according to the Duchemin formula.

Only the excess of the wind stresses obtained by this paragraph over the wind stresses according to Clause 13 need be considered. In arriving at this excess, the wind included in the total uniform loads designated in Clause 13 shall be assumed at 10 lb. per square foot.

32. The normal pressure, p, in pounds per square foot on a surface inclined A degrees to the horizontal for a horizontal wind pressure, P, of 20 lb. per square foot, according to the Duchemin formula, is as follows:

A	p	A	p
5°	3.4	25°	14.4
10°	6.8	½ pitch	14.9
15°	9.7	30°	16.0
⅓ pitch	11.5	40°	18.2
20°	12.1	45° to 90°	20.0

33. The area of circular steel stacks subject to wind pressure shall be assumed to be 55 per cent of the diametral area.

34. Coal bunkers shall be assumed to be surcharged when it is possible for them to be so loaded. The weight of anthracite coal shall be taken at no less than 50 lb. per cubic foot and the angle of repose assumed to be 30 deg.

ALLOWABLE UNIT STRESSES

35. Unless governed by a local building code, the following unit stresses, in pounds per square inch of sectional area, shall not be exceeded for stresses due to the combined dead and live loads together with impact:

Tension, net section rolled steel	16,000
Direct compression, rolled steel and steel castings	16,000
Bending on extreme fibers of rolled shapes, built sections, girders, and steel castings	16,000
Bending on extreme fibers of pins	24,000
Shear on shop rivets and pins	12,000
Shear on bolts and field rivets	10,000
Shear—average—on webs of plate girders and rolled beams, gross section	10,000
Bearing pressure on shop rivets and pins	24,000
Bearing on bolts and field rivets	20,000
Rivets used in tension	5,000
Bolts used in tension, net section under thread	10,000
Axial compression on gross section of columns:	
For l/r from 0 to 60	13,000
For l/r from 60 to 120	19,000 — 100 l/r
For l/r from 120 to 160	13,000 — 50 l/r

Where l = effective length of member in inches;
r = least radius of gyration of section in inches.

36. For combined stresses due to bending and direct loads, the foregoing unit stresses may be increased 20 per cent, provided the section thus obtained is not less than that required for bending or direct stress alone. For combined stresses due to wind and other loads the above-mentioned unit stresses may be increased 50 per cent, provided the section thus obtained is not less than that required if wind forces be neglected.

COUNTERSUNK RIVETS

37. Countersunk rivets in plates of thickness equal to or greater than one-half the diameter of rivet shall be assumed to have three-fourths the value of rivets with full heads. In plates of thickness less than one-half the diameter of rivet their values shall be taken as three-eighths that of full-headed rivets.

Rivets with flattened heads of height not less than ⅜ in., or one-half the diameter of the rivet for ⅝-in. rivets and less, shall be assumed to have nine-tenths the value of corresponding rivets with full heads. Rivets with heads flattened to less than these heights shall be regarded as countersunk rivets.

38. The allowable pressure of column bases and bearing plates on masonry shall not exceed, in pounds per square inch, the following:

On brickwork with cement mortar	250
On brickwork with lime mortar	150
On Portland-cement concrete 1:2:4 mixture	600
On Portland-cement concrete 1:3:5 mixture	350
On first-class dimension sandstone or limestone	400
On first-class granite	600

PROPORTION OF PARTS

39. Trusses shall preferably be riveted structures. Tension as well as compression members shall preferably be composed of rolled shapes or built-up sections. Flat bars shall not be used.

40. In calculating tension members, net sections shall be used. The diameter of rivet holes shall be assumed to be ⅛ in. larger than the nominal size of the rivet. In single angles connected by one leg, the net area of the connected leg and one-half that of the outstanding leg shall be considered effective.

41. The nominal sizes of rivets shall be used in calculations of their values.

Rivets and bolts in tension shall be avoided as far as practicable. In cases where they cannot be avoided and the loads carried are subject to shock, bolts with check nuts shall be used.

REVERSAL OF STRESS

42. Members subject to reversal of stress shall be proportioned for the stress requiring the larger section, but their connections shall be proportioned for the larger stress plus one-half the smaller.

43. The effective length of main compression members shall not exceed 120 times their least radius of gyration, and for secondary members and lateral bracing 160 times their least radius of gyration. Any portion of the cross-section of a compression member may be neglected in computing the radius of gyration, provided that portion be neglected in computing the safe load.

44. Plate girders may be proportioned upon the assumption that the bending stresses are resisted by the flanges and that the shear is resisted by the web. One-eighth of the gross area of the web may be considered to act as flange area. Plate girders may also be proportioned by their moments of inertia.

CRANE-LOAD DISTRIBUTION

45. Wheel loads of cranes shall be assumed to be distributed on the top flanges of runway girders over a distance equal to the depth of the girder, with a maximum of 30 in. In addition to the vertical load, the top flanges shall be designed to resist a horizontal thrust of 20 per cent of the lifting capacity of the crane, equally divided among the four or more wheels of the crane.

46. Plate-girder webs shall have a thickness not less than 1/160 of the unsupported distance between flange angles. Web stiffeners shall be used in pairs. They shall be placed over bearings, at points of concentrated loading, and at other points where R is greater than 90 or where the shearing stress per square inch is greater than that obtained from the formula 10,000 — 50 R, R being the ratio of depth of unsupported web to its thickness. They should generally be not farther apart than the depth of the unsupported web.

Stiffeners shall be designed as columns for a length equal to one-half the depth of the girder and shall have enough rivets properly to transmit the shear. When important loads are transmitted through the bearing of stiffeners, the bearing value shall be assumed at 24,000 lb. per square inch of section, excluding the area of chamfered portion over fillets of flange angles.

47. The depth of girders and rolled beams in floors shall be not less than 1/24 of the span, and if used as roof purlins shall be not less than 1/32 of the span. In case of floors subject to shocks and vibrations the depth shall be limited to 1/16 of the span.

48. When the laterally unsupported length, l, of the compression flange of beams and girders exceeds 15 times its width, b, the unit stress in the compression flange shall not exceed 19,000 — $250l/b$.

49. Steel purlins shall be single rolled shapes, plate girders or lattice girders.

50. Steel less than ¼ in. thick shall not be used. This does not apply to fillers or to webs of rolled beams and channels. Steel subject to the action of harmful gases or severe atmospheric conditions shall be not less than 5/16 in. thick.

51. Details throughout shall conform to first-class standard practice.

MATERIAL AND WORKMANSHIP

52. *Material*—Steel shall be made by the open-hearth process and shall have an ultimate tensile strength of 56,000 to 64,000 lb. per square inch. In general, steel and cast iron shall conform to the "Specifications for Steel Railway Bridges" adopted by the American Railway Engineering Association.

53. *Workmanship* — All workmanship shall be first class in every respect and in accordance with practice followed by the best modern bridge shops.

54. *Painting*—All steelwork shall be thoroughly cleaned before leaving the shop. Steelwork to be entirely embedded in concrete and cast iron shall not be painted. Other steelwork shall be given one coat of red lead and linseed oil or a graphite paint, as directed. One coat shall be given in the shop to surfaces inaccessible after assembling. Machine-finished surfaces shall be coated with white lead and tallow before shipment.

55. After erection the steelwork shall be cleaned of all dirt and rust and given one coat of graphite paint of color or shade different from that of the shop coat.

56. All painting at shop and site shall be done by hand when the surface of the metal is perfectly dry. Painting shall not be done in freezing weather.

INSPECTION AND ERECTION

57. *Inspection*—All inspection and tests shall be made at the option and expense of the purchaser.

58. If material is tested at the mills, the necessary number of test pieces and the use of a testing machine shall be furnished free of charge by the steel contractor.

59. The purchaser or his representative shall have free access at all times to the mills where material is rolled and to the shops where it is fabricated. In ample time

for his needs he shall be given dates of mill and shop operations and furnished with complete working drawings.

60. *Erection*—The structural steel and iron, except anchor bolts and loose lintels, shall be erected by the steel contractor on foundations furnished by the purchaser.

61. Care shall be taken that all steelwork be level and plumb before riveting.

62. Proper provision shall be made for resisting stresses due to erection operations.

63. Field connections generally shall be riveted. Purlins and girts, except those forming part of the bracing, may be bolted. Where there is little or no vibration in floors, connections 3 ft. or more from column centers may be bolted.

64. Drift pins shall be used only to bring parts together. Unfair holes shall be made to match by reaming.

65. After finishing work the erector shall remove his equipment and all rubbish resulting from his operations.

City Managers Chart Convention Program

Graphic Schedule of Events During Municipal Week at Springfield Helps Delegates Choose Meetings to Attend

A CONVENTION program in the form of a small chart was one of the features of Municipal Week at Springfield, Mass., Nov. 20 to 25. Ten organizations, including the City Managers' Association and the National Municipal League, held meetings in the New England city simultaneously. To avoid confusion in the interpretation of the printed program, a chart was prepared as shown. These were printed on cardboard and distributed to members. Because of the number of associations holding sessions during Municipal Week, many of the programs overlapped. The chart showed at a glance what meetings occurred at the same time, and delegates were therefore able to select the one they wished to attend. As will be noted from the illustration, various conventions were adopted to differentiate business meetings, public meetings, trips of inspection, etc.

Will Divert 1400 Additional Second-Feet at Niagara

Hope Thereby to Relieve Situation at Buffalo, Made Acute Because Canada Has Denied Energy to American Industries

RECOGNIZING the urgent necessity for additional electrical power in Buffalo, N. Y., Secretary Baker of the war department recently authorized the Niagara Falls (N. Y.) Power Company to divert an additional 1400 sec.-ft. of water from the river during the peak-load hours in the morning and afternoon. The Canadian government has stopped the exportation of large blocks of Canadian-Niagara power to American consumers, and never before has there been such a shortage of power in western New York as during the last thirty days.

Under the provisions of the special agreement with the war department all additional power generated by the Niagara Falls Power Company must be sent to Buffalo in an effort to relieve the power situation until the first unit of the new steam plant of the Buffalo General Electric Company is placed in operation. This special permission expires on Jan. 1, 1917.

After a recent hearing in Buffalo, at which practically all the large industries of the city were represented, Devoe P. Hodson, member of the New York Public Service Commission, Second District, was so impressed with the seriousness of the situation that he immediately sent a telegram to the federal authorities urging temporary relief by an additional diversion of water from the Niagara River at the Falls. Charles R. Huntley, president of the Buffalo General Electric Company, and other representatives of large industries in western New York also went to Washington and made a personal appeal to have the situation relieved.

Lighting Power Scarce

Many large Buffalo industries have been forced to suspend operations early in the afternoon because of their inability to get sufficient light and power. Thousands of homes in Buffalo have been unable to get electricity for light during the peak-load hours of the late afternoon. City streets, reports state, have not been lighted until hours after dark because of the situation. The losses to Buffalo industries within the last month or so will reach more than $1,000,000, it is estimated. Not only has Buffalo felt the effects of the Canadian embargo, but large electrochemical industries in Niagara Falls have been forced to make personal appeals to the Dominion authorities for energy to keep their plants in operation.

The Acheson Graphite Company, of Niagara Falls, N. Y., which has large war orders to furnish electrodes to the British government, entered a formal protest to the Ontario Hydroelectric Commission against the embargo on power exportation. W. Acheson Smith, vice-president of the company, received a reply from the Canadian authorities in which the Ontario commission said it could do nothing to protect American industries so long as there is increased demand for electric power throughout the province of Ontario.

Shortage of Power at Buffalo

About three months ago the Ontario government was asked for additional power by Canadian munitions factories, and a de-

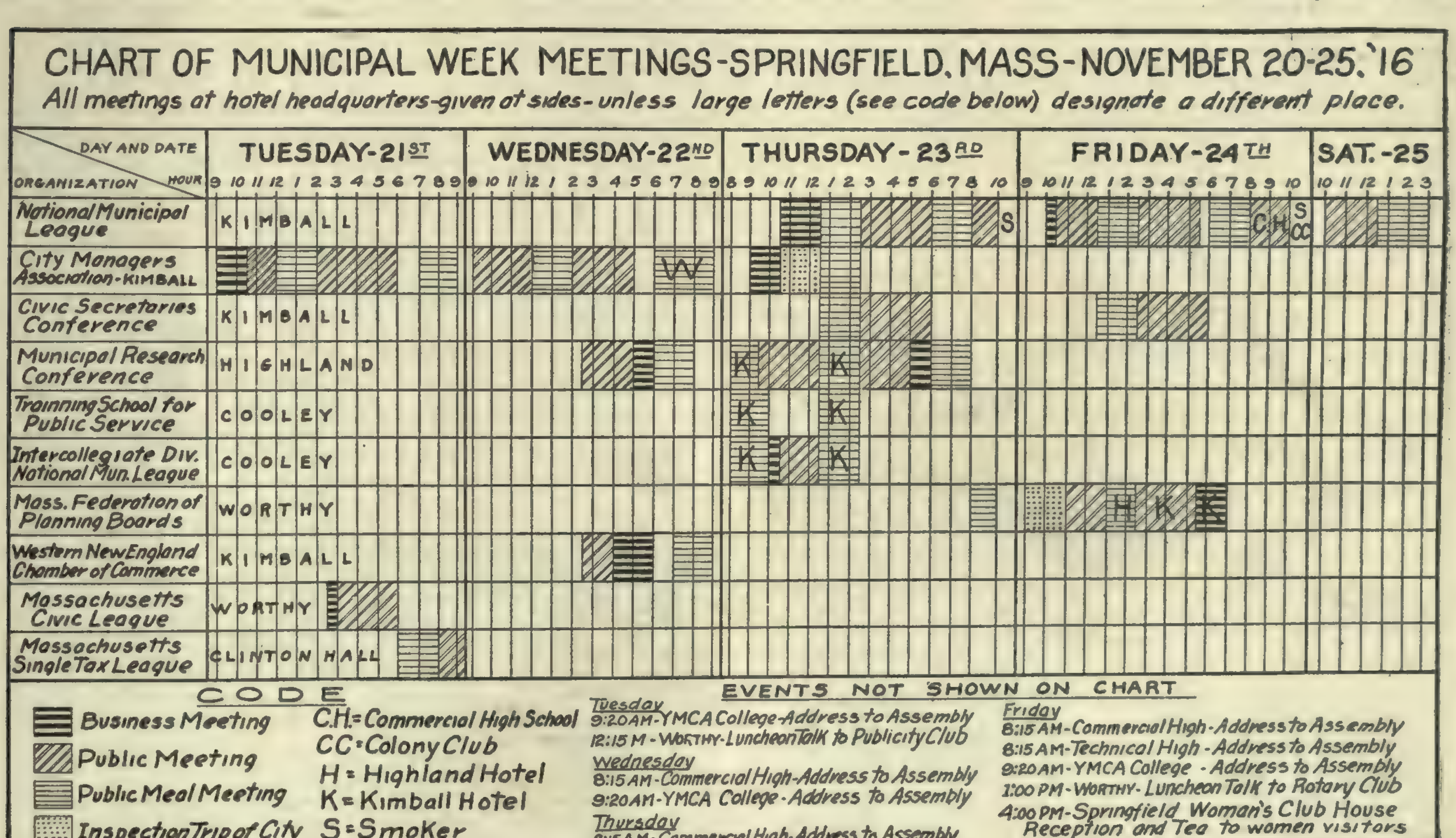


CHART TO GUIDE CONVENTION DELEGATES IN SELECTING MEETINGS TO ATTEND DURING MUNICIPAL WEEK AT SPRINGFIELD, MASS.

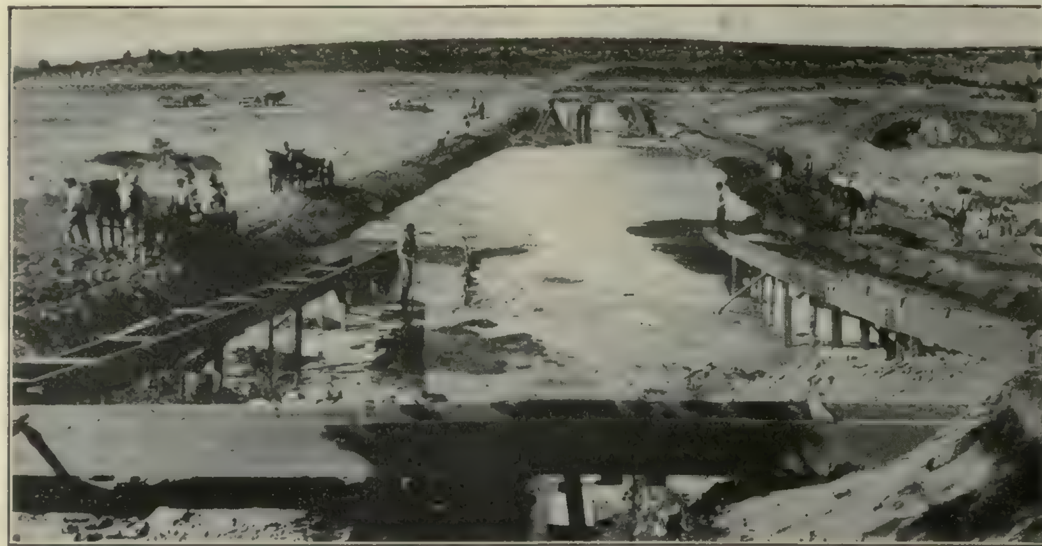
mand was made upon the Canadian Niagara Power Company for a larger supply. The company agreed to furnish 50,000 hp. after a threat had been made to stop all exportation. The Canadian Niagara company is supplying only 35,000 hp., and the commission has demanded the additional 15,000 hp. at once. Already an embargo has been placed on more than 18,000 hp. formerly sent to Buffalo and other western New York cities, with the result that American generating companies have been unable to fill the increased demands that have been made upon them.

90,000 Horsepower Needed

There is a demand for 84,000 hp. in Buffalo. What is being supplied is 37,500 hp. from the Niagara Falls Power Company, 13,000 from the Toronto Power Company, 13,000 additional from the latter company when there is no other demand for it, and 1000 hp. from the Niagara Falls Power Company, generated under a temporary permit which expires when the first unit of the new Buffalo General Electric Company steam plant is in operation. The maximum supply received is 78,500 hp., but this amount is not available where there is the greatest demand. This month, the commission's expert said, there will be a demand for 90,000 hp. It is expected that the first unit of the Buffalo General Electric Company's steam plant, generating approximately 25,000 hp., will be in operation this month.

Pipe-Joint Leakage

In the article entitled "Committee Wants Data on Pipe-Joint Leakage to Check $4,000,000 Annual Waste," in the Engineering Record of Nov. 18, page 616, a typographical error occurred in stating the leakage from a pipe line at Grandview, Ohio (third column, first paragraph). Instead of 131 gal. per inch-mile per day the leakage should have been stated as 0.31 gal. per inch-mile per day, the latter figure representing a condition of almost bottle-tightness.

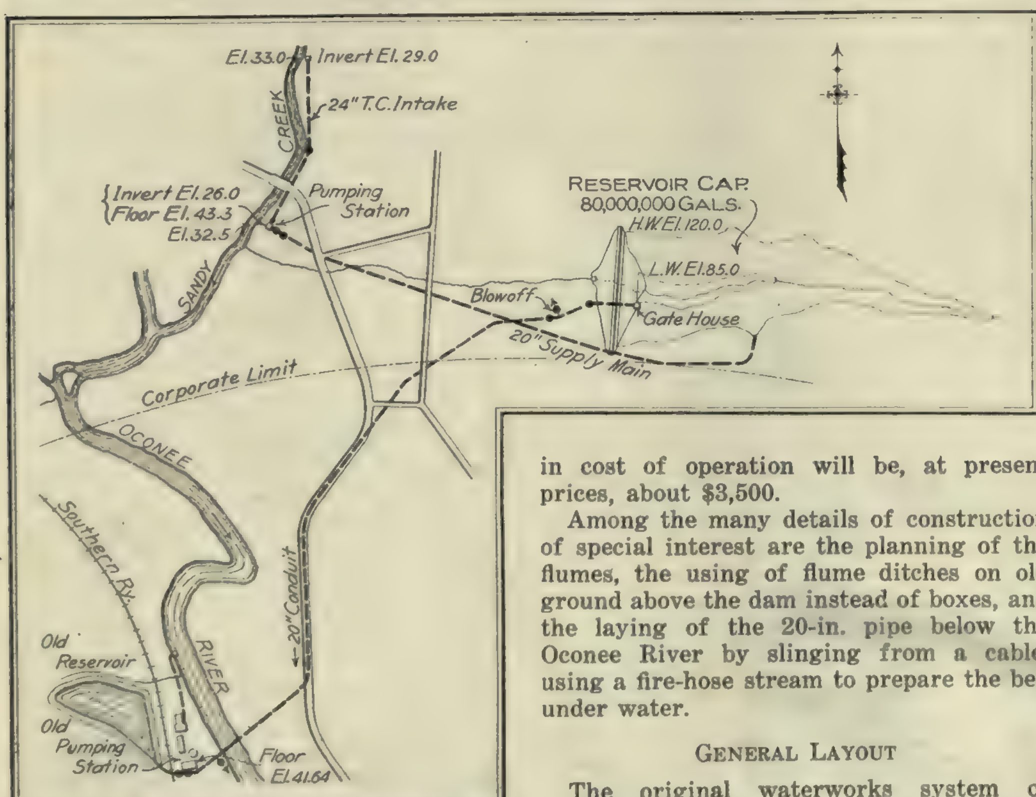


FILLING HEART OF DAM BETWEEN EMBANKMENTS BY THE HYDRAULIC METHOD

Reservoir Capacity Increased and Construction Cost of Dam Decreased by Hydraulic Sluicing

Saving in Operating Cost Resulting from New Source of Supply Is Estimated to Pay for Extending Waterworks System at Athens, Ga.

LOW construction cost and increased reservoir capacity resulted from the adoption of hydraulic sluicing methods in placing the earthfill dam for the new storage reservoir at Athens, Ga.—part of the plan for extending the waterworks system by which it is hoped to save about one-half of the operating cost of the filters for the water-supply system of this city of 22,000 population. By proper sedimentation facilities and the changing of the source of supply from Oconee River to Sandy Creek this decrease in the cost of the alum and liquid chlorine for clearing and sterilizing the water, it is estimated, will pay the interest on the new expenditure and furnish a sinking fund for retiring the bonds issued by the city to finance the project. The total cost, including property bought, is $45,000, and it is estimated that the saving per year in cost of operation will be, at present prices, about $3,500.



RELATIVE LOCATION OF NEW AND OLD RESERVOIRS

Among the many details of construction of special interest are the planning of the flumes, the using of flume ditches on old ground above the dam instead of boxes, and the laying of the 20-in. pipe below the Oconee River by slinging from a cable, using a fire-hose stream to prepare the bed under water.

General Layout

The original waterworks system of Athens was completed in 1893. As indicated by the plan, the old pumping station was located on the west side of the Oconee River, just below a 15,000,000-gal. reservoir into which water from the river was pumped. From here the water was carried to a coagulation basin and treated by Warren filters of 3,000,000-gal. daily capacity. In recent years the continual muddy condition of this river, owing to deforestation and the nature of the soil, caused an exceptional increase in the operating cost of the filter—the alum and liquid chlorine bills alone amounting to $9,000 for the past year.

Another reason for changing the source of supply was the fact that the new towns of Commerce and Jefferson on the Oconee River above Athens were discharging increasing amounts of sewage into the stream.

Better Source of Supply

Sandy Creek, a tributary ½ mile above the old station, with a minimum flow of 15,000,000 gal. per day of relatively clear and uncontaminated water, simplified the problem of how to improve the character of the supply and at the same time decrease operating expenses. A favorable site for a storage and sedimentation reservoir, as indicated on the plan, was located so as to give sufficient grade to overcome friction in the 20-in. conduit connected by gravity flow with the old pumping station.

The new pumping station, located on the bank of the creek at an elevation about 5 ft. above high-water level, is designed for a direct-connected 200-hp. motor-driven volute pump of 8,000,000 gal. daily capacity. The intake is located about 1000 ft. farther up Sandy Creek in order to get above a dairy and slaughter pen near this site. The intake pipe is double-strength terra cotta of 24 in. diameter. The 20-in. supply main was laid in an open ditch from the power house to the point of discharge in the reservoir about 1000 ft. above the outlet at the gate house near the dam.

Earth Dam Constructed by Sluicing

In order to increase the capacity of the new reservoir and at the same time decrease the cost of constructing the earthfill dam, a sluicing method was adopted. Two low

team-placed earthfills were constructed, with clay puddle walls as noted in the sections, at the upstream and downstream limits of the dam, and the water of the stream from a small spring (100,000 gal. per day) impounded to a depth of about 15 ft. This water was used over and over by the two 6-in. centrifugal pumps of 50 hp., installed one on each side of the pond. They furnished 1600 gal. per minute each, discharging through movable one-man monitor nozzles, as shown in the photograph. The sand and clay soil was easily loosened and carried through ditches and wooden flumes to the outer slopes of the dam, where the heavy particles were deposited and the fine silt drifted to the center, forming an impervious core.

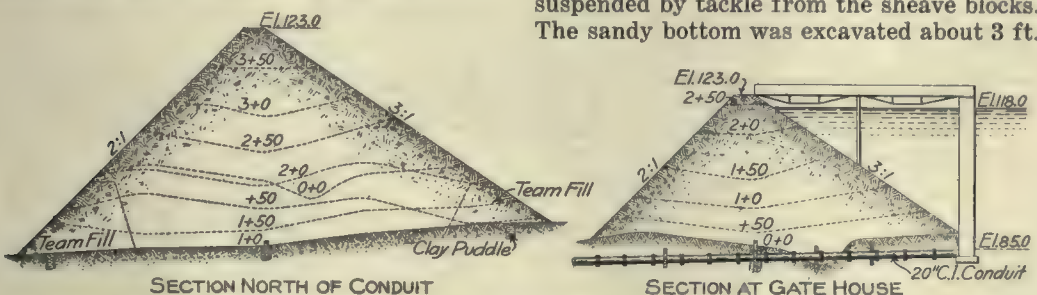
Top Placed by Teams

A slope of 3 ft. per 100 was necessary in constructing these flumes, which were 2 ft. wide and 12 in. deep and flowed half full, and hence the soil was obtained from high banks on the side of the hill as the dam increased in height. Water was returned to the pond by ditches in the old ground above the dam. Finally, as the height increased, the retaining fills placed on the two faces of the dam by teams came together, and the top was placed by teams only, using clay. An 18-in. concrete core wall was carried down to firm rock and up about 1 ft. above the original ground level. Around this core wall and above it was deposited the fine silt formed in the separation of materials by the sluicing method.

LAYING PIPE UNDER OCONEE RIVER BY SUSPENDING FROM CABLE

The 80,000,000-gal. reservoir thus produced serves the conduit of 8,000,000-gal. capacity through gates in a concrete gate house, shown in section, with a blowoff and two valves located as shown on the plan. The entire reservoir is protected from surface water by hillside ditches, to prevent overflow, and will be sodded on the slopes above. One of the advantages of the sluicing method lies in the thorough saturation of the earth in the dam, including the clay puddle walls. As the present consumption in Athens is about 2,000,000 gal. per day, the present filter capacity of 3,000,000 gal. is ample.

One of the illustrations shows the method used for placing the 20-in. riveted steel pipe used, instead of cast iron, for the section under the Oconee River. The steel cable was anchored by deadmen back of the simple timber A-frames shown, and the three sections of pipe and the bends were suspended by tackle from the sheave blocks. The sandy bottom was excavated about 3 ft. and the final level for the pipe obtained by using a firehose stream to force material under water from around the pipe. An asphalt coating was placed on the inside and outside of the pipe, which was spiral-riveted and connected by elbows to the cast-iron pipe on each side of the river.



SECTIONS OF DAM—UPSTREAM AND DOWNSTREAM EMBANKMENTS TO RETAIN SLUICED MATERIAL

Work was begun on the clearing of the site on May 1. In 96 working days about 55,000 cu. yd. of material was placed. About 40,000 cu. yd. of material in the dam was moved by sluicing at an approximate cost of 12 cents per cubic yard. Teams placed about 25,000 cu. yd.

The design was made by J. W. Barnett, for twenty-five years city engineer of Athens, and the construction by day labor was done under his direct supervision. James Barrow, superintendent of the waterworks department, collaborated with Mr. Barnett on this project.

Court Construes Pumping as "Stopping Leaks"

When Leaks in Coffer Floor Could Not Be Stopped, Contractor Used More Pumps and Collected for Extra Work

IN A DECISION handed down by the U. S. Court of Claims, Nov. 20, it was held that a clause in the contract providing for extra payment in case it should be necessary to stop leaks through the floor of the large cofferdam in which the government ship lock at Black Rock Harbor, Buffalo, N. Y., was constructed covered the cost of extra pumping which was found necessary to control such leaks. According to the terms of this decision the United States government is required to pay the MacArthur Brothers Company, contractor for the lock, $36,385.90, held by the Court to be the portion of the sum claimed by the plaintiff which he was entitled to recover on this clause plus 15 per cent profit. The original claim was for $54,748.79.

The opinion in the case, which was argued for the plaintiff by George A. King of Washington, D. C., and Henry W. MacGee of Chicago, was given by Judge Hay and concurred in by the other judges, and follows in part:

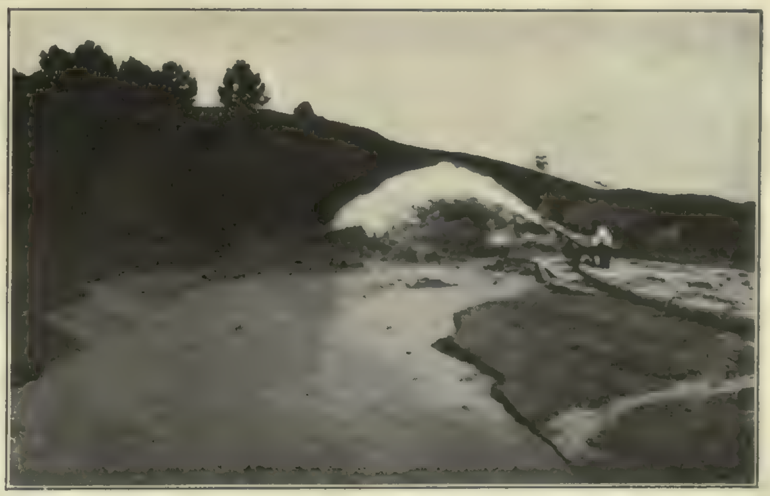
Case Reviewed

"The contract was entered into on the fifteenth day of April, 1908. The plaintiff constructed a cofferdam, as required by the specifications, and upon completion it was found to be tight and efficient and served throughout the progress of the work to exclude the water down to bedrock. On March 22, 1909, the plaintiff started to pump out the cofferdam, and on April 15, 1909, the water was lowered to the bottom of the clay filling in the cofferdam.

"As soon as the water had been lowered to the bottom of the clay filling, large leaks developed in the bedrock. The water came up in large quantities at many places throughout the entire bedrock forming the floor of the inclosure. Paragraph 52 of the specifications is as follows: 'If any leaks develop through the bedrock or through the cofferdam below the clay filling when the inclosure is being pumped out, the contractor shall stop them under the terms and agreements for payment therefor to be made with the engineer, based upon the actual cost of labor and materials at current wages and prices, plus not exceeding 15 per cent for profit.'

"The plaintiff, when these large leaks developed in the cofferdam inclosure, notified the engineer in charge of the work in

UPSTREAM FILL FOR DAM BEGUN BY TEAMS



WASHING SAND AND CLAY SOIL FROM UPPER BANKS

writing of their existence, and certain plans and agreements for stopping the leaks were considered and adopted. These plans were approved by the engineer officer as methods of stopping the leaks under paragraph 52 cited above, and the plaintiff was paid the sum of $8,327.39 for the labor and material used in these methods for stopping the leaks. These methods, however, were only partially successful.

"The plaintiff on July 31, 1909, wrote a letter to the engineer officer in charge of the work, setting forth that the only method of dealing with these leaks was to increase the existing pumping capacity. While the engineer officer did not accept this proposition of the plaintiff, yet he permitted the additional pumping to go on without protest and without suggesting any other method of stopping the leaks, and indeed acquiesced in this method of stopping the leaks as being the only one which would permit the continuance and completion of the work. It is contended by the defendants that the pumping operations were not recognized as being a part of the work of stopping leaks and that the payment of the amount claimed by the petition is prohibited by paragraph 7 of the specifications, which is as follows: 'It is understood and agreed that the quantities given in these specifications are approximate only, and that no claim shall be made against the United States on account of any excess or deficiency, absolute or relative, in the same. No allowance will be made for the failure of a bidder or of the contractor to estimate correctly the difficulties attending the execution of the work.'

Pumping Necessary

"But the Court is of the opinion that paragraph 7 does not control the labor and material used by the plaintiff in stopping leaks, for it clearly appears that the pumping process was necessary for controlling the leaks and to complete the work which the plaintiff had undertaken to perform. Therefore paragraph 52, which dealt with the stoppage of leaks, is the part of the contract which must be looked to in the disposal of this claim. That paragraph does not provide that the plans and agreements for stopping leaks shall be in writing. It only requires that the plans shall be agreed upon, and if they were agreed upon orally, or if all of the plans agreed upon had been tried and the pumping process had been resorted to by the plaintiff after he notified the engineer in charge of the work that that was the only method which was feasible for the purpose, and the engineer acquiesced by permitting the pumping to continue without protest, this would be a sufficient compliance with the provisions of paragraph 52 to entitle the plaintiff to a recovery.

"Paragraph 51 of the specifications is as follows: 'The contractor shall furnish and maintain at least two good and efficient pumping outfits, with pumps, engines, and supplies complete, for pumping out the inclosure and for keeping it drained to bedrock, as may be required, while his contract is in force.'

"It is contended by the defendants that under this paragraph it was the duty of the plaintiff to completely unwater the cofferdam, and that no claim could be made for extra pumping until this was done. This contention cannot be allowed for the reasons above stated, that the extra pumping was the method adopted by consent of the parties for stopping the leaks."

Approaches of Bloor Street Viaduct, Toronto, Have Concrete-Covered Steel Frames

Massive Appearance Produced by Deeply Paneled Concrete Facing of Side Spans Leading to Double-Deck Steel Arches

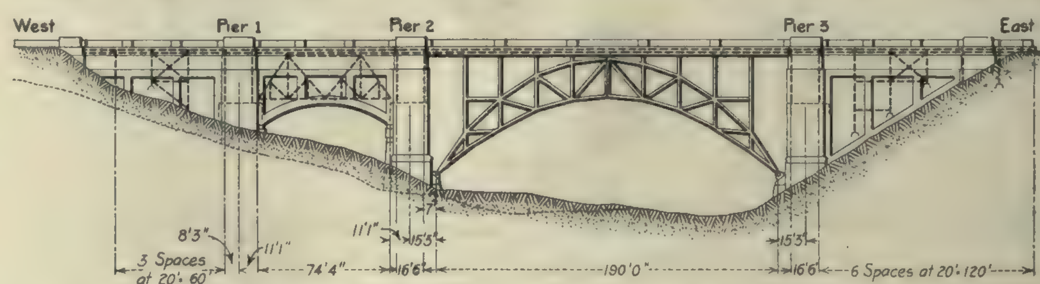
By W. F. B. RUBIDGE
Formerly Resident Engineer, Dominion Bridge Company, Toronto, Canada

APPROACHES to both the Rosedale section and the Don section of the Bloor Street viaduct in Toronto, Canada, are alike in the use of deeply paneled concrete facing on steel trusses, in order to give a massive effect to the spans leading to the main 190-ft. steel arches. The structure is a highway bridge of the double-deck type, with provision for future traffic on the lower deck. Foundation and profile conditions led to special details. For example, in the Rosedale section of the viaduct, here described, the west approach contains steel trusses covered by concrete, while the east approach is faced by vertical reinforced-concrete slabs on beams.

In 1914 the city of Toronto called for tenders for the construction of a viaduct across the Rosedale Ravine and the Don Valley, and invited designs in reinforced concrete and reinforced concrete and steel. The contract was finally let early in 1915 for structures which combine both designs, the approaches being of reinforced concrete and the main spans of three-hinged steel arches. The design adopted was prepared by the railway and bridge section of the works department of the city. The structure is designed with a lower deck for future underground railway traffic.

The foundations of all the pedestals, side walls, abutments and pier 1 on the west are of the ordinary spread type. For the main piers the foundations were carried down to bedrock, which is a hard shale at about 35 ft. below grade. Each pedestal to take the thrust from each arch rib on pier 3 is 10 ft. wide and 28 ft. long on top, battering to 30 ft. at the bottom. Small pedestals, 4 x 7 ft. on the outside, were designed to carry the outside portion of the pier. The ground on the north side was found to be so hard and uniform that the small pedestal on this side was omitted. Pier 2 is the same, except that the pedestals are 10 x 32 ft. and the small pedestals at both ends were required.

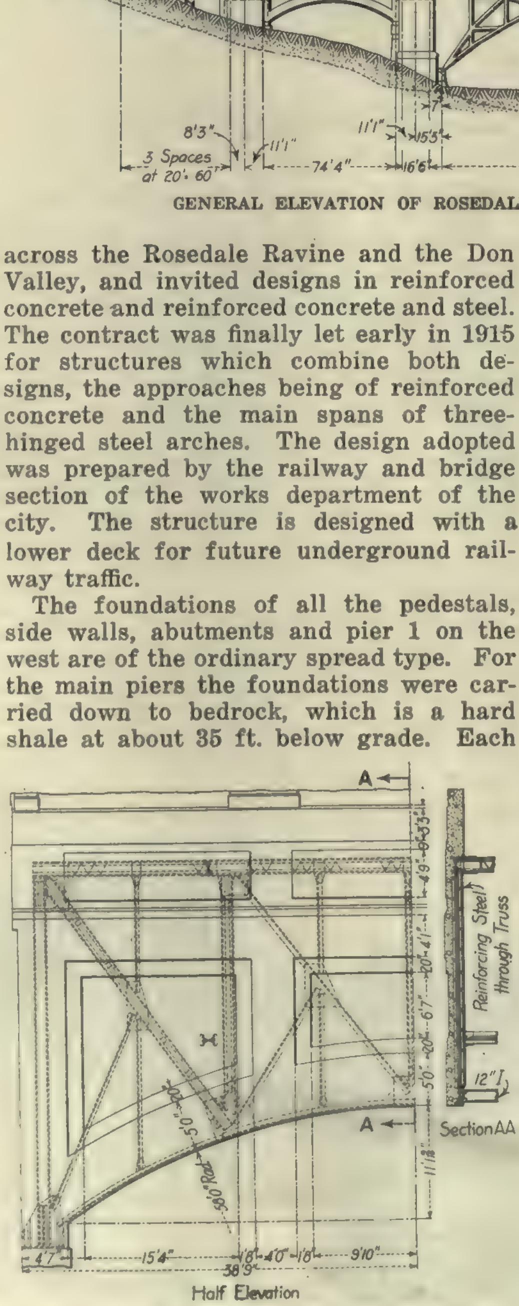
The bridge is 86 ft. wide out to out of handrailing, with two sidewalks 10 ft. 9 in. wide and two 20-ft. roadways on either side of a 14-ft. 6-in. space in the center for car tracks. The bridge is a double-deck structure, the difference in elevation of grades of the lower and upper deck systems being 22 ft. The deck on the east and west approaches is carried by columns spaced 20 ft. center to center along the axis of the bridge and 22 ft. transversely, which gives a short span under the sidewalk slabs, with beams bearing at one end on the side wall. On the piers the column spacing along the center line is reduced to 16 ft. 6 in. On the west approach 80-ft. through trusses for the underground service carry the top deck on the top chord. The soffit, which is on a radius of 58 ft., is suspended from the bottom chord of these trusses.



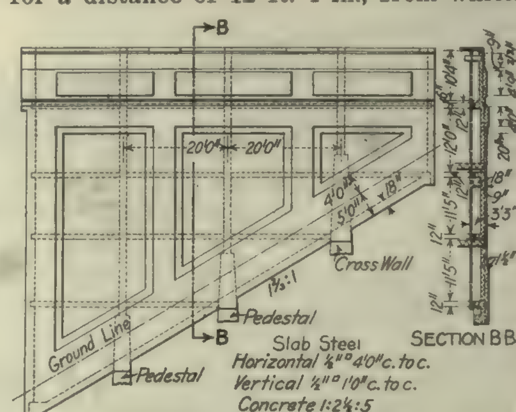
GENERAL ELEVATION OF ROSEDALE SECTION—BLOOR STREET VIADUCT

Massive Effect of Approaches

One of the striking features of this bridge is the massive effect produced by the side walls of the approaches. These walls are paneled to give relief to the large areas. Sections shown herewith give the main dimensions of the walls. It will be noticed that the exposed surfaces are vertical; also, that the back is vertical for a distance of 12 ft. 4 in., from which



DETAILS OF SIDE WALL BETWEEN PIERS



SOUTHEAST SIDE WALL OF APPROACH

point it batters ¼ in. to the foot. The paneling and general dimensions are the same for all the walls. These walls are tied in laterally, about the center, to the cross-wall up to a point 22 ft. below the top-deck grade. Additional ties are provided to stiffen the wall against deflection under heavy wind loads, by latticed steel struts framing into the columns. Ample provision is made for expansion at each end of the wall in the abutment and pier, the sliding surfaces being of zinc.

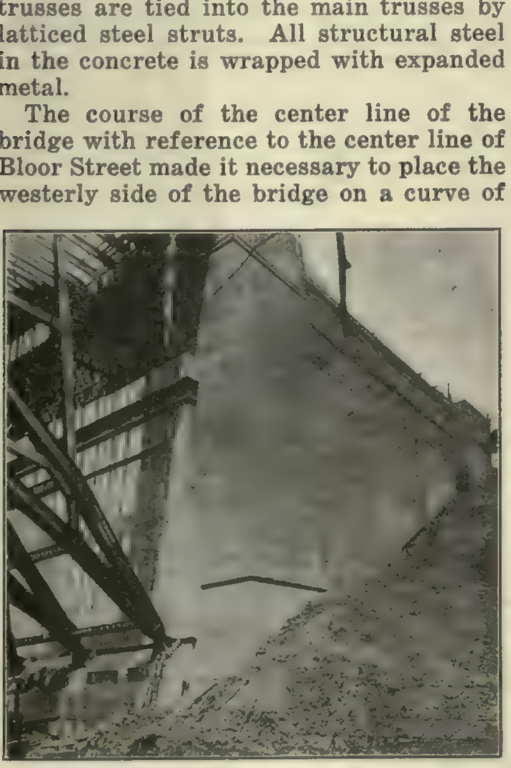
The southeast side wall presents a number of unique conditions. Owing to the large amount of fill placed south of the center line, this wall could not economically be carried on spread footings similar to the other walls. In places more than 30 ft. of wall would have been underground. The south pedestals, which are 7 ft. 6 in. by 17 ft. 6 in., are of a twin character, the column bearing on the north pedestal and the side wall on the south. This wall is in reality a vertical slab, with girders and beams all in the vertical plane; a drawing shows the arrangement of these girders and beams. The vertical reactions due to the dead load of the wall and dead and live load from the deck floor system are carried by the abutment, cross-wall, pedestals and pier. The panels for wind loading extend between the pedestals, the latticed steel struts and the deck of the bridge.

Expansion Pockets

On the approach side of pier 3 the expansion pocket for the side walls commences at a point 5 ft. below the finished ground line and extends to the deck of the bridge. Additional reinforcing was placed in the back walls to provide for the pressure of the earth. On the west side, pier 2 supports the 80-ft. span and the side walls on buttresses forming part of the main pier.

The side walls between piers 1 and 2 are carried on steel trusses, which are shown dotted in one of the drawings. The steel framing is punched to permit the reinforcing steel to pass through it. The relation of the concrete paneling and steelwork is indicated in the cross-section. The trusses are tied into the main trusses by latticed steel struts. All structural steel in the concrete is wrapped with expanded metal.

The course of the center line of the bridge with reference to the center line of Bloor Street made it necessary to place the westerly side of the bridge on a curve of



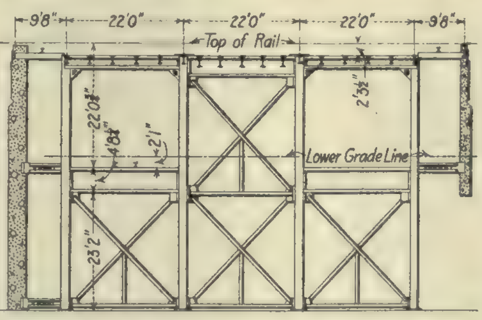
SOUTHEAST SIDE WALL DURING CONSTRUCTION

ERECTING INTERIOR TRUSSES—WEST APPROACH BETWEEN PIERS 1 AND 2

315.6-ft. radius. From the west abutment there are 60 ft. of retaining wall of the buttress type and 94 ft. of the cantilever type.

The finish on all exposed parts of the concrete is obtained by rubbing with carborundum blocks as soon as the forms are stripped. The handrailing for the 190-ft. span is carried on lattice girders, which are incased in concrete. Expansion is provided at each pier.

The proportions for the concrete are as follows: Piers and foundations, 1:3:5;



CROSS-SECTION OF EAST APPROACH

massive reinforced walls, 1:2½:5, and piers between decks, 1:2:4.

This work is being carried out under the direction of the City Department of Public Works, Bridge and Railway Section, of which R. C. Harris is commissioner; G. A. McCarthy, chief engineer, and T. Taylor, designing and construction engineer. For the Rosedale section the Dominion Bridge Company, Ltd., is the general contractor. The Raymond Construction Company, Ltd., is the subcontractor for the excavation and concrete work. The writer was resident engineer for the contractor.

Geological Survey Says Our Nitrate Is Without Value

The hope that an adequate and reliable supply of nitrate deposits might be found in the United States met disappointment Nov. 19, when the U. S. Geological Survey announced that the nitrate deposits in the country were worthless for practical or commercial utilization. The judgment officially arrived at by government experts, after a careful examination, means that if we should go to war we would have to depend on the nitrate industry of Chile for the raw product from which to obtain nitric acid, or else erect nitric-acid plants for the fixation of atmospheric nitrogen.

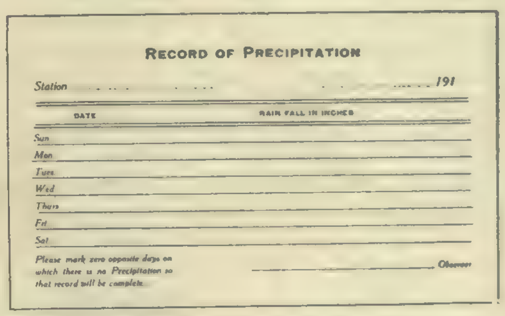
Record Hydraulic Data on Printed Post Cards

New England Power Company Gets Data from Fifteen Stations on Deerfield River on Ordinary U. S. Mailing Cards

TO KEEP a close check on stream flow at all times the New England Power Company maintains six precipitation and nine gaging stations on the Deerfield River, where five hydroelectric plants are operated in Connecticut. These gaging and precipitation stations outside the generating stations are provided with printed post cards on which data showing daily heights of water and rainfall are recorded. The printed cards, shown in the illustrations, are mailed to the dispatching office at Millbury, Mass. Using ordinary postal cards effects a saving in paper, stamps and office work. When the rainfall reaches 0.25 in. or more during the twenty-four hours, the data are telegraphed to the dispatcher.

By the work of the load-dispatching organization, the rainfall occurring at different times on the watersheds is made to benefit all the consumers on the combined systems. The interconnection of plants and the control of water from a central point also permit a reduction in operating expenses and assure better service by reducing to a minimum the possibility of total interruption at any time from line troubles or otherwise. The investment, and consequently the cost of power, can be reduced by combinations, and operating expenses can be decreased by rendering repairs easier, owing to greater facilities for shutting down. The union of adjacent water powers enables neighboring power markets to be more effectively interconnected, assuring thereby steadier levels of supply and demand.

Summaries are constantly maintained of all the causes of operating disturbance. Daily reports of operation and bulletins are forwarded from Millbury to the general manager's office at Worcester, showing all important statistics of production, water flow, reservoir conditions, load factors, probable production on date of bulletin, delivery of energy in kilowatt-hours to each customer and for the month to date, steam and purchased power used, service events and percentage data.



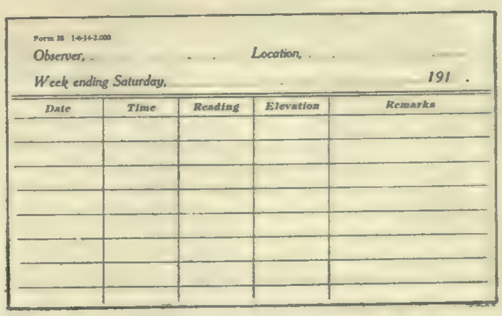
RECORD OF PRECIPITATION

Station ... 191

DATE	RAIN FALL IN INCHES
Sun	
Mon	
Tues	
Wed	
Thurs	
Fri	
Sat	

Please mark zero opposite days on which there is no Precipitation so that record will be complete. ______ Observer

RAINFALL DATA POST CARD



Form 38 1-6-14-2,000

Observer, ... Location, ...

Week ending Saturday, ... 191 .

Date	Time	Reading	Elevation	Remarks

GAGING-STATION REPORT

COFFERDAM FOR HEADGATES PUMPED OUT—TEMPORARY BRIDGE IS ON LINE OF DAM

Diversion-Weir-Canal Type Used for Pioneer Hydroelectric Development in Sandy Soil

Low-Head Dam on Sand Bottom of Middle Loup River Near Boelus, Nebraska, Rests on Piles and Has Cutoff Walls of Steel and Wood Sheeting

A DIVERSION DAM resting on a pile foundation in sandy soil 100 ft. deep is a feature of the first important hydroelectric development in Nebraska, that of the Central Power Company on the Middle Loup River. For the sandy streams peculiar to several Middle Western states the diversion-weir-canal type of power development is the only possible one. The project itself is a pioneer development, and but few dams of this type have been built for any purpose in this country.

Water Diverted Through Canal to South Loup River

The development will take over the load from a 2000-kw. steam plant at Grand Island, acquired by the Central Power Company from the Grand Island Electric Company in August, 1915, at the time the former company was organized to take over the water development begun by the L. E. Meyers Company in February, 1915. The enlarged steam plant will be maintained as a reserve, and the main distribution will be from this point.

The river level will be raised 5 ft. by the diversion dam, located a short distance above the crossing of the Pleasanton branch of the Union Pacific Railroad, and the water drawn into a canal 5 ft. below normal river level, giving a depth of 10 ft. in the canal. The water will follow this canal about 3 miles to the main 2500-kw. power house on the South Loup River, where a head of 28 ft. will be developed. No wasteway has been provided at the power house, all surplus water going over the dam. In order to divert the South Loup River, primarily for the purpose of relieving the main plant of difficulties due to flood water in the tailrace, a small dam is also being built on the South Loup River just above the main power house. Advantage will be taken of the channel, cut across a neck of land inside a meander above the small dam, to develop 500 kw. on a 10-ft. head at a second power house.

Dam Rests on Piles

Since the site of the dam is mostly sand to a depth of at least 100 ft., it was necessary to build the concrete structure on a pile foundation. At the south end of this concrete section, as shown in the drawing, four sluiceway openings occupy 62 ft. Two of these openings have steel gates with hand-operated racks, and the two nearest the spillway are provided with stoplogs. This sluiceway provides a means of controlling the flood level of the river to avoid overflowing the branch of the Union Pacific Railroad north of the dam, while the crest of the structure is high enough to impound sufficient water to keep the canal full at all times. The rest of the dam is an overflow section 43 ft. wide. Both it and the sluiceway are protected from underwash by steel sheeting 40 ft. long under the crest and by Wakefield wood sheeting driven to 30-ft. penetration 10 ft. from the downstream edge of the apron. From foundation line to the top of the concrete the dam is 10 ft. in height. Above this level are 3 ft. of flashboards to be taken out by high water. The apron tapers from 3 ft. thick below the crest to 18 in. at the downstream edge. The piles which support it are 40 ft. in length and spaced on 10-ft. centers. The apron is reinforced with ¾-in. rods running both straight and diagonally between the piles. The spillway section contains 2600 cu. yd. of concrete, and the headgates and sluiceway 1700 yd.

The north end of the dam is an earthfill 3000 ft. in length, into which the steel sheeting is continued north from the concrete portion for a distance of 200 ft. This fill is 20 ft. wide on top with a 3 to 1 slope on the upstream and a 2 to 1 slope on the downstream side. Where the wash strikes it on the upstream side it will be paved with concrete.

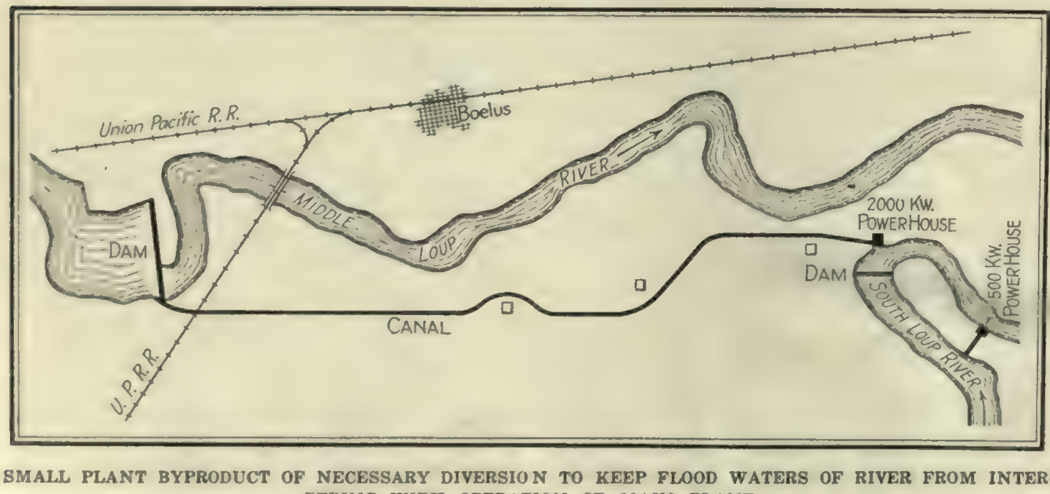
On the south end at right angles to the spillway section are the headgates, which are controlled by stoplogs. The trash racks which protect the five gates are arranged so as to act also as ice guards. A concrete walk 8 to 10 ft. wide across the headgates and sluiceway provides a mounting for the gate rigging and contains openings through which the stoplogs are handled.

Canal Partly Leveed

The canal which takes water from these headgates is 30 ft. wide on the bottom, with 2½ to 1 side slopes for the first half mile and 2 to 1 slopes thereafter. Passing water at 10-ft. depth, it has a fall of 3 ft. between the dam and the power house. For some 10,000 ft. it was necessary to build dikes in order to provide sufficient margin for the required depth, the minimum cut being 5 ft. The deepest cut is approximately 22 ft. The canal passes for the first half mile through fine sand, and for the rest of the way is almost entirely in yellow clay. About 400,000 cu. yd. was removed in building it. At its lower end the canal widens into a small forebay 500 ft. wide by 1000 ft. long.

The power house, built chiefly of reinforced concrete, contains a central wall of concrete 3 ft. thick, which divides the room containing the generators from the wheelpits. There are two of the latter, each 20 ft. wide, 50 ft. long and from 18 to 25 ft. deep. In each is mounted a horizontal turbine, the discharge from which is carried through the floor into a draft tube 10 ft. in diameter, from which it is discharged horizontally into the flumes under the section of the power house containing the generators. These discharge openings are 20 ft. wide and 11 ft. high. The walls of the wheelpits are of reinforced concrete and taper from 2 ft. thick at the base to 9 in. at the top. A concrete bridge designed to carry a 20-ton roller was built across the flumes and was taken advantage of to support the trash racks and stoplogs. These are located on the canal side of the bridge. Both wheelpits receive water through a flume 60 ft. wide and 16 ft. deep on its west end. This flume extends 20 ft. further than was at first intended, in order to end the concrete-lined portion in more suitable soil. The distance from its west end to the river face of the power house is 100 ft.

Great difficulty was experienced both in driving the cofferdam and in keeping soft material from flowing into it during the construction of the power-house founda-

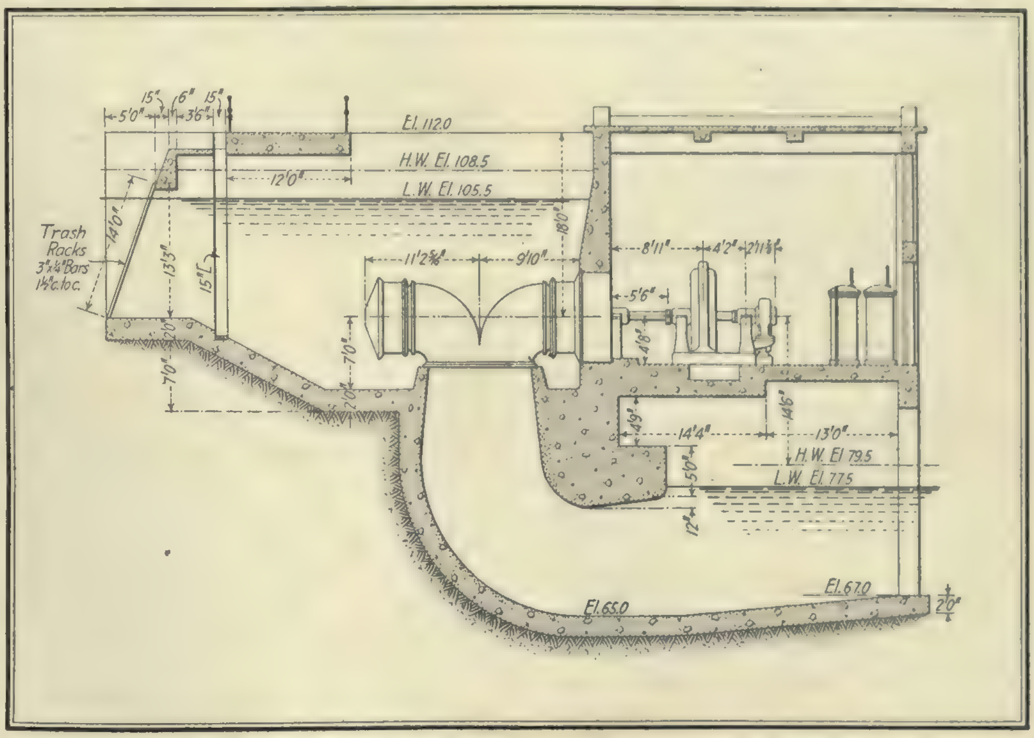


SMALL PLANT BYPRODUCT OF NECESSARY DIVERSION TO KEEP FLOOD WATERS OF RIVER FROM INTERFERING WITH OPERATION OF MAIN PLANT

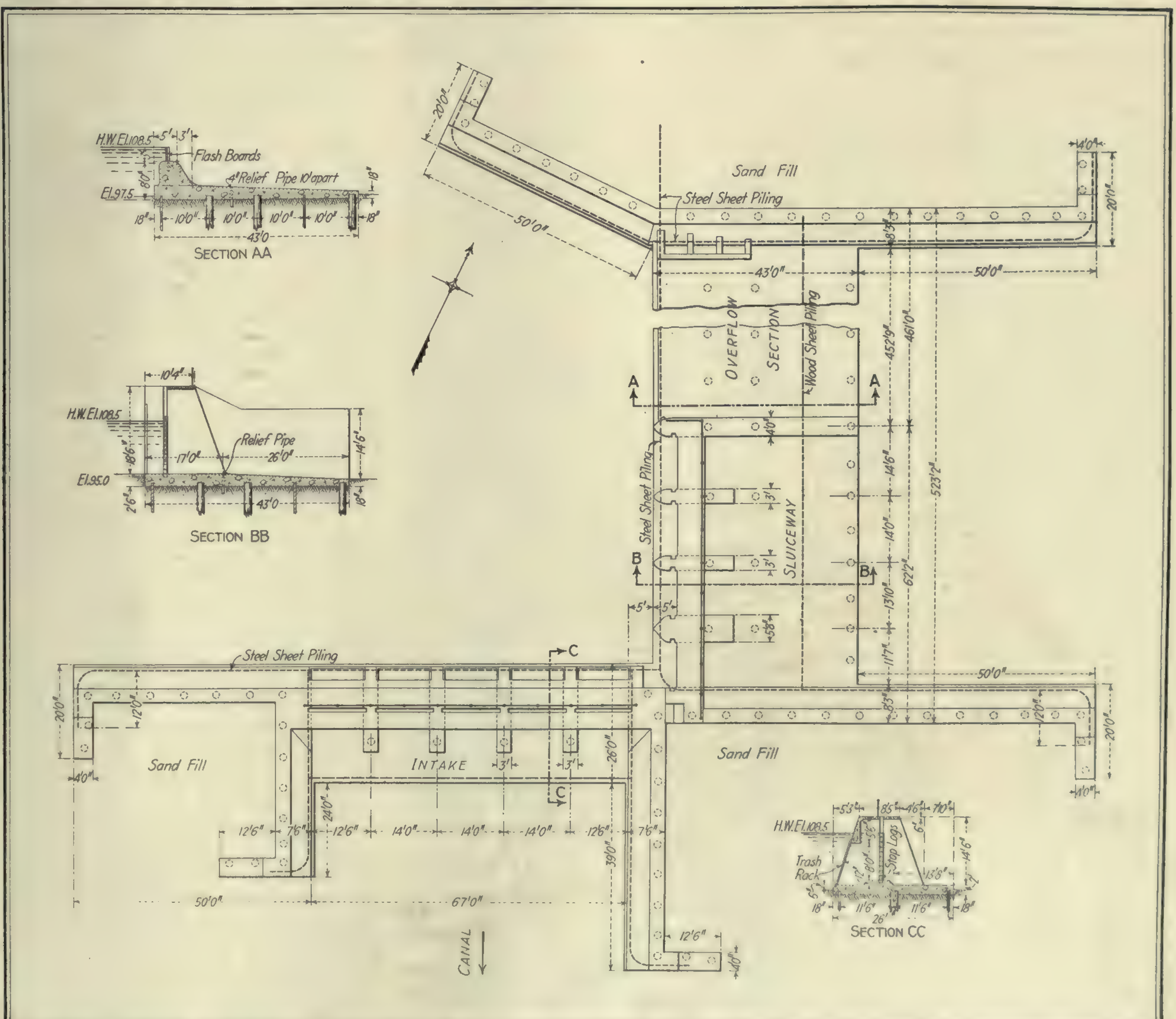
tions. The excavation extended 16 ft. below river level, and the external pressure developed was considerable. Though little water entered the excavation, every small crack that developed would let in a yard or more of material in a few minutes, and a close watch had to be kept on the sheeting. The 1200 yd. of cofferdam excavation was removed by shoveling into buckets handled with a derrick. As soon as the excavation reached grade, 2 ft. of concrete was poured over the bottom and against the sheeting on all sides. The side walls were then carried up a few feet at a time, the bracing being removed and put back between the walls. The draft-tube forms were then placed and the space between them and the side walls filled with concrete.

Two Wheels on Each Shaft

Two 42-in. diameter horizontal wheels are mounted on each shaft. Each wheel develops 1500 hp. when passing 630 cu. ft. of water per minute, making 180 r.p.m. This will develop 1250 kw. for each of the two generators. Each unit is direct-connected to its own exciter, besides which a 50-kw. motor-driven exciter is provided to serve both generators. The generating room also



TWO WHEELS MOUNTED ON SAME SHAFT DRIVE 1250-KILOWATT UNIT



DAM FOUNDED ON PILES IN SAND, RIVER BED RAISES WATER 5 FEET TO LEVEL OF CANAL, WHICH TAKES IT TO 28-FOOT-HEAD POWER PLANT

contains the three 750-kw. water-cooled transformers, which step the current up from 2300 volts to the line pressure of 33,000 volts. The high-tension lines are carried out of the building through roof bushings, from which they pass through choke coils and airbrake switches mounted on the roof to the transmission line.

The control panel for the small plant on the South Loup River is located in the switchboard of this building, and the latter plant will be floated on the line without a governor and without any special attendant.

DRAGLINES EXCAVATE CANAL

The earth portion of the main dam was built last year and a start made on the concrete portion. The latter was constructed inside of unbraced box cofferdams. The work, which was interrupted last winter by cold weather, was resumed in the spring and is to be completed this season. The canal, however, was practically finished during the fall of 1915 by two dragline excavators equipped with 2½-yd. buckets. These machines worked 22 hours a day until stopped by frost, with 800 ft. of canal remaining to be constructed next the power house.

The work is being completed by the Central Power Company.

Manure Protects Concrete in Cold Weather

Manure as an effective protection for freshly made concrete during freezing weather has been the subject of experiment at the Lewis Institute in Chicago. Concrete slabs were exposed to outdoor conditions and covered with 2, 4 and 6 in. of fresh livery-stable manure. It was determined that the 4 and 6-in. layers were sufficient to protect the concrete against a drop in temperature of 25 or 26 deg. There was no indication that there was any advantage of the 6-in. covering over the 4-in. layer. The 4-in. layer appeared to be a sufficient protection against a temperature of 12 deg. Fahr. The manure and the liquids should not be permitted to come in direct contact with the freshly made concrete. This can be easily and cheaply accomplished by the insertion of building paper, or even newspaper, between the concrete and the protective covering.

To Facilitate Laying Out Sharp Railroad Curves

Tables Permit Determining Corrections for All Lengths of Subchords for Curves Ranging in Degree from 4 to 56

By F. T. HOWES
Valuation Department, Duluth, South Shore & Atlantic Railway, Duluth, Minn.

WHEN sharp railroad curves are run in the field by the method of deflection angles, with chord lengths or subchords of less than 100 ft., a correction should, as is well known, be added to the subchord, for the reason that the degree of the curve is by definition the angle subtended by a 100-ft. chord, the arc is longer than the chord and the shorter the subchords the more closely they approximate the length of the arc. On curves of 10 deg. or sharper the correction is of appreciable moment. The accompanying tables have therefore been developed to facilitate the laying out of such curves.

In Table 1 will be found the lengths of seven convenient subchords for curves of every degree from 4 to 56. This table also gives the radius, the deflection angle for 1 ft. and the actual arc per station, as determined by the formula $A = (10/36)/(\pi\ D/\sin \frac{1}{2}\ D)$, where A is the length of the arc in feet and D is the degree of curvature.

Table 2—Ratio of Correction of Subchord to Excess of Arc per Station

Nominal length	Ratio	Nominal length	Ratio	Nominal length	Ratio	Nominal length	Ratio
1	0.010	26	0.242	51	0.377	76	0.320
2	0.020	27	0.250	52	0.380	77	0.312
3	0.030	28	0.258	53	0.381	78	0.304
4	0.040	29	0.266	54	0.382	79	0.296
5	0.050	30	0.273	55	0.383	80	0.287
6	0.060	31	0.280	56	0.383	81	0.278
7	0.070	32	0.287	57	0.384	82	0.268
8	0.080	33	0.294	58	0.384	83	0.258
9	0.089	34	0.301	59	0.384	84	0.247
10	0.099	35	0.307	60	0.383	85	0.235
11	0.109	36	0.313	61	0.383	86	0.224
12	0.118	37	0.319	62	0.381	87	0.211
13	0.128	38	0.325	63	0.379	88	0.198
14	0.139	39	0.331	64	0.377	89	0.185
15	0.147	40	0.336	65	0.374	90	0.170
16	0.155	41	0.341	66	0.372	91	0.155
17	0.165	42	0.346	67	0.368	92	0.141
18	0.174	43	0.350	68	0.365	93	0.125
19	0.183	44	0.354	69	0.361	94	0.109
20	0.192	45	0.358	70	0.356	95	0.092
21	0.201	46	0.362	71	0.352	96	0.075
22	0.209	47	0.365	72	0.345	97	0.057
23	0.218	48	0.369	73	0.340	98	0.039
24	0.226	49	0.372	74	0.334	99	0.020
25	0.234	50	0 374	75	0.327	100	0.000

Given a 20-deg. curve, and a desired chord length of 30 ft. From Table 1 the true chord length will be 30.14 ft., and there will be three chords of 30.14 ft. and one of 10.05 ft. for every 100-ft. station. From the table, the deflection for 1 ft. is 0° 06.0′. Hence the deflection for 30 ft. (nominal length) is 30 × 0° 06.0′ = 3°; the deflection for 10 ft. is 10 × 0° 06.0′ is 1°, and the total deflection per station is 10°.

Now it is found that whatever the degree of curve there is a constant ratio between the correction of subchord length and the excess of arc per station—actual length of arc minus 100. These ratios are given in Table 2 for chord lengths for each foot from 1 to 100. Using the two tables we can determine the chord lengths and deflections for nominal lengths other than those given in Table 1.

For example , given a 20-deg. curve and a proposed chord length of 22 ft. From Table 1 the excess of arc is 0.510 ft., and from Table 2 the ratio of correction is 0.209. Hence the correction for the subchord is 0.510 × 0.209 = 0.107 ft. and the subchord length is 22.107 ft. From Table 1 the deflection for 22 ft. is 22 × 0°06′ = 2°12′.

Build Concrete-Slab Cover for 19-Mile Ditch

Earth Cushion Protects Concrete from Falling Boulders—Work Done by San Diego as Result of Flood Last January

By A. C. FRANCIS
Operating Department, San Diego, Cal.

THE city of San Diego, Cal., recently completed repairs to the Dulzura conduit, a 19-mile open concrete ditch between the Morena reservoir and the Otay watersheds, at a cost of $13,290. The work, made necessary by the flood of last January, consisted of removing sand and other débris from such portions of the ditch as remained intact and the replacing of such concrete sections as had been washed out. Reconstruction of the wooden and steel flumes which had been torn away by landslides was also necessary. To prevent the entrance of dirt and débris into the open ditch, concrete slab covers were added, on which an earth cushion was placed to deaden shocks caused by falling rock.

Work was begun early in March and com-

Table 1—Radii, Actual Arcs, Unit Deflections and True Chord Lengths for Various Nominal Chord Lengths and Degrees of Curve

Degree of curve	Radius, ft.	Actual arc per station	Deflection for 1 ft.	10	20	25	30	40	50	55
				Nominal length of subchord / True length of subchord						
4	1432.69	100 020	0°01.2′	10.00	20.00	25.00	30 01	40.01	50 01	55.01
5	1146.28	100.032	01.5′	10 00	20.01	25.01	30.01	40.01	50.01	55.01
6	955 37	100 046	01.8′	10.00	20 01	25.01	30.01	40.02	50.02	55.02
7	819 02	100.062	02.1′	10.01	20.01	25.01	30 01	40.02	50.02	55.02
8	716.78	100.081	02.4′	10.01	20.02	25.02	30.02	40.03	50.03	55.03
9	637.28	100 103	02.7′	10.01	20.02	25.02	30.03	40 03	50·04	55.04
10	573.69	100 127	03.0′	10.01	20 02	25.03	30.03	40.04	50.05	55 05
11	521.67	100 154	03.3′	10 02	20 03	25.04	30.04	40 05	50.06	55.06
11°28′	500.51	100.167	03.4′	10.02	20.03	25.04	30.04	40.05	50.06	55.06
12	478.34	100.188	03.6′	10.02	20.04	25.04	30.05	40.06	50.07	55.07
13	441.68	100 215	03.9′	10.02	20.04	25.05	30.06	40 07	50.08	55.08
14	410:28	100 249	04.2′	10.02	20.05	25.06	30.07	40.08	50.09	55.09
14°22′	399 86	100.262	04.3′	10.02	20.05	25.06	30.07	40.09	50.10	55.10
15	383.07	100 286	04.5′	10 03	20.05	25.07	30.08	40.10	50.11	55.11
16	359.27	100.326	04.8′	10.03	20.06	25 08	30.09	40.11	50.12	55.12
17	338.27	100 368	05.1′	10.04	20.07	25.09	30.10	40.12	50.14	55.14
18	319.62	100 412	05.4′	10.04	20.08	25.10	30.11	40.14	50.15	55.16
19	302 94	100.460	05.7′	10.05	20.09	25.11	30.13	40.15	50.17	55.18
19°12′	299 82	100.470	05.8′	10.05	20.09	25.11	30.13	40.15	50.18	55.19
20	287.94	100.510	06 0′	10.05	20.10	25.12	30.14	40.17	50.19	55.20
21	274.37	100.562	06.3′	10.06	20.11	25.13	30.15	40.19	50.21	55.22
22	262.04	100.617	06.6′	10.06	20.12	25.14	30.17	40.21	50.23	55.24
23	250.79	100.675	06 9′	10.07	20.13	25.16	30.18	40.23	50.25	55.26
24	240.49	100.735	07.2′	10.07	20.14	25.17	30.20	40.25	50.28	55.28
25	231.01	100.798	07.5′	10.08	20.15	25.19	30.22	40.27	50.30	55.31
26	222.27	100.863	07.8′	10.09	20.17	25.20	30.24	40.29	50.32	55.33
27	214 18	100.931	08.1′	10.09	20.18	25.22	30.25	40.31	50.35	55.35
28	206 68	101 002	0°08.4′	10.10	20.19	25.23	30.27	40.34	50.38	55.38
29	199.70	101.075	0°08.7′	10.11	20.21	25.25	30.29	40.36	50.40	55.41
30	193.19	101.152	09.0′	10.11	20.22	25.27	30.31	40.39	50.43	55.43
31	187.10	101.230	09.3′	10.12	20.24	25.29	30.34	40.42	50.46	55.46
32	181.40	101.312	09.6′	10.13	20.25	25.31	30.36	40.44	50.49	55.49
33	176.05	101.369	09.9′	10.14	20.27	25.33	30.38	40.47	50.52	55.53
34	171.02	101.482	10.2′	10.15	20.29	25.35	30.41	40.50	50.56	55.57
35	166.28	101.572	10.5′	10.16	20.30	25.37	30.43	40.53	50.59	55.60
36	161.80	101.664	10.8′	10.16	20.32	25.39	30.45	40.56	50.62	55.64
37	157.58	101.759	11.1′	10.17	20.34	25.41	30.48	40.59	50 66	55.67
38	153.58	101.857	11.4′	10.18	20.36	25.43	30.50	40 62	50.70	55.71
39	149.79	101 957	11.7′	10.19	20.38	25.46	30.53	40.66	50.73	55.75
40	146.90	102.060	12.0′	10.20	20.40	25.48	30 56	40 69	50.77	55.79
41	142.77	102.166	12.3′	10.21	20.42	25.51	30.59	40.73	50.81	55.83
42	139.52	102.275	12.6′	10.23	20.44	25.53	30.62	40.77	50.85	55.87
43	136.43	102.386	12.9′	10.24	20.46	25.56	30.65	40.81	50.89	55.91
44	133.47	102.500	13.2′	10.25	20.48	25.59	30.68	40.85	50.94	55.96
45	130.65	102.617	13.5′	10.26	20.50	25.61	30.71	40.88	50.98	56.00
46	127.97	102.737	13.8′	10.27	20.53	25.64	30.75	40.92	51.02	56 04
47	125.39	102.860	14.1′	10.28	20.55	25.67	30.78	40.96	51.07	56.09
48	122.93	102.985	14.4′	10.30	20.57	25.70	30.81	41.00	51.12	56.14
49	120.57	103.114	14.7′	10.31	20.60	25.73	30.85	41.05	51.17	56.19
50	118.31	103.245	15.0′	10.32	20.62	25.76	30.89	41.09	51.21	56.24
51	116.14	103.38	15.3′	10.33	20.65	25.79	30.92	41.13	51.26	56.29
52	114.03	103.51	15.6′	10.35	20.67	25.83	30.96	41.18	51.32	56.34
53	112.06	103.65	15.9′	10.36	20.70	25.86	31.00	41.23	51.37	56.40
54	110.13	103.80	16.2′	10.38	20.73	25.89	31.04	41.27	51.42	56.45
55	108.28	103.94	16.5′	10.39	20.76	25.92	31.08	41.32	51.48	56.51
56	106.50	104.09	0°16.8′	10.41	20.79	25.96	31.12	41.37	51.53	56.56

CONCRETE SLABS PREVENT LANDSLIDES FROM FILLING OPEN DITCH

pleted the last of August. In the repair of the conduit, 20,315 yd. of earth and débris was removed, 1511 ft. of ditch was entirely replaced, 1196 ft. relined, 789 ft. of wooden flume rebuilt, and 695 ft. of steel flume renewed. Excavation cost $16,541; concrete work, $9,929; and flume repair, $14,139. Miscellaneous expenses amounted to $2,118. Nearly 1000 tons of supplies and material was hauled by auto truck from San Diego to Barrett, a distance of 40 miles, at an average cost of $8.50 per ton.

Slabs Placed Over Open Ditch

Upon completion of the repair job it was decided to place protecting slabs over portions of the open ditch where it was exposed to landslides. This concrete cover is from 6 to 7½ ft. wide and about 5 in. thick. Slabs were made by placing 8 and 25-lb. rails at intervals of 2 ft. and covering with wire mesh and concrete. At the end of each section of slabbing a small concrete wing wall prevents earth and other material on top of the slabs from falling into the ditch.

The concrete slabs are protected from falling boulders by an earth cushion several feet thick and sloping to conform somewhat to the grade of the mountainside. More than 1200 cu. yd. of earth was used in that way at a cost of 25 cents a yard.

About 3700 ft. of slab was built, at a total cost of $13,290.60. The cost per linear foot, including the wing walls and cushioning, was $3.614. This work was discontinued about the middle of October, but it is hoped that the remaining 2000 ft. of exposed conduit will be covered early next year.

Exposition Timber for Tunnel Lining

In timbering the Twin Peaks tunnel at San Francisco preparatory to pouring the concrete lining, about 19,000,000 ft. b.m. of lumber is being used. A large part of this was purchased by the contractors from the exposition company. The 12 x 12-in. timbers used in the columns of the various palaces were found to be about the size desired and for tunnel timbers they served as well as would the more costly lumber direct from the mill.

Light Timber Mast Used in Repairing Bascule Bridge

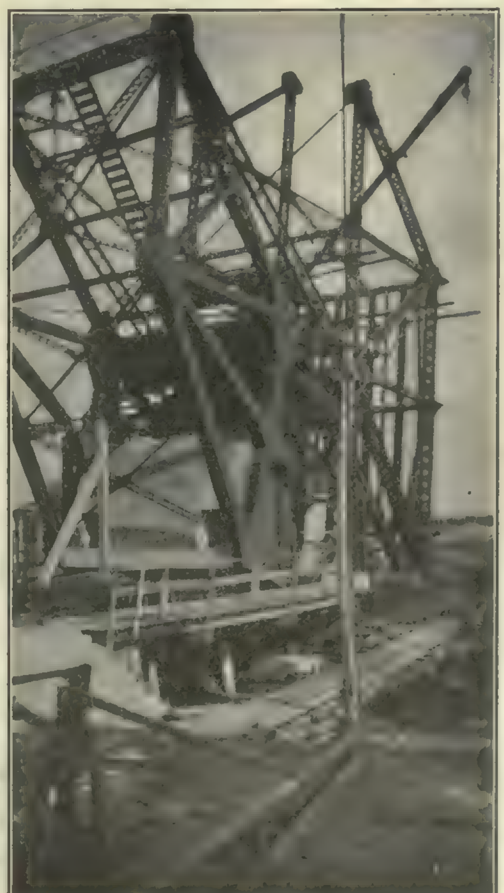
Damaged Moving Leaf Dismantled and Members Either Replaced by New Material or Straightened and Again Used

REPAIRS were completed and the damaged Strauss bascule bridge over the Sabine Neches Canal at Port Arthur, Tex., described in the Engineering Record of Aug. 19, page 228, was successfully restored to operating condition on Nov. 9. The moving leaf of this bridge was badly injured and bent when it was struck last April by a seagoing gasoline steamer. Soon after the accident a contract was let for its repair, and the dismantling and replacement have been successfully completed. A light timber mast was used in the erection work. It was connected to a heavy short timber by a double knuckle to allow movement in two directions, and could easily be attached to the steel frame of the bridge at any desired location.

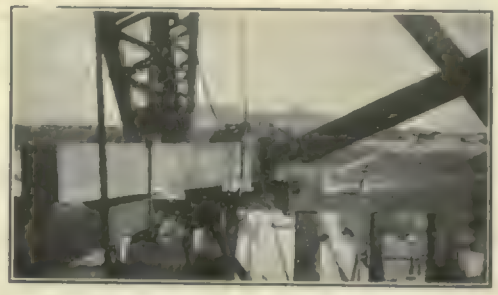
As described in the article mentioned, the span was in raised position at the time of the accident. Bracing timbers were at once placed to strengthen the moving leaf, the span was guyed with cables, the wooden floor was removed to lessen danger from winds and the counterweight was blocked against movement. The counterweight trusses and links suffered no damage.

Dismantling the Span

The moving leaf was taken down member by member. Pieces that were slightly bent were straightened and used again. Those members that were too badly injured were replaced by new members. None of the machinery was damaged and the structural members supporting it were only slightly bent. Whatever machinery had to be moved to allow of repairs to structural members was not taken down



RE-ERECTION BY TIMBER MAST



DETAILS AT BASE OF MAST

entirely, but was lashed to the counterweight tower.

The contractor's plant consisted of an air compressor to furnish the air used in cutting out rivets in dismantling and for driving rivets in re-erection, a hoisting engine placed on the ground to furnish power for handling the bridge members, and a timber mast fitted at its base with a double knuckle made up of steel plates and steel pins to permit movement in two directions at right angles. This mast was used in connection with the hoisting engine.

Details of Mast

The base piece of the mast was bolted to a short piece of timber which could be bolted to the span. These details are shown in one of the photographs. The mast was bolted to the span successively in several positions as the work progressed. Load lines for handling the steel and lines for swinging the end of the mast led to the hoisting engine on the shore. In dismantling, the mast was set and lashed to the span in position to reach the upper end, and as the members were taken down the mast was lowered to new positions as needed. In re-erecting the mast was of course raised each time.

Close to the bridge a forge was installed to heat members which were only slightly bent, and were straightened, a small derrick being used to handle the steel.

Evidence indicated that when the boat struck the bridge the piers were racked. One of the piers was cracked and one of the bottom laterals between the river piers and tower piers was broken. However, no attempt was made to straighten the piers. As a safeguard against a repetition of the accident, the city of Port Arthur has had several clusters of piles driven in addition to those originally put in when the bridge was erected.

The repair contract for the reconstruction of damaged parts was let to the Spence-Howe Construction Company, of Port Arthur, Tex. E. B. Van de Greyn of Houston, Tex., was retained as consulting engineer by the city and the contractors. The new steel members were fabricated by the Houston Structural Steel Company, of Houston, Tex.

Water in Earth's Crust

The amount of water contained in the earth's crust (to a depth of 3 miles) has been estimated by different writers with widely different results. A recent estimate is given by the U. S. Geological Survey of the total amount of free water in the earth's crust as equivalent to a uniform sheet over the entire surface of the earth having a depth of about 100 ft. This is only a small fraction of the estimate made by other writers.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Truck Used as Tractor Hauls Engine on Semi-Trailer

A DONKEY engine with its equipment, weighing about 13 tons, was recently transported by using two logs as supports and mounting them on a semi-trailer as shown in the accompanying picture. The logs weighed about a ton apiece, making the total load approximately 15 tons. The outfit was used near Seattle, Wash. The truck was a $3\frac{1}{2}$-ton Kelly Springfield.

THREE-AND-ONE-HALF-TON TRUCK HAULS DONKEY ENGINE MOUNTED ON SEMI-TRAILER

Time Clock Saves Office Work on Large Job

AN UNUSUAL office system for keeping time, checking tools and making distributions, in use on the construction work of the H. Koppers Company, is described on page 703 of this issue. It involves the use of a time clock, turning in of the distributions by the general foremen, and the issuing of from four to six tool checks to each man, and is said to save much office work and to give accurate results.

The men on going to work and leaving punch a slip in a time clock at the office. These slips are checked up by the timekeeper, who covers the job once during the day and sees that every man who has punched the clock is at work. From these slips the time is entered daily on the payroll. This timekeeper does not bother with the distribution of the labor, which is turned in each night by the general foremen. Each sub-foreman is supplied with small sheets on which he writes the names and numbers of the men in his gang and a description of the work he did during the day. This takes only a short time. These slips are turned in to the general foremen before leaving, who in turn hand them to the office force. From these slips, using the proper distribution numbers, two men in the office compile the labor charges and check the payroll.

This system simplifies the task of the timekeeper, who has only to check the time worked by the men, and also the task of the foremen, each of whom has only to put down the names of men in his gang and furnish a short description of the work done. With all the information on the desk in front of him, it is then an easy task for an office man to make the distributions and check them with the time worked. In this way three office men keep a close check on the doings of 450 workmen at a cost which ordinarily would permit of keeping only a general distribution of the time worked on different classes of construction.

Another good feature of the system is the method of checking the issuing of hand tools to the men. Each man, depending on whether he is a laborer or a mechanic, is given from four to six brass checks, each with his number on it. When he takes a shovel or a wrench from the tool house he gives up one of these checks. On a large rack on one side of the tool house are several hundred hooks, under each of a certain number of which is printed the word "Shovel," while other hooks are labeled "Pick," "Wrench," "Hammer," etc. The man's check is hung on one of the hooks labeled with the name of the tool he has taken. When he returns the tool his check is given back to him. Before pay day, or when a man is discharged, if he cannot show all the checks issued to him the storekeeper can tell in a few seconds whether he has any tools unreturned and what they are. He can also tell at a glance how many tools of any kind are out and who borrowed them.

Forms for Highway Arch Over Busy Railroad Hung from Girders

HAVING designed a concrete arch bridge for a highway crossing over its tracks at Millburn, N. J., with minimum clearance in order to reduce approach grades, the Delaware, Lackawanna & Western Railroad has constructed it by supporting the formwork from old plate girders. All three of the main line tracks below the bridge carry a heavy commuting traffic at certain hours of the day, and it was not advisable to erect any posts between the tracks. The bridge is on a skew and the main line below it on a curve at this point. The clearance allowed made ordinary arch centers out of the question.

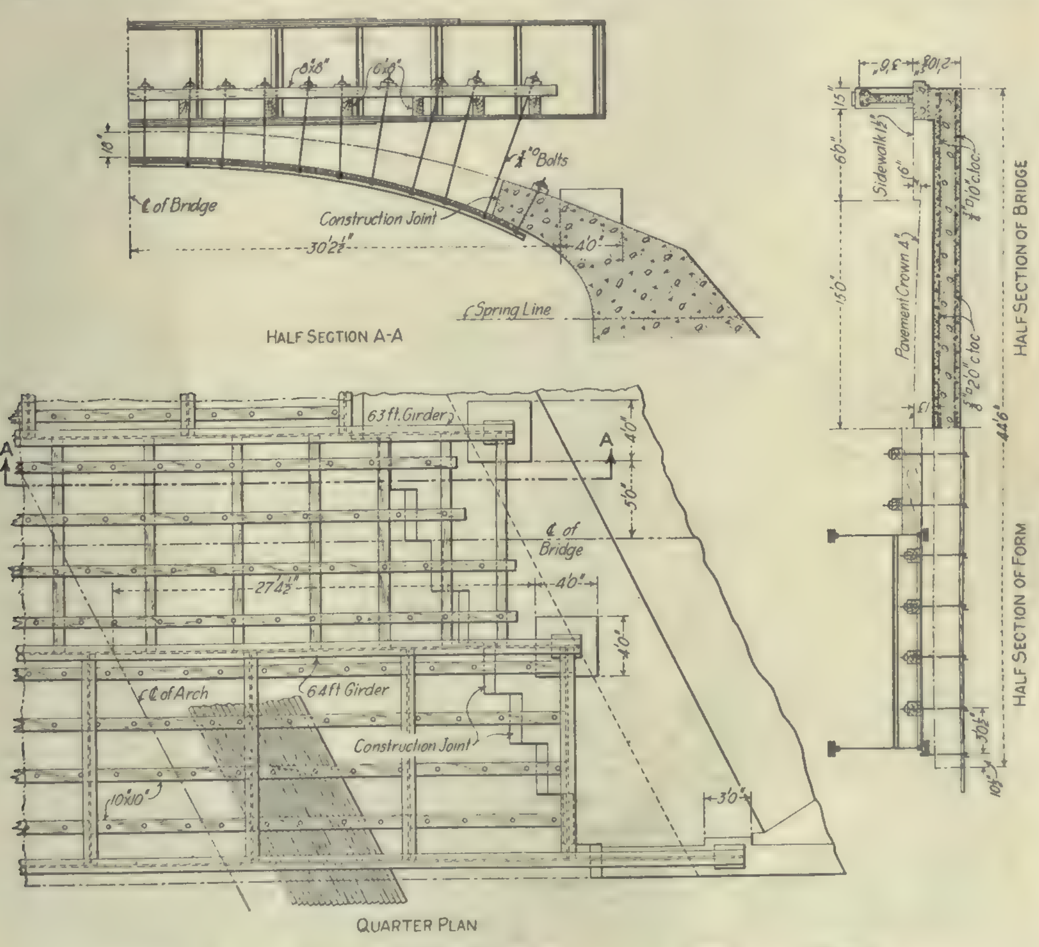
The abandoned 60-ft. plate girder bridge which was used to support this centering was not quite long enough to span the entire distance. On this account the abutments and the lower section of the arch on each side were concreted together, the

WITH TIME CLOCK THREE OFFICE MEN KEEP CLOSE CHECK ON DOINGS OF 450 WORKMEN


WHERE CLEARANCE FORBADE SUPPORT FROM BELOW, GIRDERS OF OLD BRIDGE SET ABOVE ARCH CARRIED FORMS OVER 45-FOOT SPAN

arch sections being stepped back on planes normal to the thrust on account of the skew. This overhang was supported on the falsework shown in one of the illustrations. The girders were then set on the shoulders on blocking high enough to clear the concrete at the center of the arch, but, as it proved later, not quite high enough for convenience in pouring the last of the concrete. Between the outside pairs of girders the form was hung from timbers resting on the old floorbeams, while in the center space the timbers parallel to the girders rested on cross-timbers carried by the lower flanges of the girders. In each case bolts with nuts and beveled wood washers at the top end were run radially through the longitudinal timbers to support 3 x 3-in. angles bent to the curve of the arch on which transverse wood lagging was laid. The proper curve in the form was secured by screwing up the nuts at the upper ends of the rods supporting the angles.

The bridge was built for the Delaware, Lackawanna & Western Railroad, of which George J. Ray is chief engineer, by James A. Hart, contractor, of New York City. The work was designed by A. B. Cohen, concrete engineer for the railroad, and was in charge of G. B. Barackman, assistant engineer, and G. T. Hand, division engineer.



SUPPORT OF ARCH FORM COULD EASILY BE PLACED AND QUICKLY ADJUSTED

Extra Outside Rims Help Surface Car Over Muddy Roads

THE EXTRA rims bolted to the Ford automobile shown in the photograph are equipped with undersize tires which come to a bearing on muddy roads and greatly increase the traction. According to A. E. Wishan, who described the device in *Wrinkles*, a publication of the Pacific Coast Gas Association, it proved a life saver during recent floods in one of the gas-oil fields of California. The application of this rig to the bad roads met with in the neighborhood of many contract jobs is obvious. The extra rims are bolted by means of small angle irons to each spoke of the regular wheels. The extra tires are one size smaller than those on the main wheels, so that when the car is traveling on hard roads the load is carried as usual on the main tires. When the car hits a muddy stretch, however, the extra tires come to a bearing and a great amount of traction surface is added, enabling the car to pull through heavy mud with comparative ease.

REGULAR RIM CARRIES LOAD ON FIRM GROUND

Short Pieces of Steel Sheeting Used by Welding Together

HAVING on hand some short pieces of Lackawanna steel sheeting and having use for longer piles, the contractor for the $1,000,000 addition to the Omaha Electric Light & Power Company's plant has made use of the short pieces by welding two of them together at the ends.

The two pieces to be joined are laid end to end on blocking, and the welding done with an oxyacetylene torch. It is said that the welded piles have proved entirely satisfactory. The welds are made by one man in about one hour each.

The addition to the plant is being built by the Phoenix Construction Company of Omaha.

Drum on Rear Axle of Concrete Mixer Pulls Template

By HARLAN H. EDWARDS
Urbana, Illinois

A DRUM PLACED on the rear axle of a concrete mixer is proving very convenient and effective for drawing forward the template on monolithic brick-pavement construction. The mixer shown in the photograph is a Chain Belt, used by the McCalman Construction Company near George-

STEADY HORIZONTAL PULL OF LOW-SET DRUM ON TEMPLATE GIVES SMOOTH SURFACE

town, Vermilion County, Ill. The drum is operated independently of the forward motion of the mixer by a lever placed at the side of the operator and connected to a clutch on the rear axle. By the use of this drum a low, horizontal and steady pull is exerted upon the template, making a smoother surface upon which to lay the brick than that obtained when the template is pulled forward by the jerky, uneven motion of the mixer as it moves ahead. Besides its convenience for this purpose, such a drum is useful to the contractor for hoisting where a larger and separate hoisting engine is not required.

Motor Truck Hoists Concrete

By EDMUND G. KINYON
Grass Valley, Cal.

HAVING an extra motor truck handy and wishing to avoid paying freight on a hoisting engine from the city in which his headquarters were located, the contractor for a reinforced-concrete bank building in Grass Valley, Cal., successfully substituted the truck for a hoist. The line from the cage was run through a sheave at the foot of the car and fastened to the truck, which ran back and forth a short distance on the side street where the concrete plant was located. Heavy timbers laid across the road marked the starting and stopping points for the driver. Besides this man, a laborer was used to block the wheels at the end of the run.

Chute Carried by Derrick Easily Shifted in Five Minutes

By CAPT. A. H. ACHER
Corps of Engineers, U. S. Army,
San Pedro, Cal.

A LARGE stiffleg derrick is being used by the writer to support the chutes for placing 14,000 yd. of concrete in emplacements for a big battery at Fort MacArthur, and has reduced to a very low point the time and labor required for shifting the chute line. As may be gathered from the photograph, the remainder of the 18,000 yd. to be placed by this plant will be delivered through a higher chute line leading from the upper platform.

The tower is 133 ft. high, and the lower line from the derrick mast outward has a length of 125 feet. The line swings on this radius through an arc of 270 deg., and the counterweighted chute pivoted at the end of the boom permits it to reach any point within this circumference. The chute has a 40-per cent fall in this length of 125 feet. It requires only 5 minutes to shift the end of the line to any point within reach of the rig.

The concrete work, which covers a total area of 150 x 500 ft., was charted and laid out to be poured in 60 working days of eight hours each. Construction was begun on Nov. 10 last, and is being carried on by the writer as construction officer under Major G. B. Pillsbury, district engineer officer, with G. A. Barcroft as superintendent and C. J. Fischer as overseer.

Form for Ventilating Ducts Collapsed by Pulling Cord

SIX VERTICAL pieces of wood fitted together as shown in the sketch and held at intervals by spreaders placed in the center as indicated were used by the Turner Construction Company to form ventilating flues in building a manufacturing plant at Hoboken, N. J. These flues, which will be used to carry away waste gases generated by small furnaces, are 8 in. in diameter and are grouped around the elevator shafts. The forms, as described in a recent issue of *Concrete*, were assembled and wired together to set in place while pouring was under way. The spreaders in each form were roped together, the holes through which the rope passed being off center so that the blocks would come out quickly when the rope was pulled. After the concrete had set and the spreaders had been removed, the other pieces were easily loosened with a bar and taken out by hand.

TRUCK AS CONCRETE HOIST

CHUTES SUPPORTED BY DERRICK TO POUR 14,000 YARDS AT LOW COST FOR SHIFTING

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Propose $260,000,000 Program for Chicago Transit

Subway Commission Includes Eleven Miles of Subway in Recommendations Requiring $60,000,000 in Next Three Years

Eleven single-track miles of double-track subway, 64 miles of new elevated lines and 150 miles of new surface lines are recommended by the Chicago Traction and Subway Commission as the first steps in the solution of Chicago's transit problem. The full report of the commission, which consists of William Barclay Parsons, Robert Ridgway and Bion J. Arnold, is not yet available—in fact, the main features are made known at this time only because a Chicago daily newspaper in some way obtained possession of and published a part of the report early this week. Approximately $100,000,000 is the estimated expenditure necessary by 1926 to give Chicago satisfactory transit facilities. Three three-year construction periods are recommended, and the program for the first calls for an expenditure of $60,553,000. The ultimate investment, to carry out the plans of the commission through the year 1950, is placed at at least $260,000,000.

The general plan aims to provide main rapid-transit lines that will serve all parts of the city and carry people to and from all the business districts; to provide through routes outside the loop district; to provide better means of travel through the central district, and to relieve surface congestion wherever necessary. Unified operation of all Chicago's local transportation facilities is recommended, with the control vested in the city council, but with a board of supervision and control given the broadest administrative powers.

Two Subways Recommended

For the first three-year period the beginnings of two subway systems are recommended, one for the elevated systems and one for surface cars. The former is for the purpose of separating the north and south from the east and west loop traffic. It is proposed to separate the grades of the north and south and east and west elevated lines in Fifth Avenue, and carry the Northwestern-South Side traffic on an extension of the Fifth Avenue line south to Polk Street and east to the South Side Elevated. Thus the Metropolitan and Lake Street lines would have the exclusive use of the north, east and south sides of the loop. Further relief for the Northwestern-South Side line, and a direct route through the heart of the loop, would be afforded by a double-track subway to be built in State Street from Eighteenth Street to Chicago Avenue. This subway would cost $10,350,000, it is estimated.

The other subway, for surface cars, would be a loop under Jackson and Washington Streets and Michigan Boulevard. Its estimated cost is $7,181,750.

These subways and the elevated extension in Fifth Avenue and Polk Street are only part of the program for the first three-year period, which embraces twenty-three items of line extensions, connections, additional tracks, rolling stock and the like. The ultimate, $260,000,000 plan provides for 58.1 miles of subway, of which 53 miles are for rapid transit.

Concrete Pipe Association to Meet in Chicago in February

The annual convention of the American Concrete Pipe Association will be held Feb. 12, 13, and 14, in Chicago. As the meeting comes during the second week of the Cement Show, opportunity is afforded for a big attendance.

City Engineering Employees Ask Increase in Salary

Present Petition to Chicago Council—Cite High Cost of Living and Increases in Labor Wage as Reasons for Demand

Basing their arguments on the fact that in 1910 their salaries were fixed after exhaustive study, that the cost of the necessities has risen 50 per cent since then, and that compensation that was fair under past conditions cannot be so considered under present changed conditions, the engineers employed by the city of Chicago have presented a petition to the mayor for substantial increases in their salaries. It is shown that the salaries of the employees in the city engineering service have been practically unchanged for twenty years. During that period men engaged in other lines of work coming under the direction of the engineering service have had frequent increases in compensation. A list of companies which have voluntarily increased the salaries of their employees is also printed as proof of the necessity for better compensation.

Increase in Labor Wage

In Exhibit B of the petition it is shown that the pay of the average foreman has increased from 1897 to 1916 approximately 51 per cent; that average skilled labor has had an increase of 83 per cent, and average common labor, 220 per cent. The foreman who received $112.50 a month in 1897 is now paid $170.25; average skilled labor received $86.78 in 1897, while now $158.83 is the figure. Average common labor has increased from $39.58 to $126.67 in the same period.

The petitioners believe that "when engineers who are in charge of work and responsible for its proper execution are paid less than the foreman and some of the mechanics working under their direction, neither can attain the highest efficiency. A corps of men feeling themselves underpaid as compared with other employees cannot, in spite of the best intentions on their part, render the service which will result in the most economical expenditure of the city's funds."

It is proposed by the engineers that a $30 per month increase be granted to those now receiving $90 to $125 a month, and a $40 increase to those now being paid $135 to $200 a month.

Committee Will Study Conservation of Water in Pennsylvania

A committee to study water conservation throughout Pennsylvania and to draft legislation to be presented to the 1917 session of the general assembly of the state was recently appointed by Dr. Samuel G. Dixon, state health commissioner, who was chairman of a conference on the subject held recently at Harrisburg.

Doctor Dixon will act as chairman of the permanent committee, whose members are Gifford Pinchot, president of the National Conservation Association; Dr. Henry S. Drinker president of Lehigh University; William H. Keller, deputy attorney general; John B. Eichenauer, member of the Pittsburgh Flood Commission; George S. Webster, director of the Department of Wharves, Docks and Ferries, Philadelphia; Prof. Edgar Marburg, of the University of Pennsylvania; S. B. Elliott, member of the Pennsylvania Forestry Commission, and J. A. Wells, vice-president and chief engineer of the Pennsylvania Water & Power Company. The committee will be enlarged from time to time.

Plan $6,500,000 Reservoirs in Adirondacks

Glens Falls, N. Y., Applies for Formation of Upper Hudson Regulating District—Would Control Flow of Hudson River

Two great reservoirs in the Adirondack Mountains, costing about $6,500,000, are included in plans for the Upper Hudson River Regulating District presented last Monday to the Commission on River Regulaton at Albany, N. Y. The application was made by the Chamber of Commerce of Glens Falls, N. Y. It is intended that the cost of the project shall be paid by the municipalities or counties benefited.

Under the application it is proposed to construct a dam at Conklingville on the Sacandaga River that would form a lake 42 square miles in area, flooding 30,000 acres of land and parts of twelve villages. This would also require the relocation of 40 miles of highway and 8 miles of railroad. This reservoir would contain 20,000,000,000 cu. ft. of water.

Propose Dam on Schroon River

The second reservoir project is for a dam on the Schroon River at Tumblehead Falls, which would back up the water on the river and on Schroon, Brandt and Paradox lakes to a height varying from 20 to 30 ft., burying parts of the towns of Chestertown, Horicon, South Horicon and Pottersville and flooding 30 miles of highways. A lake would be formed 24½ square miles in area containing about 16,000,000,000 cu. ft. of water.

The Sacandaga project, the estimated cost of which is $4,661,000, is considered the more feasible. The water regulation it would afford in the Hudson River would increase the available horsepower at developed sites from 29,490 in the dry seasons to 131,697.

Most of the fifty persons present at the hearing seemed to be in favor of the project. The opposition was mostly because of the scenery that would be destroyed. After hearing preliminary arguments the commission adjourned the hearing to Jan. 30.

Affects Industries All Along Hudson

In presenting the project Elmer J. West, president of the Glens Falls Chamber of Commerce, said there were two main reasons why storage reservoirs should be built on the Sacandaga and Schroon rivers—the increase of power and the reduction of spring floods. The project is more than a local one, said Mr. West, and affects every manufacturing industry along the Hudson River from Corinth to tidewater.

D. F. Emery of Glens Falls said the water power had decreased for years at that point on account of the destruction of the forests on the upper Hudson watershed and the drain upon the river by the Glens Falls feeder, which takes water to the Champlain Barge Canal. To counteract these two influences, said Mr. Emery, storage reservoirs are necessary, not as an altruistic endeavor, but in the material interest of the people of Glens Falls and of those below.

Expected to Decrease Flood Damage

A. E. Roach, representing Troy, pointed out that the annual damage by floods at that point was from $250,000 to $300,000, while every five or six years it exceeds $500,000. The river-regulating project, said Mr. Roach, was expected to decrease this damage and also to increase the amount of power generated at the federal dam in Troy.

George Welwood Murray, representing the Schroon Lake Association, entered a strong protest against the creation of a storage res-

ervoir in the valley of the Schroon River. The contemplated dam at Tumblehead Falls, he said, would entirely envelop not only Schroon, Paradox and Brandt Lakes, and wipe out the villages of Chestertown, Horicon, South Horicon and Pottersville, as stated in the petition, but would also submerge the village of Adirondack, a large part of the village of Schroon Lake, and all of Severance and Paradox villages. The entire Schroon Valley, said Mr. Murray, would be completely ruined as a vacation and health resort on account of the drawing down of the water during the dry seasons. He questioned the right of the power owners on the Hudson River to disturb the property rights of the people of the Schroon valley for the purpose of power production.

Adopt Automatic Schedule for American Society Conventions

The board of direction of the American Society of Civil Engineers, at its meeting of Oct. 10, considered and adopted a "method by which the annual convention would move automatically from one district to another in such sequence as would insure that all parts of the country are brought into closer touch with the society's work."

The rotation of districts in which conventions shall be held was adopted as follows:

Year	District	Center of District
1917	7	Wisconsin
1918	11	New Mexico
1919	[illegible]	Maine
1920	12	Oregon
1921	5	Georgia
1922	10	South Dakota
1923	6	Ohio
1924	[illegible]	Arkansas
1925	3	Quebec
1926	8	Indiana
1927	13	Nevada
1928	4	Pennsylvania

A suggestion that a second meeting be held outside of New York City was also considered. The board is of the opinion that if such a meeting could be given a distinctly technical character and be designated as one of the business meetings provided for by the constitution it would result in centering activity in each district at least once in six, instead of twelve, years, as would otherwise be the case. The board, therefore, decided that the option of assuming responsibility for a second meeting in any year shall be offered to each district in turn, with the understanding that it can be accepted or declined.

Chicago Formally Opens Its Public-Utility Galleries

An initial section of utility galleries was formally opened Dec. 5 in Chicago. It is 1200 ft. long, and is located at Canal and Monroe Streets. Telegraph, water, electric light and power, pneumatic mail tubes, telephone and Sanitary District services are accommodated, and there is ample room for future expansion. The galleries were described in the Engineering Record of Nov. 13, 1915, page 593.

John Ericson, city engineer, as a member of the Commission on Downtown Municipal Improvements, with Alderman W. J. Healy as chairman, made the first suggestion that a gallery be considered in connection with the construction of the new Union Station, although the district was outside that which the commission had under consideration. The commission took the matter up seriously, and finally the city engineer was instructed to proceed with designs of the galleries. At the first consideration and layout of the project there were obtained the service and advice of Ray Palmer, former commissioner of gas and electricity; H. L. Dean, assistant engineer of that department; also H. S. Baker, assistant city engineer; and L. C. Dumond, secretary and engineer of the Commission on Downtown Municipal Improvements. Later the suggestions of the engineers of the various utility corporations, as regards many details, were obtained.

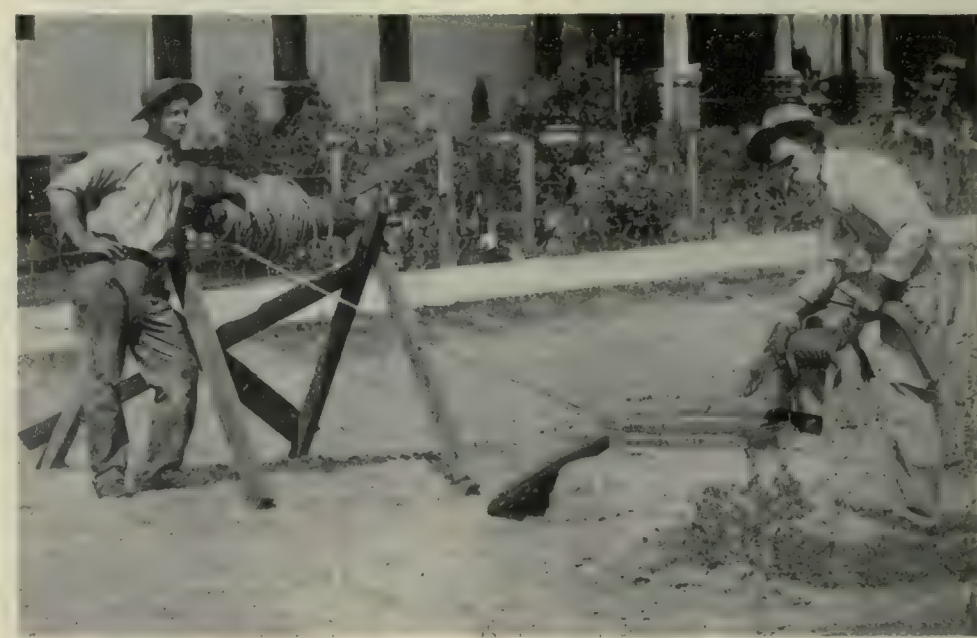
Recommends Two Municipal Piers for Camden, N. J.

The construction of two municipal piers at the foot of Spruce Street constitutes the first recommendation made to the city of Camden, N. J., by B. F. Cresson, Jr., chief engineer of the New Jersey Board of Commerce and Navigation, as the result of a study of how to develop Camden's possibilities as a port. Mr. Cresson proposes one pier about 600 ft. long and 326 ft. wide and another about equally long and 75 ft. wide. On the wider pier it is proposed to erect parallel three-story buildings so designed as to serve as both pier sheds and warehouses. Rail connections would reach both piers. The total estimated cost of the improvement is $881,473.

Two Bids Received for Incinerating San Francisco Garbage

In response to the call of the city of San Francisco for proposals to dispose of the city's garbage, as announced in the Engineering Record of Nov. 11, two proposals were received by the board of supervisors on Nov. 20. Neither of the propositions contemplated the destruction of garbage by incineration, the method of disposal which it has been agreed would be the more satisfactory, but proposed that the refuse gathered from various sections of the city should be used to fill in low lands, which would be later converted into industrial sites.

The offers were from Richard Schmidt, who agreed to pay 20 cents a ton, and from A. B. Moffit and F. B. Smith, who offered to pay 22½ cents a ton.



Alligator Used to Clean Clogged Sewers in Florida City

A 600-FOOT 12-INCH SEWER in Fort Meade, Fla., recently became clogged with sand and dirt. Several sewer-cleaning contrivances were used and about $1,500 was spent, but to no avail. The pipe remained in its unsatisfactory condition. Just when everyone had given up in despair, Ben R. King, superintendent of water and sewers, secured a small alligator, to which he fastened a rope. The animal, when lowered into the pipe, proceeded toward the next manhole, dragging the rope after him. When the alligator had traversed one section of the sewer, the rope, to the middle of which knotted chains were attached, was pulled back and forth and the obstructions removed. Mr. King now has ten alligators which he uses in sewer cleaning in Florida cities.

This information and the picture were supplied by George W. Simmons, Jr., sanitary engineer for the Florida State Board of Health, Jacksonville, Fla.

New England Waterworks Men Convene December 13 in Boston

The New England Waterworks Association will hold its December meeting next Wednesday at the Hotel Brunswick, Boston. The nature of color in water and waterworks in Cuba are the subjects of two papers to be presented by Thorndike Saville, of Cambridge, and Robert Spurr Weston, consulting engineer, of Boston.

To Reclaim Land in St. Louis

The City Plan Commission of St. Louis, Mo., in conjunction with four of the municipal departments, has just issued a report outlining a combined project of industrial development and flood relief from the River des Peres. In addition to a sewer and channel in the river valley it is suggested that a railroad be built to complete the belt line around the city and that a scenic driveway be constructed. The cost of the project is estimated at $8,000,000. The proposed work, the report points out, will make available for industrial and residential purposes extensive tracts of land now unfit for use because of floods and offensive conditions in the stream which drains this territory. Harland Bartholomew is engineer of the City Plan Commission.

Discuss Regulation of Traffic

The Washington State Good-Roads Association held its annual convention Nov. 16 and 17 at Centralia, Wash., with 130 delegates present. Several resolutions affecting traffic on highways were adopted and will be recommended to the state legislature.

Limiting the speed of motor trucks to 15 miles per hour, as well as regulating the loads, was discussed at length. Inspection by the highway department of all roads constructed, whether by the state, county or township, was also thought advisable. A uniform system of designating and marking state roads throughout the state, legislation providing that county engineers be appointed by county commissioners instead of being elected at large, and the standardization of speed, lighting and other requirements of automobiles came in for their share of attention. The installation of a uniform system of cost accounting for the construction and maintenance of all roads, whether by state, county, township or district, and including such cost figures in the biennial report of the state highway commission, was recommended.

Surveying for 35-Mile Ship Canal Along Sacramento River

The project for constructing a deep-water ship canal from Sacramento, Cal., to San Francisco Bay, as outlined on page 431 of the Engineering Record for Oct. 7, has taken definite shape to the extent that funds have been appropriated for the final survey of the proposed route. On Nov. 21 the Sacramento Chamber of Commerce announced that it had available $1,500 in cash and a promise of $2,000 more toward the work. According to an agreement with the state engineering department, these funds, raised by the city, will be increased by an equal amount of state funds, so that a total of $7,000 is now considered available.

The plan is to construct a channel for deep-water vessels which will be entirely separate from the main channel of the Sacramento River and thus free from silting, current and tidal effects. Of the total length of 35 miles, which is estimated by Major P. M. Norboe, assistant state engineer, as the length in which excavation will be necessary, 14 miles is in river channels already used for river craft. Only such excavation as will straighten bends and deepen the channel will be required. The remaining 21 miles will be in original excavation in earth, the surface of which varies from approximately 5 ft. below to 10 ft. above mean tide. Major Norboe has estimated that a canal with a minimum depth of 30 ft. can be excavated at a cost of about $1,000,000.

Annual Meeting of American Society January 17 and 18

The sixty-fourth annual meeting of the American Society of Civil Engineers will be held Jan. 17 and 18 at the house of the society in New York City. The business meeting will be called to order at 10 o'clock Wednesday morning. The annual reports will be read, officers for the ensuing year elected, members of the nominating committee appointed, reports of special committees presented, and other business transacted. Arrangements for excursions and entertainments will be announced later.

Special meetings of the society will be held Friday, Jan. 19, at which the business to be transacted will be limited to a discussion of the progress report of the special committee on materials for road construction.

Proposes Two Million Dollar Additions to Lockport Plant

Additions to the hydroelectric plant of the Sanitary District of Chicago at Lockport are recommended in an exhaustive 353-page report by Gardner S. Williams, consulting engineer, on "all facts and questions arising in connection with the cost and operation of the district's hydroelectric plant and electrical development." His suggested plan for increasing the gross income from $969,000 to $1,357,000 would increase the profits by $300,000, says Mr. Williams. A huge equalizing basin for the storage of water at Lockport is the plan. It would cost about $1,000,000 and the increase in power available would be sufficient, with an average flow of 10,000 cu. ft. per second, to increase the sale of current 40 per cent. Additional generating capacity would cost $900,000. He also suggests replacing the present generators with more modern equipment, thereby increasing the output 10 per cent.

Yes, He's German!

A correspondent comments upon the meetings of the New England and American Waterworks associations as follows: "Meeting at Portland, Me., dry; next one at Richmond, Va., dry. They even make us *drink* their water. That's what I call combining business with pleasure to the limit."

Office of Public Roads Appoints District Engineers

The U. S. Office of Public Roads and Rural Engineering has appointed the following engineers to take charge of the work in the districts named:

L. I. Hewes, District 1, comprising Washington, Oregon and Idaho; C. H. Sweetser, District 2, comprising California, Nevada, Arizona and New Mexico; J. A. Whittaker, District 3, comprising Montana, Wyoming, Utah and Colorado; E. O. Hathaway, District 4, comprising the Dakotas, Minnesota and Wisconsin; J. C. Wonders, District 5, composed of Nebraska, Iowa, Kansas and Missouri; J. D. Fauntleroy, District 6, made up of Arkansas, Louisiana, Oklahoma and Texas; J. T. Voshell, District 7, comprising Michigan, Illinois, Indiana and Kentucky.

J. T. Bullen will have District 8, which includes Florida, Georgia, Alabama, Mississippi, South Carolina and Tennessee; Guy H. Miller, District 9, composed of Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont, and H. K. Bishop, District 10, Pennsylvania, Ohio, West Virginia, Virginia, Maryland and North Carolina.

Newlands Commission Cannot Complete Report by January 9

Coincident with the opening of Congress, and the unusual interest in possible railway legislation which is likely to prove the most important subject to be considered, it was announced that the Newlands joint commission, which is investigating the transportation problem, would not be able to make its report by Jan. 9, the date called for in the act creating the commission. It was suggested that the commission would ask for an extension of the time limit. The commission has had an opportunity thus far to examine only one witness, and the members feel that they cannot go into the problem before them as thoroughly as they wish in the time remaining.

Railway Maintenance Departments Want Eight-Hour Day Too

Declaring their work is "dirty, laborious and underpaid," 400,000 members of the maintenance departments of American railways filed a petition Dec. 4 with Congress asking to be included in "any eight-hour railroad legislation."

Southwestern Engineers to Organize

A. F. Barnes, dean of engineering of the New Mexico College of Agriculture and Mechanic Arts, is endeavoring to organize a Southwestern engineering society. Letters have been received from prominent engineers in New Mexico, Arizona and Texas expressing the need of such an organization. Among the men who have promised their support are Dean G. M. Butler, of the University of Arizona; Dean S. H. Worrell of the Texas School of Mines; Professor Brenneman of the University of New Mexico; Samuel I. Bousman, engineer for the Chino Copper Company, Hurley, N. M.; H. L. Stevens, consulting refrigeration engineer, El Paso, Tex.; E. H. Baldwin, project manager of the Elephant Butte Dam, and S. O. Andros, Albuquerque, N. M., chairman of the New Mexico State Directors, Naval Consulting Board.

The object of this organization will be to promote the science of engineering in the Southwest. The principal means for this purpose are to be meetings for the reading and discussion of professional papers, especially upon such questions as are peculiar to this region, and opportunity for special intercourse, thus establishing a common interest in the welfare of the engineering profession.

It is planned to call at an early date a meeting of those engineers that have shown interest in the matter. At such a time tentative plans and a program for a general meeting will be considered.

What Engineers and Contractors Are Doing

P. L. ECKERT, a prominent contractor of Wilkes-Barre, Pa., after thirty years of active construction work in the vicinity of that city, is removing his entire business to Detroit, Mich.

H. M. STICKER, a member of the highway engineering staff of the Portland Cement Association, is visiting Pennsylvania cities to make an extensive study of all types of concrete roads.

J. E. BRECKENRIDGE has been engaged as valuation expert by the board of city commissioners, Jersey City, N. J., to assist the city in its effort to secure increased valuations on local second-class railroad properties.

GRANT SMITH & COMPANY of St. Paul, maintaining contracting offices throughout the Northwest, recently opened a permanent office in the Multnomah Hotel, Portland, Ore.

GEORGE WATKINS EVANS, consulting mining engineer, of Seattle, has accepted an offer to become engineer in charge of the Northwest division of the U. S. Bureau of Mines, with headquarters at the newly established station at the University of Washington. Mr. Evans is well known in mining circles in the West and Northwest, having been engaged in several examinations for the government as well as for private enterprises. In 1915 he examined the Bering River coal fields in Alaska and subdivided that field into leasing units for the government. During the last summer he examined the Nenana coal fields in the interior of Alaska for private interests, and made a study of the fuel needs of the interior of Alaska. Dorsey A. Lyon, president of the Salt Lake mining and metallurgical testing station, will have charge of the Seattle station.

ARTHUR B. MURPHY, formerly assistant engineer in the office of the city engineer of Albany, N. Y., is now assistant engineer to the chief engineer of the Coventry Land & Improvement Company, of Akron, Ohio.

K. L. MINER, bridge inspector for the New York Central Railroad, has been transferred from the Adirondack division to the Ottawa division. As supervisor of bridges and buildings of the latter division he will have to do with strengthening bridges for heavier traffic. His office is at Ottawa, Ontario.

A. L. UPHAM, in the employ of the Portland Cement Association, has been transferred from work in Indiana to Pittsburgh, where he will manage the local office.

E. H. DAVIS has resigned as road supervisor and civil engineer of Spalding County, Georgia, to take a place as engineer for the state highway commission. It is expected that Mr. Davis will be employed on the Dixie Highway from Atlanta to Macon.

PELLISSIER & DIBBLE, engineers and architects, of Springfield, Mass., have removed their offices to the Third National Bank Building.

D. A. WALLACE has resigned as resident engineer of maintenance for the Canadian Pacific Railway to become associated with the Imperial Munitions Board at Ottawa.

C. E. EDWARDS, who has been in the employ of the U. S. Reclamation Service since 1910, was recently made superintendent of construction on the Yakima-Sunnyside project. Mr. Edwards joined the Reclamation Service as rodman immediately after graduation from the Ohio Northern University in 1910. He

rose to the grade of engineer and general foreman in 1913, when he was on the Okanogan project in Washington. His latest promotion came when he was recently transferred to the Yakima-Sunnyside project.

WILLIAM E. WILBUR has left the employ of Harrington, Howard & Ash, consulting engineers, of Kansas City, Mo., to become associated with Klyce & Kackley, civil and consulting engineers, of Miami, Fla. He is now working on the Miami causeway project and expects to be resident engineer in charge of inspection of the work. After graduation from the Iowa State College in 1911, Mr. Wilbur entered the employ of Waddell & Harrington, consulting engineers, of Kansas City, and remained with Mr. Harrington when the new firm of Harrington, Howard & Ash was formed.

HENRY H. DAMON, formerly assistant engineer with the New York Public Service Commission, First District, is now engineer in the Bureau of Yards and Docks, Washington, D. C. Mr. Damon is a graduate of Harvard University, class of 1906, as well as of the Massachusetts Institute of Technology, class of 1908. His first work after graduation was with the Charles River Basin Commission. That was followed in 1909 by his appointment as instructor in mathematics on the Massachusetts nautical training ship U. S. S. Ranger. Upon his return from a six-month cruise to European ports Mr. Damon went to the Philippine Islands as assistant engineer, Bureau of Public Works. After about three years he returned to the United States to take a position as structural designer for Stone & Webster on the new Massachusetts Institute of Technology buildings. His appointment as assistant engineer with the New York Public Service Commission came in 1915.

E. F. REAGAN, who had charge of construction of the Dickson Trust Bank Building in Richmond, Ind., is now with the James Stewart Company, with headquarters in St. Louis. He will have charge of building additions to the Leschen Rope Company's plant. Mr. Reagan was graduated from Purdue University in 1907 and has been engaged in the construction of fireproof buildings since then.

SHIRLEY C. HULSE, of Bedford, Pa., is at present with the Tallassee Power Company, Alcoa, Tenn.

ERNEST MCCULLOUGH, chief engineer of the fireproof construction bureau of the Portland Cement Association, has been appointed a member of the committee on fire-resistive construction of the National Fire Protection Association.

LEWIS R. FERGUSON, of the Portland Cement Association, is accompanying R. J. Wig, of the U. S. Bureau of Standards, on a trip along the Atlantic and Pacific coasts for the purpose of examining various concrete structures exposed to sea water.

W. S. CURTIS, of San Francisco, has been appointed assistant engineer in the California State Department of Engineering. It is expected that his first work will be an investigation of the water supply of the state hospitals.

ALLEN KISINGER has resigned from the waterworks department of Cincinnati to become city engineer of Norwood, Ohio.

M. C. SELDEN, formerly division engineer of the Chesapeake & Ohio Railway, has been appointed trainmaster of the Rivanna division.

L. M. BROOKS, formerly with Norton, Bird & Whitman, engineers, of Chicago and Baltimore, is now engineer of construction for the Electro-Mechanical Company of Baltimore.

OLIVER C. SHELEY was recently elected county engineer of Jackson County, Mo.

E. I. DAVIS, formerly with the U. S. Reclamation Service at Hermiston, Ore., has been appointed chief engineer of the Anderson-Cottonwood Irrigation District, California. He succeeds H. H. Henderson, who resigned recently. Thomas H. Means, of San Francisco, serves the district as consulting engineer.

J. W. GWINN has been appointed president of the new county board of review of Jefferson County, Ala. The board supervises public work all over the county. Mr. Gwinn was formerly county engineer.

ARTHUR C. EVERSHAM, who was appointed engineer of construction for the Kansas City Bridge Company in October, 1915, has resigned. He is now terminal engineer of the Union Pacific Railroad at Kansas City. Before going to the Kansas City Bridge Company, Mr. Eversham was assistant to the chief engineer of the Kansas City Terminal Railway. He was graduated from the University of Cincinnati in 1902. Among his more important work is that on the Detroit River tunnels for the Michigan Central Railroad from 1905 to 1909.

EDWARD M. BIGELOW, who resigned as state highway commissioner of Pennsylvania in April, 1915, has been made director of the Department of Public Works of Pittsburgh, to succeed the late Robert Swan. Mr. Bigelow has been identified with the engineering department of Pittsburgh for many years and helped to make possible the construction of Grant Boulevard in that city.

MAX L. CUNNINGHAM, consulting engineer, of Oklahoma City, has been appointed state engineer of Oklahoma. His first engineering experience was acquired in 1898 with the Illinois Central Railroad. Since then he has been engaged in railroad and general engineering and contracting in the Southwest.

R. G. WYMAN was recently made division engineer of the Atchison, Topeka & Santa Fe Railway, with office at Amarillo, Tex.

JOSEPH WRIGHT, for ten years in the employ of the U. S. Reclamation Service, has been made resident engineer on an extensive paper-mill and water-power project north of Vancouver, B. C. For nearly eleven years, beginning in 1895, he was with the War Department on river and harbor improvements in the Vicksburg district. For six years he had charge of construction in the Chicago district. While with the Reclamation Service he constructed the Corbett dam on the Shoshone project, ten miles of the Garland canal and the Ralston reservoir dam; on the Milk River project he built the Dodson dam with government forces. Mr. Wright also directed the construction of the Lower Yellowstone dam and on the Flathead project he prosecuted the driving of the Newell tunnel for a year and directed dam and canal work as well. The St. Mary's canal, including two long river pipe line crossings and a system of high drops, was also built under his direction. In 1906 Mr. Wright was with Hugh L. Cooper and made preliminary surveys and investigations for the Mississippi River power plant at Keokuk.

D. A. BLACKBURN has opened an office as consulting irrigation engineer at Brawley, Cal.

C. S. BUTTS, principal assistant engineer of the St. Louis Department of Public Utilities, has been appointed engineer in charge of the construction of the municipal dock at North Market Street.

A. B. CLARK has resigned as deputy commissioner of the New York street cleaning department.

THOMAS E. JEFFRIES, assistant U. S. engineer in charge of work in Kanawha County, W. Va., has resigned after about 35 years of service.

RAYMOND W. PARLIN has been appointed deputy commissioner of the New York street cleaning department, to succeed A. B. Clark, resigned. Mr. Parlin studied civil engineering at the Massachusetts Institute of Technology from 1903 to 1908, alternating his student work with employment by the Massachusetts State Board of Health and private concerns interested in the disposal of manufacturing wastes. Mr. Parlin was also employed on the construction of the Pepperell (Mass.) waterworks. Practically all of his time has been devoted to sanitary engineering practice.

GEORGE F. COTTERILL, state highway engineer and former mayor of Seattle, was the principal speaker at the luncheon of the Hoquiam (Wash.) Commercial Club, Nov. 22.

RUDOLPH EVERS has resigned from the engineering department of the Interborough Rapid Transit Company to become structural engineer for G. D. Jenssen & Company, architects and engineers, of New York City. Mr. Evers had been with the Interborough since 1911, and at the time of his resignation was engaged on the three-tracking of its elevated lines.

ROBERT S. BEARD has been made acting assistant city engineer of Kansas City, filling the vacancy left by Clark R. Mandigo, who resigned, as noted in this column recently, to go with the Portland Cement Association. Mr. Beard has been in the engineering department for several years, and also with the Kansas City Terminal Railway.

O. E. ELTINGE, formerly assistant engineer to E. B. Murray & Company, consulting engineers, has been made chief draftsman of the sewer division of the Kansas City Engineering Department.

Obituary Notes

HAROLD PARKER, former chairman of the Massachusetts Highway Commission and a native of Charlestown, died recently at his home in Lancaster, Mass., at the age of 62. He received his early education in Philadelphia and Lancaster and was a graduate of Phillips Exeter Academy. After attending Harvard University for two years Mr. Parker entered the employ of the Pennsylvania Steel Works. Later he established the civil engineering firm of Parker & Bateman, with offices in Clinton, Mass. In 1900 he was appointed to the Massachusetts Highway Commission, and after serving as a member for a few years succeeded W. E. McClintock as chief executive of the board. Upon his retirement from the commission in 1911 Mr. Parker became vice-president of the Hassam Paving Company, of Worcester, Mass., and also acquired an interest in the lumber industry. In 1913 and 1914 he was a member of the advisory board of the highway department of the state of New York. He was at one time president of the Massachusetts Highway Association and chairman of the Wachusett Mountain State Reservation Commission and of the Massachusetts Forest Commission. He had also been a member of the Massachusetts House of Representatives. Mr. Parker was a member of many organizations, including the American Society of Civil Engineers, Boston Society of Civil Engineers and Engineers' Club of Boston. He was in charge of the work of the Massachusetts Highway Association at a time when the building of roads capable of withstanding automobile traffic first assumed importance.

F. S. BATES, general sales manager of the Rensselaer Valve Manufacturing Company, died recently in Troy, N. Y., at the age of 50. Mr. Bates had been in the employ of the Rensselaer organization for twenty-three years.

W. W. SCRANTON, president of the Scranton Gas & Water Company, died Dec. 3 at his home in Scranton, Pa., at the age of 72. Mr. Scranton was graduated from Yale University in 1865. Later he devoted his energies to the Scranton Steel Company, which plant, it is believed, was the first to roll 120-ft. steel rails from the ingot. The Lackawanna Steel Company absorbed the Scranton concern in 1901, after which Mr. Scranton gave his time to the gas and water company, which now owns property valued at $15,000,000.

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Zoning Our Cities

THERE can be no doubt that in time each of the large cities of the country will be divided into zones restricted as to class of structure and occupancy. Such restrictions are absolutely essential if our cities, considered as a whole, are to become efficient. The word "efficient," as here used, applies to everything that can be reached by the police power of the state and that can contribute to public welfare and better health. Europe is far ahead of us in its municipal management, though here height-restriction ordinances are becoming more frequent, while zoning is not unknown. The restricted-district plan worked out in New York within the last two years and now effective is, of course, the most important step taken so far in the United States. Moreover, the conditions at New York were extremely complicated, so that no city in the country need fear to attack the problem on account of its complexity. In no other community in the United States will the factors be found so many and so involved. Chicago is now considering the matter. An ordinance is before the City Council which, if passed, will result in putting the matter officially before the legislature of the state. We trust that the measure will receive favorable consideration by Chicago's governing body, to the end that the second city of the country may join with New York in affording an example for the other communities of the country.

A Talk on City Planning

APROPOS of the previous remarks on the zoning of cities, it is not amiss to refer to one of the most stimulating as well as interesting talks which the editors of this journal have heard—that by Nelson P. Lewis, chief engineer of the Board of Estimate and Apportionment, New York, at a recent meeting of the American Society of Civil Engineers. While Mr. Lewis did not confine himself to restriction and zoning, he touched on these subjects as part of the general problem of city planning. Moreover, he brought out most forcibly the engineer's function in city planning, and warned the members of the profession that if they did not appreciate their opportunities and their responsibilities in this respect, the field would be preempted by other specialists, less qualified for the task. Engineering societies that can induce Mr. Lewis to talk before them will not only have a rare treat on account of the interesting way in which he presents his subject, but will get points of view on a growing and important field of engineering endeavor.

Reinforced-Gypsum Roof Decks

AN important modern development in the application of gypsum to long-span beam or deck-slab construction is described in the article by V. G. Marani on page 745 of this issue. It will be followed next week by an article on the methods used on the first building in which 10-ft. units, cast at the site, have been employed. The economic possibilities of material weighing only 17 lb. per square foot of roof surface is apparent, and, in addition, the low heat conductivity and fire-resistive qualities are advantages long recognized in the extensive use of gypsum tile for roofs and of gypsum blocks for partitions. The results given by Mr. Marani for the strength tests of the new construction should have the very careful attention of structural engineers. Undoubtedly a wide development awaits the material and the greater the number of engineers and experimenters interested the more rapid will be the development.

The Webb Bill

SELDOM has a business measure before Congress received so wide indorsement as the Webb Bill, which permits competing organizations to combine for foreign-trade exploitation. It has already been passed by the House of Representatives. The Senate's attitude is not known, but it is fair to assume that the reasonableness of the measure, its indorsement by business interests and the press, and even by the President in his recent annual message to Congress, will result in a favorable attitude toward the measure in the Senate. The real danger that confronts it is that in the rush of matters the bill may fail of consideration. This would be a calamity. As the President said, referring to the passage of the measure, "The thing must be done now, because the opportunity is here and may escape us if we hesitate or delay." Manufacturers throughout the country are studying the bill and are discussing ways and means of taking advantage of its provisions, so that if it is passed, there may be prompt action. One industry has already acted. Timber producers of the Pacific Coast have organized the Douglas-Fir Exploitation & Export Company to sell co-operatively in foreign markets and to apportion among themselves by agreement the business that may be developed. They have had the courage to proceed even before the bill has been enacted, confident that in a test in the courts the legality of their act would be upheld. Needless to say, the Federal Trade Commission and the Bureau of Foreign and Domestic Commerce have been kept duly apprised of the lumbermen's plans. What these manufacturers have already done, producers in other lines are contemplating. General action, however, will be withheld until the bill is passed. The importance to this country of the development of the large foreign trade cannot be overemphasized, and it is to the interest of all that the government permit our manufacturers to do as Europeans have done, and are doing—co-operate in the exploitation of foreign markets.

Fire Hazard in Frozen Pipes

IN a bulletin issued last year by the National Fire Protection Association attention is called to the fire hazard which frozen water pipes present. The warning is worth repeating at this season, for it offers an opportunity for waterworks engineers to reduce the number of conflagrations in their cities by educating water users to a realization of the dangers involved in attempting to thaw out service pipes by heat from burning oil-soaked rags or other ill-advised methods in which an open flame is used. The advice is timely, for this is the season when trouble with frozen mains begins. The proper way for the householder to restore an ice-clogged pipe to service is to wrap it with cloth and pour hot water upon it or, if the freezing is too severe to yield to this treatment, the best plan is to send for a plumber. Apparently this is a minor detail, but attention to it may prevent needless fire losses running into thousands of dollars.

Financial Considerations

IT IS with much surprise that the Engineering Record has noted a rather drastic address, delivered before an engineering society in England, in which the engineer is severely criticised for his failure to appreciate the financial phases of his enterprises. "There is undoubtedly among all technical men a feeling of contempt for financial results," says the speaker. We do not believe that the charge would hold in this country. The fact that the address was delivered before the Junior Institution of Engineers may, in part, explain the speaker's attitude. It may have been intended to carry effect by the severity of the arraignment. The speaker did, it is true, recognize that young engineers were particularly apt to neglect the financial effect of their work, and, thus limited, the Engineering Record can to an extent agree with him. But when he extends his strictures to "all technical men" this journal must part company with him. It does not know conditions in England; it does know them here, and

feels that it is on safe ground in declaring that, by and large, American engineers do appreciate the financial side of the work intrusted to their care. It is but natural that the young man fresh from college should emphasize the technical and subordinate the financial. No matter how strongly and how often his teachers may emphasize the importance of costs, there is not and cannot be present a control similar to that wielded by a holder of the purse strings. Nor is there the salutary and chastening influence which comes from checking actual costs monthly against the estimates. But when the young man gets into practice he soon realizes that the economic side of what he does is equal in importance to the technical and he gives proper place in his thinking to the matter of cost.

The Engineer's Function

WHAT is said in the foregoing paragraph regarding the American engineer's appreciation of costs brings to mind a recent editorial in the Chicago *Daily News*, which protested against the inclusion in the report of the Chicago Traction and Subway Commission of any franchise plan devised by the engineers. We do not know the constitution of the editorial staff of the *News*, but we strongly suspect that the editorial in question was not written by a journalist but by a lawyer. It has all the provincialism that characterizes the attitude of that profession toward the members of other professions and avocations. The reason given by the *News* for its position is that "Chicago has always been careful to take the views of its advisers only on matters respecting which they are especially qualified to speak." It does not go on to prove, however, that the three engineers composing the Traction and Subway Commission are not "especially qualified to speak" on franchise questions. There may be certain legal phases on which the advice of the lawyers is needed, but it is absurd to suppose that the engineers in question would fail to avail themselves of counsel on these phases. Certainly, the financial and economic aspects of Chicago's subway and traction problem come within the engineer's function. The franchise relation, in modern contracts, is controlled chiefly by the financial features of the plan, and these in turn are essentially of an engineering character, dealing necessarily with operating costs, the life of structures, etc. Unquestionably in such a large problem as that presented at Chicago the experience available on every phase of the subject needs to be commandeered. Those who know the engineering temperament will not doubt that the engineers composing Chicago's Traction and Subway Commission have called to their aid all those who could help. But while counsel and help are needed, there is no law of the Medes and Persians which provides that only lawyers are capable of working out a satisfactory franchise relation, as lawyers are prone to think.

Dredging Work in a New Light

DOUBTLESS many contractors and not a few engineers entertain the notion that dredging, especially for land reclamation, is a very simple proposition, hardly calling for the study and effort demanded by bridge building or subway construction. True, when one visits a dredging contract there is so little to see that one is tempted to conclude there is "nothing to it." Even if the contract is a big one the units are scattered and only one can be seen at a time. Frequently even the crew of that one is out of sight, except for a man wandering without apparent object about the deck, if it be a "floater," or an aimless-looking individual or two on the levee if it be a land machine. Usually there is little to watch but the monotonous pouring of a muddy stream from a discharge pipe or the equally monotonous movements of a bucket or dipper whose very size and power are lost on the watcher by reason of the contrast with all outdoors.

But what keeps the muddy stream filled with a profitable percentage of solids? Why does the bucket come up time after time with a full load? Where are the brains behind these seemingly aimless monsters eating dirt out of ditches and spewing it up along the banks? A fascinating account of both the mechanical and human problems which these brains have worked out, and whose solution spells the reclamation to profitable uses of thousands of square miles of waste land, begins on page 730 of this issue. Written by a man who has himself contributed to the recent developments in this field, the three articles of this series will leave few readers in doubt as to whether dredging work requires as much foresight, energy and ability to handle men as any other branch of engineering construction.

The problem of providing an economical source of power for these tools, touched on in the first article, bids fair to be met with a solution that will point the way to a great improvement in all construction power plants where electric current is not available from an outside source. Mr. Shaw considers the internal-combustion engine driving an electric generator as the most feasible power unit for dredge service. More than a year and a half ago this journal pointed out the advantages of such a power plant for general contract work in remote sections.

To-day the human element is a factor in all construction work, closer study of which will give very large returns. The second article of this series, dealing with this element, is one of the most human documents this journal has had the good fortune to publish in recent years. The methods outlined by Mr. Shaw are suggestive not only to dredging contractors but to their brethren in other fields as well.

In the third article is brought out an admirable example of the way in which accounting systems and business methods can be adapted to the work in hand. The importance Mr. Shaw attaches to the value of close personal contact of managers with the work and field organization cannot be overstressed. This, too, applies to every sort of construction work.

All in all, the series is, in its field, one of the most important this journal has ever published.

American International Corporation's Activities

BECAUSE of its unusual scope and the attention it attracted upon its organization, the first published report of the activities of the American International Corporation has unusual interest. It is called a preliminary report and is addressed by the president to the stockholders assembled in annual meeting Dec. 6. What strikes one most forcibly is the wide range of the corporation's activities and the number and variety of propositions made to it. Moreover, it is apparent that the company has whipped an organization into shape in an incredibly short time. Possibly these things should create no surprise when the experience and ability of the officers and the members of the board of directors are considered.

No less than 1230 propositions seeking financial support and development have been presented to the corporation for investigation. Of these, the field of operation of 347 is in South America, 326 in the United States, 256 in Europe, 73 in Asia, 71 in the West Indies, 47 in Central America, 41 in Canada, 29 in South Africa and the remainder in Mexico, Australia and Alaska. The distribution of the European group is especially worth noting. Russia leads the list with 64 proposals, thus bearing out the statement frequently made that in Russia lie America's great foreign-trade and foreign-investment opportunities. Spain (and it will come as a surprise to those not familiar with foreign conditions) is second on the list, offering 47 investment opportunities. Thirty-nine came from Italy, 29 from France, 14 from England, while the 63 others are scattered throughout the other European countries. Of South American states, Brazil and Argentina, quite naturally, head the list, the former with 80 and the latter with 65 propositions. China, again supporting statements frequently made as to our foreign opportunities, offered no less than 45.

The classification as to the nature of the propositions is equally interesting. Foreign development work is essentially of an engineering character. Therefore transportation and communication (railroads, tramways, shipping terminals, telephones) head the list with a total of 332 cases. Mining and public utilities add 312 proposals to the engineering classification, while of the 156 classified under agriculture and under commerce and industry, a goodly proportion, such as irrigation, reclamation and manufacturing plants, have an engineering basis.

Of the proposals actually accepted and undertaken, readers of the Engineering Record have already been apprised, through the news columns of this journal, of three—the Uruguayan contract for the

construction of waterworks and sewerage systems, the American International Terminals Corporation and the Chinese railroad concession. In addition, the corporation has acquired interests in the Pacific Mail Steamship Company, the Allied Machinery Company of America, the International Mercantile Marine Company and the New York Shipbuilding Company. A special corporation has been formed to take care of South American work, the Rosin & Turpentine Export Company has been organized and interest acquired in the United Fruit Company and in the tea-importing business.

It is apparent that these activities put the corporation in a new class among American business enterprises. Europeans have long been accustomed to see organizations expand in the export field; and undoubtedly here, the opportunities now being appreciated, other corporations will follow in the steps of the American International, provided our people will change their present point of view and be willing to invest in foreign enterprises. Such activities will create new markets for American goods and thereby help to stabilize our industrial structure. While a private enterprise, the work of the American International Corporation has a national import because of its bearing on the nation's industrial conditions.

A Study of Efficiency

THE work conducted by the Ministry of Munitions in England has come to be of the most intensive character. Every effort has to be bent toward turning out with comparatively untrained labor—principally women and youths—the maximum possible quantity of shell and other material. The ministry has therefore been driven to conducting an analysis of results in the search for the most efficient conditions of labor, and some of its results have proved to be of large interest.

In particular they bear out much that has been done in this country, but the data on a large scale have particular value. Some time ago recommendations were made as to the limitation of hours of work, including the suggestion that the weekly hours, including overtime, should not exceed 67 for men and 60 for women. A later report, after investigation of results, indicates that in many instances these hours are too long for the highest efficiency. In one instance it was found that in doing light machine work a large group of women increased the total output 8 per cent on a drop of the working week from a little over 68 hours to slightly less than 60. In a similar instance in which a body of youths under military age was employed a decrease of the working hours from 12 to 8 actually raised the weekly output 19 per cent.

Attention, too, is being directed to the results of proper intervals of rest, on which considerable stress has been laid by American investigators. In one instance rather widely quoted two training officers, on a bet, started their respective commands on a task in trench digging. One officer sent his men in to work as hard as they could and keep at it till the task was finished. The other deliberately sent his men in for all they were worth, and periodically took them out to rest, with the result that he won his bet with considerable to spare. This is a striking example of the rigorous way in which the modern theory of human activity works out in practice.

What effect demonstrations of this kind, hitherto not common in England, will have on general efficiency is impossible to say, but it looks very much as though the fruits of the experiments, somewhat familiar here, would be reaped across the water as well, a fact not to be forgotten in considering the probable commercial conditions after the close of the war. The general effects of the scientific study of manual labor are being amply shown here. One of the most recent instances is that of a very large factory crowded with work which is deliberately going on to multiple shifts, at least two, and three when necessary, each of 8 hours.

Additional data on all these matters are greatly to be desired for application when the stress of competition rises swiftly, as it is bound to do one of these days. It is no longer the man, or the machine, that must be considered alone, but the factors of the most efficient combination of the two.

Those First Valuations Again

EXCEPTION is taken by the carriers concerned to practically every feature of the first two tentative valuations reported by the Interstate Commerce Commission. The formal protests of the Atlanta, Birmingham & Atlantic Railway and the Texas Midland Railroad, which are abstracted on page 735, make it appear that the valuations have settled into a contest—the government versus the railroads. The commission has evidently declined to accept many of the views set forth by the railroads in the various valuation conferences. It seems, in fact, to have followed more closely the theories of the state commissions, eliminating intangibles together with items that many call tangible, deducting depreciation regardless of serviceability and reading into the Minnesota rate decision a prohibition against the true reproduction cost of land —and it goes without saying that the railroads have protested.

The fact that these two cases are in the nature of test cases has of course not lessened the efforts of the carriers to cover all the objectionable features of the reports. Besides the seeming fallacies pointed out by this journal in the issue of Nov. 11, page 579, the carriers criticise the program of construction, the classification of quantities, the unit prices, and even the very form of the reports, which, they say, renders it impossible to check or dispute the details. Whether there is ground for the criticisms of quantities and prices is for those familiar with the properties in question to say. There does seem to be basis for the objections to the piecemeal and incomplete character of the reports.

One issue raised by the Atlanta, Birmingham & Atlantic looks to be a pertinent one. The road, though the valuation was completed only recently, was valued as of June 30, 1914. At that time the road was in the hands of a receiver and in a bad way as to earnings and expenses. Apparently it was considerably overcapitalized. Since then the property has been reorganized, with a drastic assessment and a $20,000,000 reduction of capitalization, and there have already been decided improvements in the matter of net earnings. Yet there is no mention of all this in the commission's report. Technically, the commission has done the correct thing, producing its valuation as of the date of valuation. Practically, it has illustrated a trait of courts and commissions of presenting facts that mislead because other facts are ignored. The newspapers were quick to grasp the apparent fact that the first valuation reported showed only $24,000,000 value against $59,000,000 capitalization. However successful this and other railroads may ultimately be in proving that their present value exceeds their capitalization, the damage is done. Many will look no further, seeing that the first valuation has shown rank stock watering.

The carrier's protest should show thoughtful people the folly of too hasty conclusions. A circular from the general secretary of the Presidents' Conference Committee points out that the commission's own reproduction cost of the Atlanta, Birmingham & Atlantic, when made to include all of the items reported—land, materials and supplies and property owned but not used—together with $200,000 cash in hand, would be $29,032,413 instead of $24,154,998.

In this connection the Engineering Record regrets having ignored materials and supplies and property owned but not used in the total given on page 598 of the issue of Nov. 11. The figure of $26,446,441, plus $433,000 for materials and supplies, would, we take it, be the value for ratemaking purposes derived from the commission's report; but for a comparison with capitalization the additional $2,153,000 for property owned but not used should be included.

But the carrier claims much more than the $29,032,413. For the tangible items exclusive of land it claims $32,397,878 instead of $24,154,998; for tangible items not recognized by the government it claims $6,681,383, and for land, instead of $2,291,413, normal market value, it claims a reproduction cost of $8,192,369 plus $1,860,329 interest, or $10,052,698. Adding these we have $49,131,959 as compared with the $24,154,998 announced by the newspapers, and with $39,290,000, the present capitalization.

It is not necessary to accept the carrier's estimate on its face value to perceive that it is too early to say that the government's valuations are proving the widespread charges of overcapitalization.

Dredging Equipment for Any Contract Should Be Chosen to Fit Exactly the Conditions Expected

If a Job Does Not Justify Installation of Proper Equipment, It Does Not Justify a Bid—Conditions Governing Dredging on Reclamation Work and How Four Common Types of Dredge Meet Them

By ARTHUR M. SHAW
Consulting Engineer, New Orleans, La.

WHEN MR. SHAW'S ARTICLES were received by the Engineering Record they were described by the editor who examined them as "one of the most human documents we have ever received."

THE FIRST ARTICLE, published below, describes the common types of dredges used in land-reclamation work, with the advantages and limitations which suit each to the different conditions met; it also analyzes the types of power plant in use, foreshadowing the application of electric power generated with internal-combustion engines.

THE SECOND OF THE SERIES, to appear in the issue of Dec. 23, outlines the advantages of progressive training for employees—a plan by which every man is prepared to step into the place above him, giving the men an incentive to stay with the job and reducing delays from illness or changes in personnel.

THE THIRD ARTICLE, which will be published Dec. 30, emphasizes the necessity for close contact with the work and constant watchfulness — necessary to success in any undertaking—and tells how they are maintained by the successful dredging contractor.—EDITOR.

IN APPROACHING a dredging job of any magnitude the first and most important problem which confronts the contractor is the selection of the most suitable equipment. To the contractor the difference between the performance of a dredge which is of just the right type for the work in view and one which will "do nearly as well and save buying a new outfit" will often represent the difference between a profit and a loss. Contractors doing a large general business may well afford to maintain a fleet of dredges from which they can select the proper type for any ordinary work offered. Even with companies controlling a wide variety of outfits, however, it is often most economical to provide entirely new equipment for special work in order that the special conditions may be met in the most efficient manner. No work of importance should be undertaken with equipment unsuited to its peculiar conditions. If the profits which may reasonably be expected are not large enough to justify the installation of the proper equipment, they are not large enough to justify the labor, expense and risk involved in placing a bid.

Past Performance Best Guide in Selection of Equipment

The best guide in the selection of equipment is found in records of past performances, though it should be kept in mind that good results have been secured in individual instances by nearly every type of machine now being sold. Prospective purchasers are frequently led into error by the misapplication of data secured under conditions varying materially from those which will obtain on the work in view. Certain well-developed types of dredges will work economically under a considerable range of conditions, but there is no one machine which is best suited to all, or even to most conditions.

This discussion of various types of equipment and the power plants used to operate them is confined principally to those used in the reclamation of lands in the lower Mississippi delta. The types considered are dipper dredges, orange-peel and clamshell dredges, hydraulic dredges and dragline dredges. Other types which have been used to a limited extent will not be considered in this discussion. There have also been developed certain types of wheel ditching machines capable of digging such large ditches that they might almost be considered under the head of dredges. In their manner of operation and style of organization, however, they have not enough in common with the ordinary dredge for consideration here.

Two Types of Dipper Dredges

Dipper dredges may be mounted on scows or may be operated on land. In the latter case they are supported on car wheels, with short sections of portable track, on broad-tread wheels for running on planks or on hard ground, on rollers for moving on planks, or on caterpillar treads, or are rigged as "walking" dredges. Wherever it is practicable to secure sufficient water the floating dredge is usually preferred, as the expense and delays incident to moving ahead as the work progresses are reduced to a minimum with this type. On isolated work, requiring frequent tearing down and rebuilding, if a floater is to be used, the land outfit is preferred.

Tearing down and rebuilding a floating dredge is a tedious and expensive operation. The salvage from an ordinary wooden hull is usually a negligible (and frequently a minus) quantity. Some of the new types of steel hulls, built in sections, have met these objections in an ingenious manner and should materially increase the field of operations of floating dredges. In a number of cases moderately large dredges have been moved intact over considerable distances across land, but the writer has yet to learn of any individual owner who has made such an experiment and who is ready to attempt it a second time.

BUCKET DREDGE WITH LONG BOOM WOULD BE USEFUL IN LEVEE BUILDING

Vertical and Bank Spuds Compared

The greatest variation in the details of floating dipper dredges is found in the types of spuds used, in the manner of raising and lowering the spuds and in "pinning up." There are two general types in common use—the vertical and the bank spuds. Vertical spuds are comparatively simple, are adaptable to a wide range of depth and are independent of the width of canal. They are usually raised and lowered by independent engines, either by means of cables or by compound gears engaging a heavy rack which is attached to the spud. Cables are now quite generally preferred, though the rack is still in common use and is preferred by some. Neither type has any marked advantage in the matter of simplicity. The cable system has one considerable advantage in that it permits setting the engines farther aft, where they can be more easily attended to by those having the care of the main engines.

The power for raising spuds on some dredges is compounded by means of worm gears, but the writer considers a worm gear a necessary evil, to be tolerated on some machines but never on a dredge.

Bank spuds give greater stability to the hull, being, as their name implies, set out on the berm or bank. They permit the use of a much longer boom on a dredge of given width than is possible by the use of vertical spuds. On some machines the bank spuds act as an outboard support, the strain being carried to the hull by a well-braced structure acting as a beam. In other cases the strain is transferred direct to the top of the A-frame. That portion of the spud which rests on the bank is in the form of a plank platform, and for work in soft material these platforms are extended so as to cover a considerable area. In some cases these platforms are hinged along the center so that they may be more easily raised out of sticky material. One of the principal objections to bank spuds is that they often crush down the berm, inducing slides in the levee or waste bank. It is impracticable to use bank spuds in wide canals or open water of any considerable depth.

Owing to the powerful thrust of the dipper acting in various directions, the rigid bracing of spuds and fastening of all spud connections, whether of the vertical or bank type, are most important.

Dipper Dredge Best for Hard Digging

Comparison with other types of dredges is most favorable to the dipper type when

working in hard, compact material such as cemented gravel and ledge rock. It is usually preferred for digging through heavily timbered country, especially through trees having large tap roots. Its ability to bring a tremendous amount of power to bear at a single point contributes to its popularity in heavy timber work. Whenever possible, however, all large stumps should be loosened and shattered before the dredge reaches them.

Dredges are designed for handling earth, and there is no economy in delaying and overstraining them in grubbing stumps when it is reasonably practicable to remove, or at least loosen, the stumps by other means. In soft ground, blowing stumps entirely out of the ground should not be attempted, as the ground beneath them does not afford sufficient resistance to make this possible without an excessive cost for dynamite. A better plan is to bore a hole into the stump and place the explosive where its shattering effect will be the greatest.

Blasting Pays with Dipper Dredge

Hard gravel and rock should be blasted ahead of the dredge even though it may be possible to make some progress without first loosening the material. Dipper dredges equipped with crowding engines on the boom and with special teeth on the bucket will make fair progress without preliminary blasting in soft limestone rock which is in fairly thin layers. It will usually be found more economical, however, to do some preliminary blasting in all such material.

Loss of time frequently occurs in the use of a dipper dredge by the jamming into the bucket of a large stump or boulder, though a skillful operator will seldom permit this to occur.

In mucky soils dipper dredges often disintegrate the material to such an extent that much of it is carried in suspension in the canal for several hours, to be deposited later in the bed of the canal and materially reduce the section. In the very soft trembling prairies of southern Louisiana this will occur to a certain extent with any type of dredge, but is most noticeable with dipper and dragline machines, which require a long movement of the bucket in filling.

Grab-Bucket Dredges Handle Sand or Mud and Build Levees

Variations in mounting and methods of moving are much the same with grab-bucket dredges as with the dipper type. Spuds are usually cable-operated. The spuds are used as anchors only, since there is less necessity for pinning up a dredge with this class of machinery. For levee construction and other classes of work on which the bulk of the material is to be dumped to one side of the excavation, gravity swing outfits are preferred on account of their simplicity, low first cost and economy of operation.

Orange-peel and clamshell buckets are most efficient in handling gravel, sand and soft material, though boulders, pig iron and blasted ledge rock are handled economically by the larger, three-bladed orange-peels of extra-heavy construction. In hard, packed sand the clamshell is most suitable, as it gathers its load by the scraping action of the blades. In hard digging teeth are placed on the edges of clamshell buckets for loosening the material. Though, owing to the large number of wearing parts, repairs are frequently required with grab buckets, they are readily made, usually by the substitution of small bushings and pins. A liberal supply of these repair parts should be kept in stock. It is usually found most economical to keep an extra bucket on hand so that at least one may be in perfect condition at all times.

Orange-Peel Best for Loading on Irregular Surface

Orange-peel buckets are preferred to clamshells for digging stumps, widening canals and other work where it is necessary for the bucket to fill on irregular surfaces or grab hold of materials of varying density. For digging stumps other than those having large tap roots the orange-peel dredge of large size is fully equal to any other type. Its ability to dig on all sides of a stump, tearing loose each individual main root, makes up for its lack of the great lifting and shoving power of the dipper dredge.

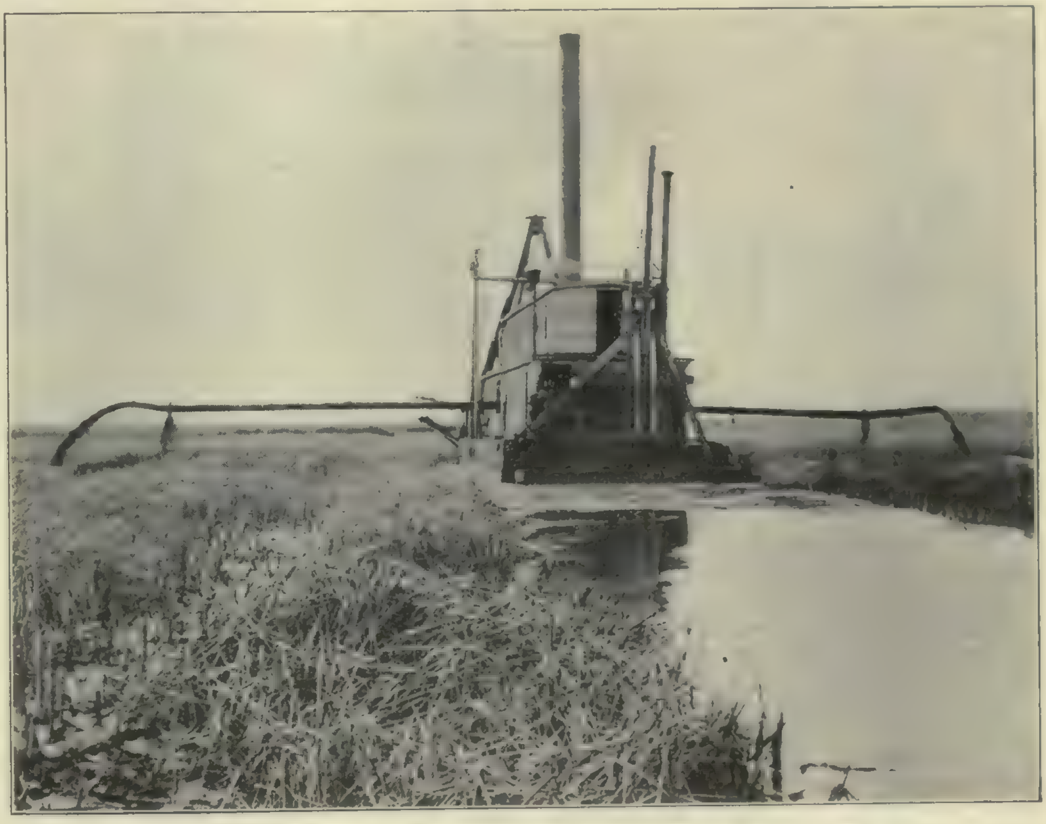
While not well adapted to digging hard sand, the orange-peel bucket may be used in such material with moderate success if properly handled. To insure economical loading the bucket should be dropped into the pit in a partly closed position, the blades being held as nearly vertical as practicable. After dropping, the closing line should be overhauled slightly and released, repeating this operation as many times as may be necessary to load the bucket. It is not usually feasible to secure a full load by this method, nor is this desirable, as the "suction" in such material is so great that it is almost impossible to break loose with a full bucket of packed sand.

Though careless manipulation of dredges of any type when working in soft muck will stir up the material in much the same manner as will a dipper dredge, grab buckets, if intelligently handled, will excavate such material much better than any other bucket dredge. When working in material easily carried in suspension by the water, the bucket should not be permitted to bury itself in the bottom of the canal, but should be held by the "standing line," so that it will load with only such material as it can take out of the canal. Overloading and consequent dropping of broken material back into the water is the cause of most of the loss in section through sedimentation of canals dug by grab buckets. In cleaning out old canals which have become partly filled with fine ooze especial care is necessary to insure tight closing of the bucket. In the tough muck and Sharkey clay which are typical of the lower Mississippi delta grab buckets may be loaded 30 to 40 per cent beyond their rated capacity without danger of any considerable portion of the load dropping off.

Grab-Bucket Dredge Could Build Levees

Until quite recently most of the river levees on the lower Mississippi were built by wheelbarrow or team work. These methods are now largely superseded by land dredges and by tower and cable rigs, though a few floating dredges are also used. As the material for building these levees is taken from the river side and land equipment cannot be operated excepting during moderately low stages of the river, the working period is reduced to a few months of each year. It would seem as though, by making a slight modification in the specifications for the construction of these levees, it would be possible to use floating dredges with extra-long booms for a large portion of such work.

Economy would be effected both by the use of more efficient equipment and by making possible a longer working season. With a fleet of dredges, either privately or publicly owned, such as those described by Fred H. Tibbetts in *Engineering News* of Sept. 4, 1913, page 456, the levee authorities would have available an excellent equip-



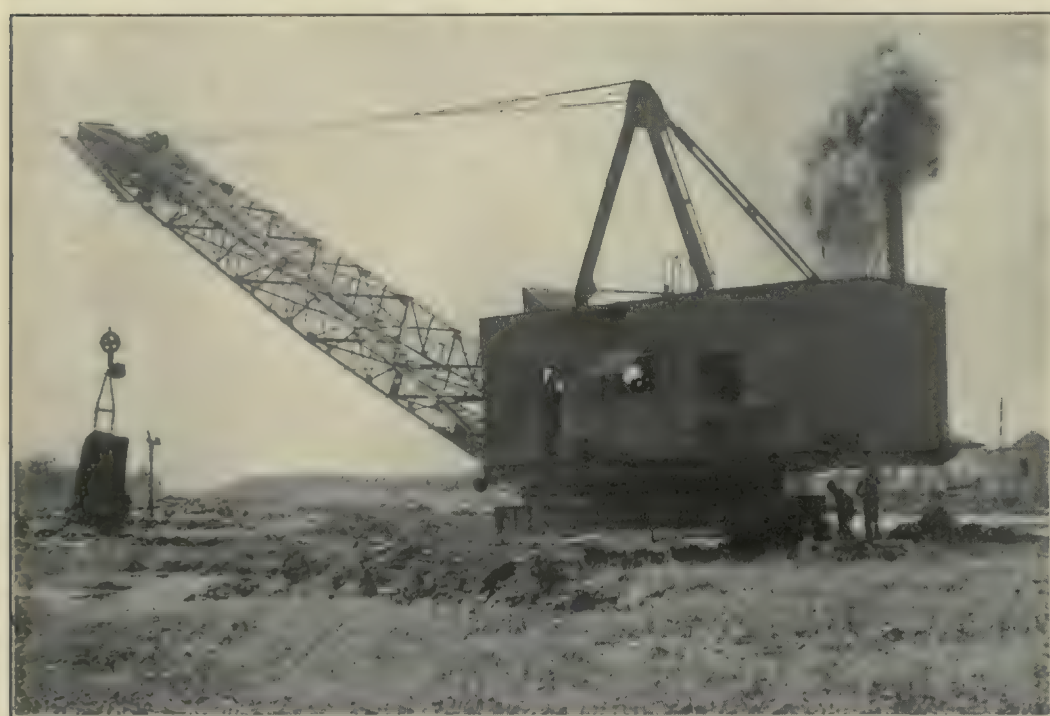
WHERE ADJACENT LAND MAY BE FLOODED, SUCTION DREDGE IS OFTEN BEST TOOL

Discharge lines, supported by guys from A-frame, cocked up at ends so heavy material can escape at open joint and form ridge to dam fine silt back from canal section.

ment for coping with many of the emergencies which have in the past resulted in disaster.

DRAGLINE ESSENTIALLY LAND MACHINE

It is seldom that a dragline dredge is mounted on a barge, as its operation tends to form a mud roll ahead of the bucket which cannot easily be removed excepting as the machine backs away from its work. Dragline machines are moved on rollers, trucks or caterpillar treads. The "whirler" type is usually preferred, as it can reach back for sections of track which have been passed over and transfer them ahead. An excellent type of track for a heavy skid excavator operating on soft ground is described by D. W. O'Bannon in the *Excavating Engineer* for July, 1916.



DRAGLINE, MOST EFFICIENT WHEN BACKING AWAY FROM WORK, IS ESSENTIALLY A LAND MACHINE

The dragline machine has a marked advantage over other types in that it can handle a larger bucket for a given power unit than any other bucket dredge. Little if any lifting force is required while the bucket is filling, and the power for loading is applied in nearly a direct line from the winding drum, thus making it possible to exert practically the entire power of the engine in filling and cutting through obstructions. The dragline embodies many of the advantages of both grab-bucket and dipper dredges, with some of their disadvantages, as well as some peculiar to itself. It can dig around a stump in much the same manner, though not so well, as an orange-peel and can bring great power to bear at a single point in an effort to overturn the stump. Large stumps cannot be lifted clear of the pit without the use of chains, and in making an extra hard pull there is always present the danger of overturning the machine or of pulling it from its supports.

These machines will handle almost any material that can be excavated by a dipper dredge. They are not well adapted for digging soft material which washes easily. The stirring action is much the same as that of the dipper dredge and the bucket is not so well able to retain the material. Observation of a dragline machine engaged in excavating material deposited by a sluggish current in an old canal showed that the bucket was taking out only about 30 per cent of its rated capacity at each load. In suitable material, however, it will load considerably beyond the rated capacity. Under skillful manipulation a dragline machine is capable of dressing off a levee much better than can be done by any other type of bucket machine.

HYDRAULIC DREDGES PREFERRED FOR FILLING LOW LAND

Hydraulic dredges are often preferred for interior canal construction on account of their ability to spread the excavated material over a wide area, thus avoiding wasteful and unsightly banks. They are not often used for levee building on reclamation projects, though they have been so employed with good results. The preferred method in cutting new canals is to make a first cut with a small bucket dredge, dumping the material in about equal quantities on either side, to form a barrier which prevents the material excavated by the hydraulic dredge from flowing back into the canal. In other cases a small hand-built levee serves the same purpose. A levee or ridge of sod 2 ft. in height will usually retain the discharge from a 12-in. hydraulic dredge, provided the point of discharge is 30 ft. or more beyond the levee. For canals having a section much in excess of 10 yd. per linear foot a larger levee will be required.

Suction dredges are subject to delays through the stoppage of suction pipes and pumps from grass, roots and other débris, though the larger sizes are seldom troubled by anything smaller than stumps. Nothing less than a 10-in. pump should be used for work of this class, owing to frequent stoppage of the suction line, while the very large sizes are usually unsuitable because they require so large a hull that they cannot be used in the smaller canals. A 12-in. dredging pump with all necessary equipment can be mounted on a barge 24x80 ft., which will be found suitable for digging 30-ft. canals—a common size for the smaller systems. A 12-in. pump, equipped with a suitable cutter, will pass a surprising amount of solid articles. In cleaning out the Chalmette slips below the city of New Orleans a solid cannon ball from the Chalmette battlefield, pieces of ship's rigging and various other bric-à-brac were brought out by the suction dredges.

TYPES OF CUTTERS ADAPTED TO DIFFERENT MATERIALS

The greatest variation in these dredges is found in their cutter heads, their design and speed of rotation being dictated by the character of the material excavated. In hard, gravelly material a rugged cutter head is required which will produce the maximum agitation in the material. In the muck and soft clay soils of the lower Mississippi delta, on the other hand, a slicing action of the blades secures better results, especially if combined with only moderate speed of rotation. The cutter head shown in the illustration, made by the Ellicott Machine Company, is well adapted to a wide range of material. For soft muck, however, it would be greatly improved by reducing the section of the blades, thus increasing the clearance between them, and by lengthening the "basket" along the axis of the shaft. This would produce a less rugged head, but one which, if revolved slowly, would bring the soft muck to the suction with less breaking up of the material.

EXPERT HANDLING PREVENTS CLOGGING

In the construction of wide canals or basins the ladder which supports the suction pipe and cutter head may be rigid laterally, but for the excavation of narrow canals a ladder is required which is flexible in all directions, as the space is too limited for keeping the intake to its work by swinging the hull. The swinging device should be subject to the easy control of the operator in order that the greatest economy of operation may be assured. The effective work of a hydraulic dredge depends to a great extent on the percentage of solids discharged. This percentage will drop with a dull, sickening thud if the dredge is operated carelessly or if it is not equipped so that the cutter head may be kept close up to the work and so regulated that it will not clog. In deep excavations care must be used to prevent undercutting to such an extent that heavy material can drop down onto the ladder and cutter head and choke the pump or wreck the end of the ladder.

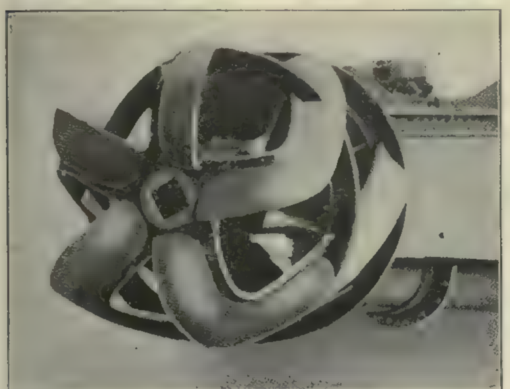
Hydraulic dredges for canal excavation should be equipped so that they will discharge normally through a Y connection on both sides of the canal. The point of discharge should be not less than 50 ft. beyond the side of the hull, the pipes being supported by gallows frames or A-frames with cables. Each discharge should be equipped with a valve so that it can be closed temporarily for passing obstructions or intersecting canals. Where growing crops or other improvements do not prohibit the discharge of water and mud over adjacent lands hydraulic dredges are preferred to any other type for cleaning out old canals which have lost much of their original section through sedimentation.

Suction dredges may handle stumps by first undermining and then dragging them out with a line from a winch head on board the dredge. Although stumps may be taken out in this manner this type of dredge cannot be operated economically in a heavily timbered area.

Most of the power problems in dredge operation and design are common to all the classes of equipment described. Hereto-

fore steam power has been used almost exclusively, the smaller dredges being equipped with the simplest type of slide-valve hoisting engines. Hydraulic dredges have usually employed a better grade of engine in their main power unit.

Great difficulty is experienced near the coast in securing suitable boiler-feed water. The unlimited use of raw water from the canals results in expensive delays and repair bills through the rapid deterioration of boilers, steam piping and engines. This trouble is reduced, though not eliminated, by the use of condensers. A dredge equipped with a complete salt-water outfit, including condenser, circulating and vacuum pump and a high-speed evaporator, was constructed by the writer in one instance for use in waters which were exceptionally bad. This plant has now been in nearly continuous operation for three years with no serious delays from the steam end of the outfit. Although the steam auxiliaries cost nearly the same as the boiler itself, it appears by comparing the operation of this dredge with that of others operating in the same water, but not similarly equipped, that the extra equipment has paid for itself several times over.



CUTTER SUITED TO WIDE RANGE OF MATERIALS

The intermittent but frequently excessive demands for steam on most types of dredges makes it necessary that an ample capacity for producing dry steam should be provided. Condensers, evaporators and steam separators are an aid, but nothing will fully make up for a deficiency in boiler capacity. Foaming, due to overcrowding the boilers, especially when supplied with poor water, reduces the available power of engines, carries away the lubrication and contributes to a large extent to engine breakdowns.

SHORT STACKS A DISADVANTAGE

Another factor in limiting the power supply is curtailment of draft through the unnecessary abbreviation of the stack. There is no reason why the average floating dredge should not carry a smokestack more nearly approximating the length established as good practice in other lines of steam engineering. In spite of this fact it is not uncommon to see an 80 or 100-hp. dredge boiler supplied with a 20-ft. stack. The design of the stack, however, should be based on the coal burned per hour rather than on the rated horsepower of the boiler, which should be considerably in excess of the theoretical requirements.

The accompanying table illustrates the writer's ideas as to suitable proportions for a 1½-yd. orange-peel, gravity-swing dredge designed for a given reach of 50 ft. from the side of the excavation. These proportions contemplate setting the machinery down in the hull. If set on deck, it would be advisable to increase the diameter of stack to 30 in. and reduce the height to 40 ft. Such an outfit should operate on about 300 lb. of coal per hour.

SUITABLE PROPORTIONS FOR 1½-YARD ORANGE-PEEL DREDGE WITH 50-FOOT REACH

Width of hull	36 ft.
Length of hull	80 ft.
Depth of hull	6 ft.
Length of boom	75 ft.
Spread of main drums	16 ft.
Double-cylinder main engine	10x12 in.
Boiler	80 hp.
Diameter of stack	27 in.
Height of stack	50 ft.

The lack of suitable boiler-feed water and the difficulty of transporting fuel and supplies to their plants have caused many dredge owners to consider the use of internal combustion engines in the place of steam power. The high price of gasoline makes this unavailable as a dredge fuel, but recently-developed engines operating on low grades of kerosene, distillate and even crude oil are now generating power for practically all purposes and are being used to a limited extent on dredges. These engines lack the flexibility of the steam plant and their use on dredges requiring numerous simultaneous operations presents serious difficulties. It is believed, however, that these will be overcome. In large plants the result will doubtless be secured by the use of a single or double power unit driving a generator which will furnish current for the individual motors used to drive each portion of the mechanism. The experience already gained in the operation of electrically equipped dredges in other sections will be of value in this development.

CONSTANT-SPEED ENGINES SATISFACTORY

Gravity swing dredges may be operated satisfactorily by single, constant-speed engines, the speed of hoisting lines and other operations being regulated by the slipping of friction clutches. The control of hoisting speed by the slipping of frictions is considered by many as wasteful and unsatisfactory, but with a properly designed device it has been found satisfactory, especially on machines of moderate size. For such service, the friction blocks should be of generous dimensions and turned true so that there will be complete contact over a large area. Maple seems to be preferred for friction blocks by manufacturers of dredging and hoisting machinery, but the writer has secured better results at a smaller cost by using well-seasoned black gum. Any good pattern maker can turn out a satisfactory set of blocks if given an accurate set of drawings to work from. A small gravity swing dredge has been operated from a constant-speed, internal-combustion engine for a period of over three months without renewal of the black gum friction blocks used in controlling the main hoisting drums.

Mileage Used as Basis for Computing Depreciation

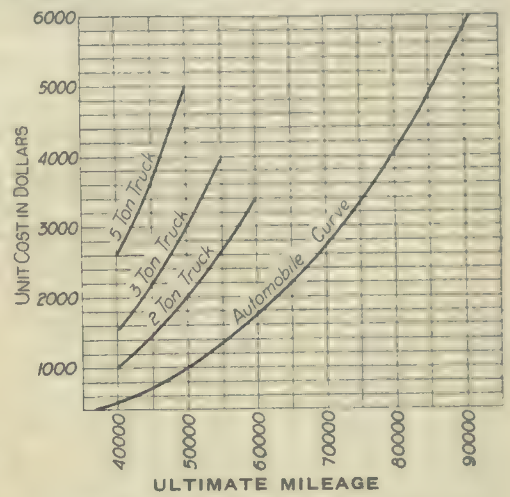
Value of Automobiles and Motor Trucks of Given Cost and Size Written Off at Rate Based on Probable Mileage

By ASA E. PHILLIPS
Superintendent, Sewer Department, Washington, D. C.

THE SUBSTITUTION of a mileage basis for the time-of-service basis heretofore used has been suggested by the writer for determining the average approximate depreciation of municipally owned automobiles and trucks of various makes. The plan is intended to be used only for the purpose of equipment valuation. It requires, of course, some simple and approximate rule for determining what may be called the ultimate mileage, or that mileage beyond which considerable renewals, reconstruction or entire replacement would theoretically be necessary. With machines of various makes, merits, types and costs, such a determination should have a uniform basis. Obviously, the most available is the single factor of initial cost.

EMPIRICAL FORMULAS DERIVED FROM DATA AVAILABLE

The automobiles and trucks owned by the District of Columbia are used chiefly on construction work and operate over an area of about 70 square miles. Only a comparatively small portion of this district has as yet smooth pavements, and the vehicles under consideration are operated largely in unimproved sections. The following simple empirical formulas, based on such data as are available, have been derived as a tentative solution of this vexatious problem of valuation:



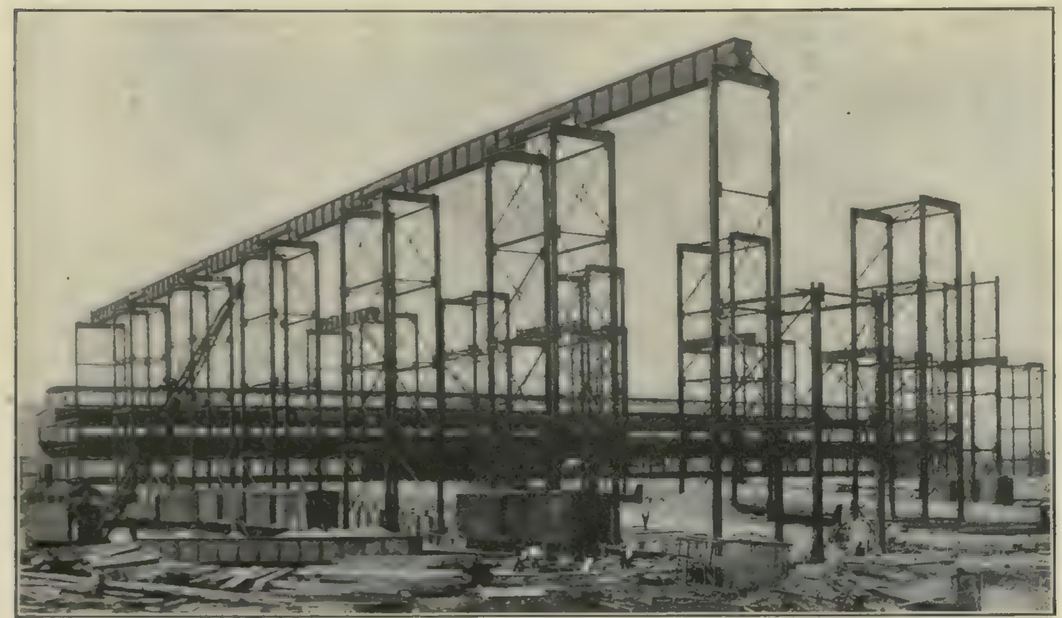
DEPRECIATION IN TERMS OF MILEAGE

For automobiles, $M = 5000 \sqrt[3]{C}$;

For trucks, $M = 5000 \sqrt[3]{\frac{C}{L}}$

M = Ultimate mileage;
C = Initial cost;
L = Load capacity in tons.

Based on these formulas, the curves shown in the diagram indicate the ultimate mileage for automobiles costing from $300 to $5,000 and for trucks costing from $1,000 to $5,000. In the case of trucks it has been assumed that under service conditions the ultimate mileage varies inversely as some function of the load carried. In other words, it is assumed that a 3-ton truck of the same initial cost would probably have less mileage than a 2-ton truck, other conditions being equal. These formulas, of course, should be used only for the purpose for which they were derived, and can in no sense be relied on to give a measure of relative values. Possibly, however, they may have a somewhat wider application in the way of determining the mileage which should be realized from reconstruction and replacement, and might be made to serve as an indication of the economic expediency of such an investment. So much depends, however, on the condition of roads and on the care, good sense and judgment of operation that the question of the actual ultimate mileage of such vehicles is beyond any possible statement.



CRANE RUNWAYS 95 FEET HIGH AND 600 FEET LONG ON 15 X 25-FOOT TOWERS

Special Trusses of Rolled Beams Used in Walls of Sun Shipbuilding Plant

Five Launching Ways Are Served by Ten 15-Ton Cranes of 112-Foot Span and 95-Foot Lift—Runways Cantilevered at Each End

SUPPLEMENTING the general description of the new plant of the Sun Shipbuilding Company near Chester, Pa., in the issue of Oct. 21, page 498, special features of the steel framework of the main buildings and the high crane girder supports above the shipways are here illustrated. Heavy trusses built of Bethlehem beams with connections for runway beams, roof columns, rafters and floor girders are used in the walls between the main parts of the buildings. As shown in the previous article, the main buildings are laid out as a large H in plan. At the junction between them overhead trusses span two 80-ft 6-in. openings and one 69-ft. opening corresponding to the bays of the fabricating shop, which is the cross-bar of the H.

The five sets of crane runways above the reinforced-concrete shipways are supported upon high towers 15 x 25 ft. in plan, with girder beams for the vertical columns. In fact, this type of rolled section was used for columns throughout the buildings. The heavy columns required to support the above-mentioned trusses between the buildings are 30-in. 200-lb. Bethlehem girder beams.

TYPICAL DETAILS OF TRUSS

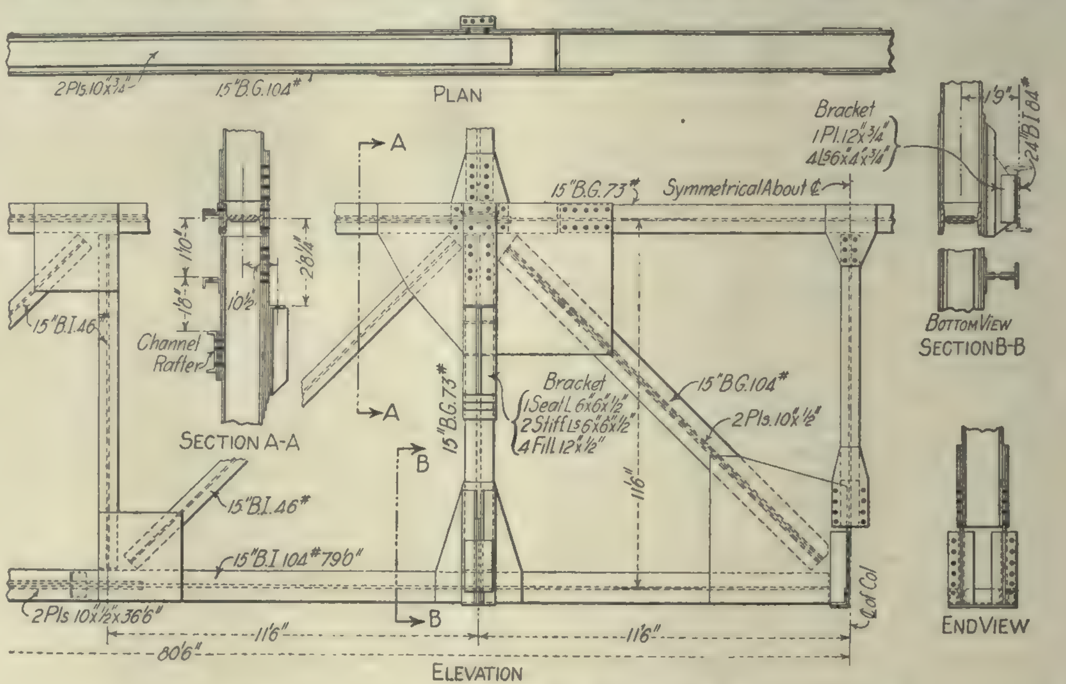
The latticed girders or Pratt trusses spanning the openings between the laying-out shop and the fabricating shop are designed to give 20-ft. clearance. They carry the roof columns of the outside buildings, the sloping rafter for the roof of the fabricating shop, the plate girders supporting the mold-loft floor, and the 5-ton crane runway beams in the laying-out shop. As indicated by the typical details here reproduced, these trusses are built of 15-in. Bethlehem beams and girders, making the connections for the attached parts relatively simple. It will be seen that the top-chord member is made continuous across the columns between adjacent trusses, introducing continuity of action, which, however, was not considered in computing the stresses, but it was done to give additional stiffness.

The total weight of these heavy trusses is 21 tons for the 80-ft. 6-in. spans and 16 tons for the 69-ft. spans. They were detailed with ½-in. gusset plates and ⅞-in. rivets.

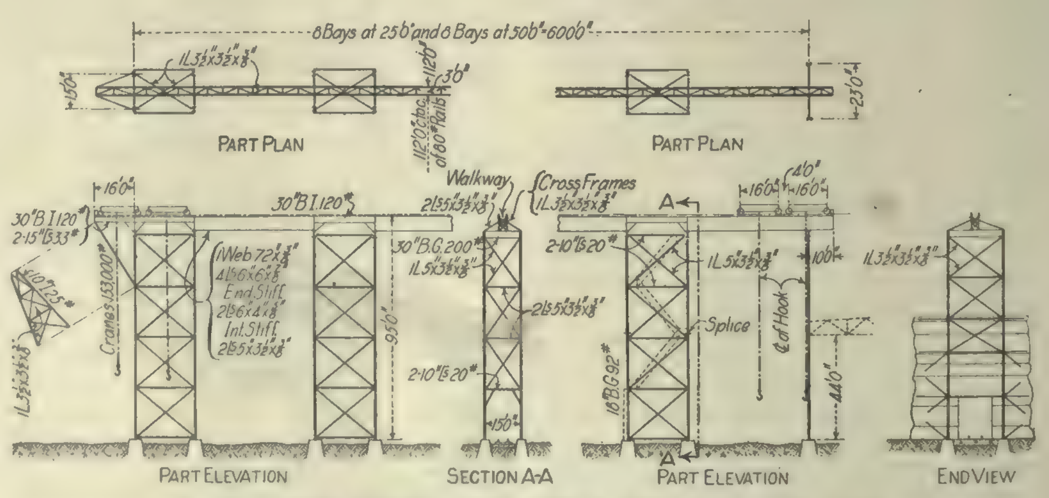
The five launching ways to the south of the assembling shop are served by overhead bridge cranes, two in each aisle, of 15-ton capacity, 112-ft. span and 95-ft. lift. The total 600-ft. length consists of eight alternate 25-ft. and 50-ft. bays, with towers designed as shown in one of the drawings. The runway beams are 3 ft. apart, braced by angle bracing and cross-frames, as indicated in the plan and end views. The main girders are 6 ft. deep and the tower spans are 30-in. I-beams. Transverse 30-in. 200-lb. girder beams carry the loads to the columns.

Diagonal bracing of single angles is used on all sides except for the lower panel in the transverse planes, where a portal is required to allow clearance above the railroad track passing through the towers. Horizontal bracing is provided at each panel point. In the design 25 per cent was added to crane-load stresses to allow for impact.

At each end the runways project beyond the supporting bents. On the north end the 6-ft. girder is designed as a cantilever projecting 10 ft. over the roof of the assembling shop, thereby permitting the hook of the end crane to fall close to the building. On the south, or river, end special runway girders composed of 30-in. Bethlehem I-beams with a 15-in. channel riveted to each flange project 16 ft. beyond the end tower, bringing the hook over the stern post and rudder frame of the ship. Braced diag-



TYPICAL DETAILS OF 80-FOOT 6-INCH TRUSS BETWEEN MAIN BUILDINGS



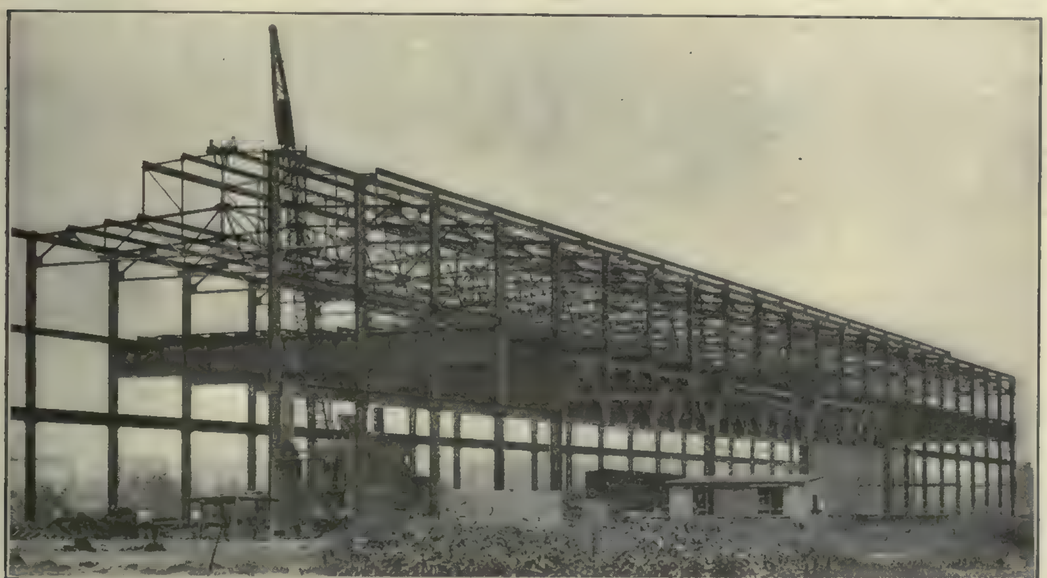
BRACED TOWERS SUPPORT CRANE GIRDERS ABOVE LAUNCHING WAYS

onal struts support this end, as shown, by a connection to the tower panel point below.

10,000 SQUARE FEET OF SLIDING DOORS

About 10,000 sq. ft. of sliding doors are required, consisting principally of five large doors, 23 ft. wide and 38 ft. high, opposite the shipways, permitting complete bulkheads to be removed from the assembly shop to the shipways.

Among the other features in these large buildings may be mentioned the rubberoid roofing used on 2-in. sheathing and 12-in. channel purlins for the roofs; the continuous bands of solid rolled-steel Fenestra wall sash (with 30-per cent ventilation in the walls and 50-per cent ventilation in the monitors), giving 80,000 sq. ft. of glazing out of the total 170,000 sq. ft. of side walls, or 47 per cent; the design of the roof trusses in the fabricating shop to carry concentrated loads of 3 tons at any panel point to provide for future monorails, with 12-in. I-beams for attachment as required, and the use of minimum-size angles of 3 x 2½ x 5/16. About 6000 tons of structural steelwork was erected in four months by two 30-ton industrial cranes equipped with 85-ft. booms and 15-ft. outriggers.



HEAVY TRUSSES AT CONNECTION OF LAYING-OUT SHOP WITH FABRICATING SHOP

All the main buildings were designed by the engineering department of the Belmont Iron Works of Philadelphia, of which J. G. Shryock is designing engineer. The steel was fabricated at their Eddystone bridge shop, of which A. F. Rader is superintendent. The erection work was done by their erection department, of which B. T. Mial is manager. All details were subject to the supervision and approval of the Sun Shipbuilding Company, of which J. Howard Pew is president and J. N. Pew, Jr., vice-president.

Painted Curbs Warning Signals

By ordinance many cities specify that vehicles may not stand within a certain distance of a fire hydrant. In San Bernardino, Cal., it is 15 ft., and as a reminder the fire chief has had the hydrant curb painted red. In addition in white letters are stenciled the words "Keep Away." In some of the outlying districts of Chicago the curb opposite catchbasins has been painted red, presumably for the purpose of quick location should the sewer clog and flood a large area of the adjacent pavement. Following a heavy snowfall the location will be facilitated, as gutter plows will uncover the curb.

Railroads Involved Protest Against First Two Tentative Valuation Reports

Atlanta, Birmingham & Atlantic and Texas Midland Take Exception to Many Features of Findings of Interstate Commerce Commission

PROTESTS are made by the Atlanta, Birmingham & Atlantic Railway on fifty-six counts and by the Texas Midland Railroad on twenty-eight against the tentative valuations of those roads reported in October by the Interstate Commerce Commission. In the main, these protests are along the line of the arguments presented by the carriers at the various valuation conferences that have taken place in Washington, and could have readily been predicted. Features of them are here presented, however, as they relate to the first two railroads reported on by the commission. (Abstracts of the reports were published in the Engineering Record of Nov. 11, page 598.) The two protests have been published and distributed among the carriers by the general secretary of the Presidents' Conference Committee, Thomas W. Hulme, Philadelphia. The Atlanta, Birmingham & Atlantic brief contains fifty-nine pages, and is signed by E. T. Lamb, president; that of the Texas Midland contains forty-three pages, and is signed by L. W. Wells, assistant to the general manager and chief engineer. It may be noted that where the commission allows $24,154,998 for the reproduction cost, exclusive of land, of the Atlanta, Birmingham & Atlantic, the carrier claims $39,079,260.74.

Atlanta, Birmingham & Atlantic

Exception was first taken by the Atlanta, Birmingham & Atlantic to the capital liabilities reported—$59,565,176. Mr. Lamb admits that the figure was correct for June 30, 1914, the date of valuation (when the property was under a receivership), but points out that by the reorganization of Dec. 31, 1915, the capitalization was reduced to $39,290,000 par value. He points out further that since the reorganization gross revenues have increased, transportation expenses have decreased and the company has acquired a large cash balance. He contends therefore that a tentative valuation not completed until Oct. 19, 1916, and given to the public on that date, which does not direct attention to the changes in ownership, the reduction of outstanding capital liabilities and the increase of earnings, all prior to Oct. 19, 1916, is misleading, and is calculated to affect the carrier injuriously.

Complete omission is charged of various elements of property used but not owned by the carrier. Among these are the passenger stations at Atlanta and Birmingham.

MANY ARBITRARY ASSUMPTIONS CHANGED

Objection is raised to numerous so-called arbitrary assumptions. These include assumptions that certain lands actually acquired and held for carrier purposes were not so acquired and held, the assumption having been made without consultation with the carrier; that in reproduction right-of-way and terminal lands will be ready on the date construction begins, without the necessity of a prior purchase and expenditure upon which interest will accumulate; that when the physical parts of a railroad have been connected for initial operation the construction is complete, and no other construction expense will be necessary; that in reproduction there will be no depreciation in engineering costs but will be depreciation in labor costs, and in taxes, interest and all other overhead costs. "It is assumed," states the protest, "that as to certain physical properties only cost figures are to be ascertained and reported, and that as to certain other properties, such as land, only figures of value are to be ascertained and reported, and that as to depreciation the same is to be ascertained and reported in terms of 'value' and that by a combination of these several figures of 'cost' and 'value' a sane and intelligible result of the 'value' of all the property and its 'cost of reproduction' may be determined."

Regarding aids, gifts, grants of right-of-way and donations, protest is made against the placing of land in that category merely because the consideration named in the deed was nominal. Attention is called to an alleged donation in the town of La Grange, where, as a matter of fact, the protest states, the grant was the result of a valid contract giving the town a substantial concession in the matter of rates from the East, which concession has cost, is now costing and will continue to cost the carrier a substantial sum of money.

WORKING CAPITAL OMITTED

Working capital, Mr. Lamb finds, is omitted in the tentative valuation, although it appears in the accounting report that on June 30, 1914, the carrier had a total of current assets, including cash on hand, amounting to $1,576,359.74. The carrier protests that there should be included in the cost of reproduction a sum for working capital not less than $200,000.

The protest holds it inconsistent to make no allowance for development expenses, while nevertheless reporting a net loss amounting to $4,446,095.25, some part of which loss, the brief states, was undeniably incurred in developing the property. The carrier claims under this heading a sum of not less than $2,500,000.

The commission's engineering report is

asserted to be in error in assuming that in reproduction the bulk of construction material would be delivered by construction trains. In the mountainous regions it is protested that this would be impossible.

Interest During Construction

Where the commission allows $1,215,737 for interest during construction, the carrier claims $3,183,446. The carrier protests that the construction period assumed should be from 36 to 60 months instead of from 18 to 36, that not less than 6 per cent per annum interest should be allowed and that to this should be added an allowance for discounts and commissions. As to all other overhead items the figures the carrier claims are based on the same percentages as those used by the commission, applied to the figures of the various roadway and equipment accounts increased to the amounts claimed by the carrier.

Table 1—Allowance of Commission and Allowances Claimed by Atlanta, Birmingham & Atlantic for Various Items

Class	Commission	Carrier
Road:		
Engineering	$589,503	$1,004,426
Grading	5,263,885	6,992,993
Trestles and culverts	2,370,728	2,985,590
Ties	999,281	1,366,408
Rails	2,717,804	3,023,265
Ballast	381,770	830,340
Track laying and surfacing	716,765	1,210,489
Equipment:		
Steam locomotives	1,263,647	1,353,362
Freight-train cars	2,895,376	3,065,254
Passenger-train cars	399,780	488,930
General expenditures:		
Interest during construction	1,215,737	3,183,446
Total	$22,546,132	$30,058,370
Georgia Terminal Company	903,270	1,442,256
Alabama Terminal Railroad	705,596	897,252
Grand Total	$24,154,998	$32,397,878

Table 2—Additional Allowances Claimed by Atlanta, Birmingham & Atlantic

Abandoned property	$210,000.00
Development cost	2,500,000.00
Appreciation	1,250,000.00
Current assets, including working capital and materials and supplies	1,576,359.74
Telegraph property	123,709.00
Property leased to Woodward Iron Company	1,021,314.00
Total	$6,681,382.74

The commission allowance of $589,503 for engineering in the case of the Atlanta, Birmingham & Atlantic proper the carrier considers grossly inadequate. The carrier protests that this amount should be not less than $1,400,426. It contends that the allowance for engineering should be not less than 5 per cent of roadway and equipment accounts 3 to 47, exclusive of accounts 39, 40 and 41. The carrier protests that the amounts allowed for engineering in the case of the terminal companies are also grossly inadequate.

Abandoned Property

To support his contention that much abandoned property should be included in reproduction cost, Mr. Lamb cites the case of the Eastern Railway of Alabama. Here was a 20-mile line which interfered materially with the proposed line of the carrier, and rather than construct an entirely new line avoiding the existing road it was found cheaper to buy the existing road, utilize 8.3 of the 20 miles and abandon the remainder. The line cost $429,000, and the total salvage did not exceed $229,000. The carrier claims therefore an allowance of $200,000 at this point under the heading of abandoned property.

These are only a few of the company's criticisms of the commission's treatment of the road, equipment and general-expenditure accounts. The carrier also enumerates a long list of items omitted entirely, these including contingencies, assessments for public improvements, overhead crossings actually paid for, engineering and reconnaissance expenses in preliminary and location surveys, excess cost of maintenance and operation before track and roadbed have seasoned, franchises, appreciation, maps and plans, and time tables, car schedules, tickets and many other materials that would have to be purchased as part of the investment in advance of earnings. The commission is held to be in error in failing to show "other values or elements of values." The carrier disagrees absolutely with the commission's interpretation of depreciation, but complains in addition that because the commission's report does not set forth the basis for the depreciation deduction, and because, furthermore, the government's field men have been permitted to modify the declared practice of the commission as set forth in the memorandum of the Engineering Board, the carrier is unable, when dissatisfied with an estimate made, to show that any rule, method or principle was departed from. The carrier complains also that the methods of arriving at unit costs have not been set forth fully and clearly enough to permit the carrier to check the figures.

A comparison between the allowances made by the commission and those claimed by the carrier for some of the principal items is afforded by Table 1. The grand total allowed by the commission, exclusive of land, is $24,154,998. The total of the corresponding items as figured by the carrier is $32,397,878. In addition to this, however, the carrier claims the items shown in Table 2, for which the commission makes no allowance. They total $6,681,382.74, bringing the grand total, exclusive of land, to $39,079,260.74.

Treatment of Land Protested

Coming down to land, the carrier protests against the giving of land a different treatment from that given the other physical properties of the carrier. It protests that with "present value" shown as it has been for land, while for all other physical properties only cost figures are reported, it is impossible to determine the total cost of reproducing all the physical properties of the carrier owned or used by it for its purposes as a common carrier, or to determine the present value of the same. The carrier protests that in order to determine either the present value of all the physical properties or the cost of reproducing same, all of them, including land, must be treated alike, and either the present value or the cost of reproducing must be stated after each piece of such physical properties.

The carrier protests that inasmuch as the commission's land report states that "the fair market value of similar adjoining or adjacent lands was ascertained, and the unit of value of such lands constituted the value which was applied to the zones of the carrier's lands," the figures reported do not state the true present value of the lands, and are meaningless and worthless for any purpose. As instances where the so-called "present value" is considerably less than the amount actually paid, the brief cites one parcel given a "present value" of $3,843.75 that actually cost the company $39,992.17 and another given a present value of $20,775 that actually cost $40,658.43. The carrier protests that in the absence of evidence showing that it was reckless or improvident in prices paid for lands, it cannot be allowed, in determining the cost of reproduction of its property, a less amount than it actually paid.

Further protest is made that certain lands have been classed as non-carrier lands that were acquired for carrier purposes and are now so held, and that in acquiring and holding such lands for carrier purposes it has acted reasonably and prudently and with good judgment.

As compared with the "present value" of $2,291,413 allowed by the commission, the carrier claims a cost of reproduction on the valuation date, exclusive of interest, of not less than $8,192,369. In addition to this it is contended that interest should be allowed on its lands at 6 per cent per annum for from two to four years, amounting to a total of $1,860,329.

Texas Midland Railroad

Considerably less detail is given in the protest of the Texas Midland Railroad. No figures are presented to show what reproduction cost totals the carrier would claim. In general, the arguments are similar to those of the Atlanta, Birmingham & Atlantic. The carrier does, however, present claims of unit prices considerably in excess of those allowed by the commission. Some of the comparative figures are presented in Table 3. The carrier also asserts that 14 miles of railroad under joint use with another company were omitted entirely from the tentative valuation.

Table 3—Comparative Unit Prices Allowed by Commission and Claimed by Texas Midland Railroad

Account	Commission	Carrier
Earth excavation, cu. yd.	$0.15	$0.18
Earth embankment, cu. yd.	.135	.18
Hardpan	.24	.35
Loose rock, cu. yd.	.35	.43
Solid rock, cu. yd.	.67	.97
Pile trestles, lin. ft.	11.80	20.00
Concrete, cu. yd.	$8.90 to 11.80	*15.00
Ballast, sand, cu. yd.	.15	.36
Ballast, stone, cu. yd.	.65	.80
Tracklaying and surfacing:		
Ballasted track, mile	780.00	1,185.00
Installing turnouts, each	20.00	50.00

*Only 1118 cu yd. of concrete in all.

Five Cities Now Operating Home-Made Alum Plants

Highly basic aluminum sulphate as a coagulant for water purification is now being made by plants on the ground in five cities —Columbus, Ohio; Trenton, N. J.; Springfield, Mass.; Omaha, Neb., and Montreal Canada. In addition a private plant is being operated at the factory of the Independent Packers Fertilizers Company, Columbus, from which a number of water plants have been supplied with the alum cake in which 10 to 14 per cent of the aluminum content is basic. C. P. Hoover, chemist in charge of the Columbus water softening and purification plant, recently was granted patent 1,197,123 on this process of purifying water. One of his main claims is that this highly basic alumina being less stable than the acid combined alumina dissociates quickly. Hence there result a quick coagulation, large flocks and quick sedimentation. This is considered of particular advantage in treating cold water, as ordinarily the reactions in it are slow.

Timber-Incased Concrete Caisson to Be Sunk 142 Feet for New London Bridge

Jets Opening Outside as Well as Under Cutting Edge to Guide High Boxes—Three Air Caissons and Two Cofferdam Abutments in Contract

TIMBER-INCASED concrete caissons sunk by open dredging to depths beyond the reach of the pneumatic process feature the construction of the new Thames River Bridge of the New York, New Haven & Hartford Railroad at New London, Conn. In sinking these caissons, 30 x 94 and 42 x 99 ft. in plan, to depths of 110 and 142 ft. below mean low tide level, an extensive system of jets, arranged to loosen the material beneath and to play a film of water up any one or all of the four outside faces, is being used to guide them down in correct position. Requiring some 3,000,000 ft. b.m., these piers represent an unusual consumption of structural timber for a single bridge project.

Besides the three dredged caissons, two abutments are being built in cofferdam, and the fourth pier will be sunk by the pneumatic process. As the rock ledge dips about 40 ft. in the length of this pier, three cylinder piers will be sunk to support it instead of sinking a full-size caisson. This will greatly reduce the rock excavation under air. Except the compressor plant for these caissons and the plant at the shipyard where the caissons are built, the work is being carried out largely with floating equipment, including an unusual concrete barge, described on page 752 of this issue.

Wood and Concrete Caissons

The three caissons to be sunk by open dredging have cutting edges of steel filled with concrete, not only under the outside walls, but also under the center wall and cross-walls between the dredging pockets. This construction will give greater bearing in going down and reduce the stresses from possible uneven support. It also makes possible the use of heavier concrete walls between the dredge wells. The lift pier caisson has a longitudinal wall of reinforced concrete, while the two narrow caissons have timber center walls 3 ft. thick. The reinforced-concrete walls surrounding the dredge wells give a strength and stiffness unattainable with an all-timber structure, while the use of timber for outside walls and dredge wells gives greater ease and flexibility of construction after floating than with an all-concrete structure. With the latter, concrete must be kept above water; while with the caisson designed, the top of concrete is below water during the entire sinking, and it is not expected that extra weight will be needed. The pier shafts themselves will be started 30 ft. below mean low water.

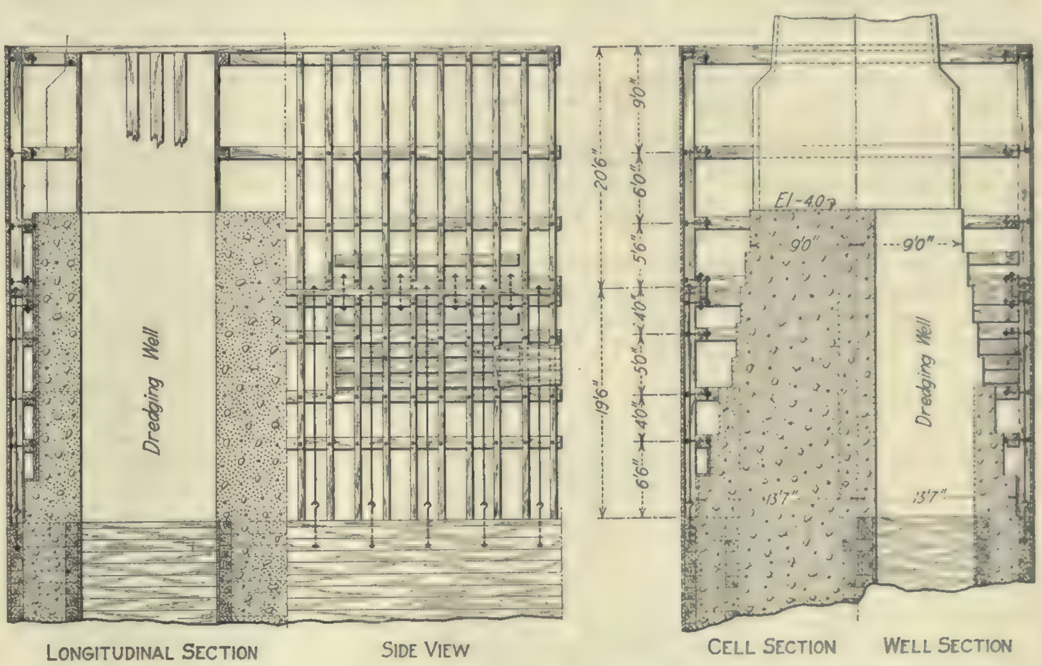
Caisson Launched from Marine Railway

The contractors leased a marine railway of 2500-ton capacity on the west bank of the Thames a mile above the site. Here the caissons for piers 1 and 2 have been begun and launched and that for pier 3 is being built. The cutting edges are assembled on a false bottom resting on the ways and the timber work is carried up about eight courses. The concrete is then placed in the cutting edges and up to a depth of one course in the cribwork. A mixer at the center of the north side of the ways is supplied by a track to the end of a pier north of the ways, where sand and gravel are received in scows. Cement is delivered on a siding from the Central Vermont Railroad. The concrete is placed by a derrick, which is also used to set the steel and timber.

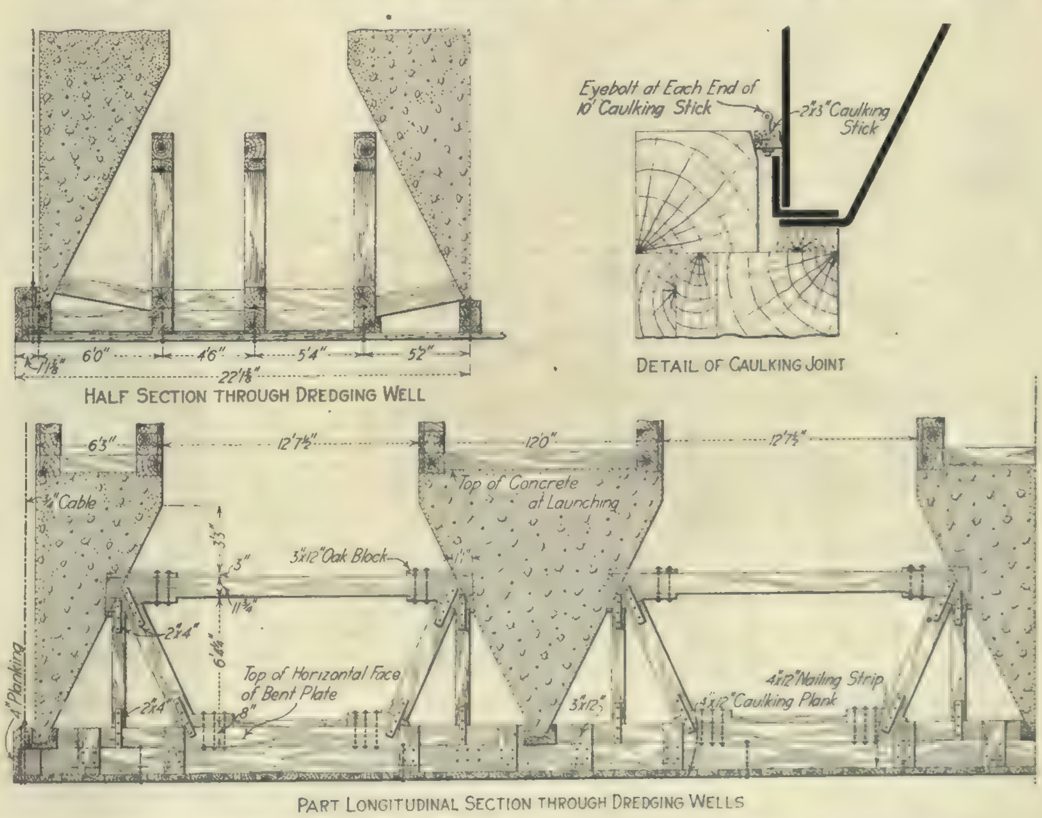
With the caisson concrete above the lower course of timber the ways are lowered down the railway till the structure floats and can be towed to the site. The timber for the first buildup is delivered and framed at the north side of the ways, where a power saw is located. The rest of the timber is delivered and framed in the north end of the shipyard. Here it is rolled into the water, rafted by courses, and towed to the bridge by gasoline launches.

Second Buildup Placed Before Removing False Bottom

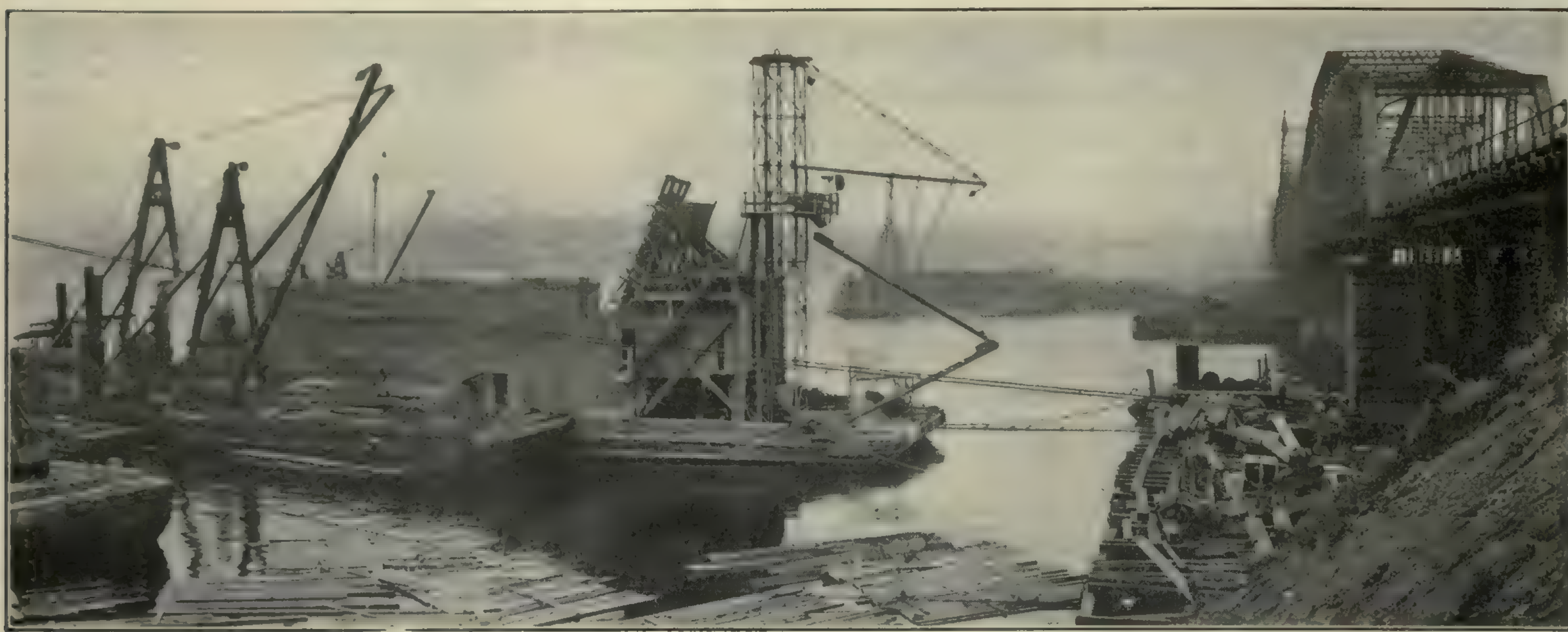
For placing the second buildup the caissons have been tied up successively to the north end of the fender pier for the present drawspan, where an air compressor and a boiler for running the air boring machines and drift-pin hammers are installed. With a derrick boat alongside to place the timbers, the caissons are built up as high as they can float and still permit the removal of the false bottom. The dredging wells are then filled with water to river level, thus relieving the pressure on the false bottom, and enough gravel is dumped into the dredging wells to overcome the buoyancy of the false bottom. About 80 yd. was required for the first



TIMBER AND CONCRETE DESIGN OF CAISSONS GIVES GREAT FLEXIBILITY IN CONSTRUCTION



FALSE BOTTOM'S SEAL TO CAISSON BROKEN FOR REMOVAL BY PULLING OUT CALKING STICK



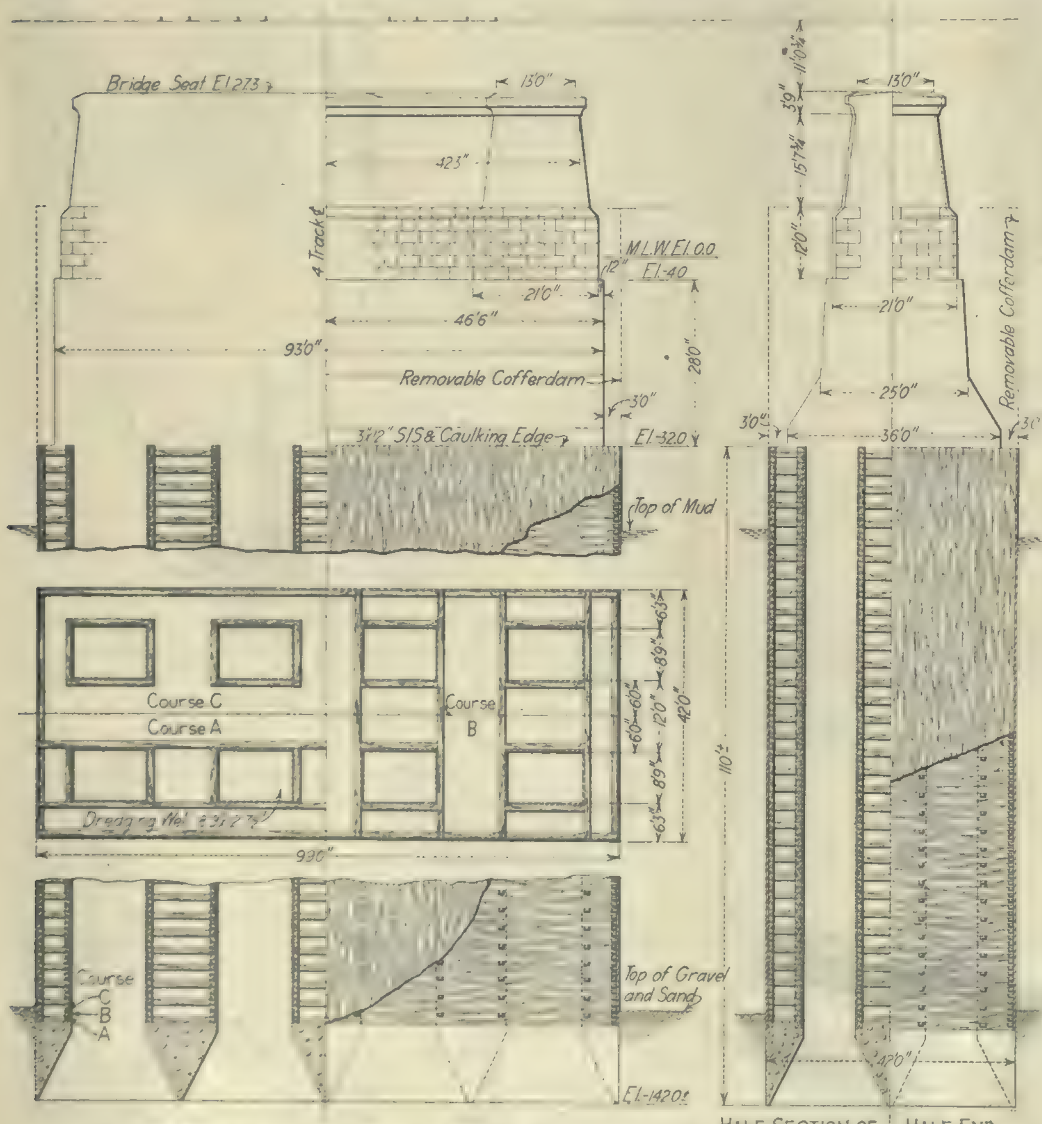
LARGE CAISSONS, SUNK TO UNUSUAL DEPTH BY OPEN DREDGING, WILL CARRY FOUR-TRACK STRUCTURE TO REPLACE BRIDGE AT RIGHT

Mixer boat and derrick barges between west abutment and pier 1 at left, large caisson tied to old fender pier in center and present bridge at right.

box. The bottom is recovered by lines attached to it before sinking. The caisson is then towed to place and set by water ballast in the buoyancy cells. Dredging is then begun, and dredging and concreting are continued till the top course nears high tide level.

When the bottom is removed, the caisson is floated by the air space above the concrete between the outer walls and the dredging-well walls. The pressure on the dredging-well walls, which are sheathed and calked, sprung the corners of the dredge wells in the first caisson and sunk it just after the bottom had been loosened. The caisson was raised by putting on another buildup and pumping it out.

When the first sinking is completed, a second buildup of timber, extending in the case of pier 1 clear to the top of the caisson section, is placed. A small air plant on a barge is used to supply the boring tools. This barge also supplies steam for the pumps used to unwater the space surrounding the dredge wells for concreting. With piers 2 and 3 sunk 32 ft. deeper than pier 1, a third buildup is necessary. Sinking is then resumed and carried on till it becomes necessary to place the removable cofferdam, inside which the pier shaft is to be built. Only one cofferdam, with four end and four side sections, is required. This is to be used successively for all three piers, extra panels being inserted for the large pier. A single set of ordinary bracing is provided for this dam, which will be removed as the masonry of each pier shaft is brought up and replaced by blocking. The cofferdam is secured by rods, reaching above water, to hook bolts in the top of the outside skin of each caisson. To release it, these rods are loosened and dropped till they are free of the hook bolts, when the bolts left above water to secure the sections to each other can be taken out, allowing the cofferdam to fall apart.



ONE REMOVABLE DAM, DETACHED BY PUSHING DOWN LONG RODS, USED FOR THREE PIERS

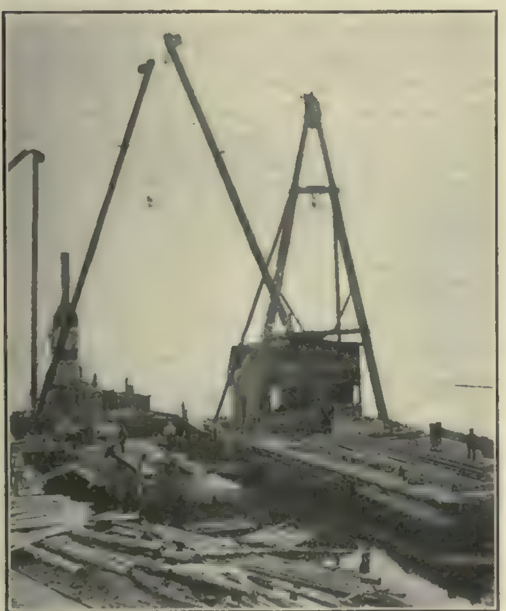
The dredge wells of the caissons are to be filled with mass concrete. They will probably be sealed under water and pumped out.

That most of the sinking will be through mud and very soft clay has been determined by careful soundings. Gravel in varying depths will be encountered toward the end, however, as all three of the dredged caissons will be landed on gravel. To wash out material and allow the caissons to move laterally in any desired direction, jet openings are provided on the outside of the cutting edge as well as on the bottom. The openings on the outside are of ¾ in. diameter, spaced about 8 ft. apart and 3 ft. 8 in. above the cutting edge. These jets, thirty-six in number, are arranged in six groups of six jets each—one group at each corner with three jets along the side and three on the end of the caisson; the last two groups have one jet along each side of the caisson. Each group of six is supplied with water at 150 lb. pressure through a 4-in. pipe line. Each of the eight dredge wells is provided with eight jets, two on each side of the well. Each well has two 4-in. pipe lines for its group of jets, the risers being located at diagonally opposite corners of

the well. Large pumps mounted on a barge are used to operate the jets and if necessary sufficient capacity for supplying all the openings at once can be provided.

AIR CAISSONS OF STEEL

The three caissons to be sunk by the pneumatic process for pier 4 will be 22-ft.-diameter cylinders with steel cutting edges and shafting and with wood-stave skins filled with concrete. They will be built and launched from the marine railway, towed to the site in turn and landed. Air will be used from the start of sinking, and about 45 lb. pressure will probably be needed before the deepest one is sealed. The air plant is being set upon the east shore back of the east abutment. A trestle to carry the air mains and a walk for the



PULLING SHEETING AT WEST ABUTMENT

men will be built from the bank out to the pier. The Matheson locks used by the contractor are operated by independent hoists, which will be set on staging around the pier.

To allow the approach fills to be made the abutments are to be completed at an early date. The west abutment, the first work started in the river, is now above water and the single-row cofferdam of steel sheeting in which it has been constructed is being pulled for use on the east abutment. These abutments rest on concrete mats on gravel, from which three concrete piers rise to a point 13 ft. above low tide. Here they are capped by a reinforced-concrete bridge seat. On the water side riprap will be placed around these abutments to retain the earthfill inside and behind them.

PLANT AND MATERIAL HANDLING

Some gravel and all of the sand come by water from a pit on the Thames River above the site. This pit, however, runs too high in sand to supply all the gravel, most of which is brought up the sound from the neighborhood of New Haven. To avoid interruption to the work from foggy and stormy weather during the winter, a reserve of 4000 yd. of sand and double that quantity of stone is being accumulated on the east bank above the line of the approach fill. All the cement is received by rail and unloaded into a 20-car house south of the main line on the west bank. A belt conveyor carries cement from this house to a barge at the waterfront which is loaded with enough cement at a time for a 300-yd. run.

The concrete plant is mounted on a barge. It consists of a tower on one end and a derrick on the other, with sand and gravel storage on the deck between. It usually places more than 300 yd. in a 10-hour day. Aside from a derrick mounted back of the west abutment, the derricks at the shipyard and a locomotive crane used to handle the timber at the same place, six derrick boats are taking care of most of the work. A floating piledriver is used in cofferdam construction and three deck scows are required to handle cement and to float a small air plant and the jetting plant employed in building up and sinking the caissons. A gasoline towboat with a 55-hp. engine and a launch are kept in service.

Work was started in March, 1916. Up to a short time ago 800,000 ft. b.m. of timber, including all that is to be left in place, has been put on the caisson for the first pier, and sinking on this pier had been about three-fourths completed. The second pier caisson has been placed and the second buildup on it is under way. Work has been started on the upper part of the west abutment and on the cofferdam for the east abutment. The third and last dredging caisson is being constructed at the shipyard.

Very good deliveries of high-grade yellow pine have been secured. This timber, which three years ago would probably have been shipped by water, comes in by rail. Five hundred thousand feet of 3-in. sheeting alone, dressed with a calking edge at the mill, is included in the timber order.

The bridge substructure is being built by the Holbrook, Cabot & Rollins Corporation for the New York, New Haven & Hartford Railroad, of which Edward Gagel is chief engineer; W. H. Moore, engineer of structures; I. D. Waterman, engineer of construction. P. B. Spencer, division engineer at New London, is in direct charge of the improvement. The work is being handled from the Boston office of the contractors under the direction of J. W. Rollins, president of the firm. L. S. White is in charge of the work as superintendent.

Teach Engineering Students Fundamental Principles, Says Dr. D. S. Jacobus

Retiring President of American Society of Mechanical Engineers Discusses Needs of Educational Systems as They Now Exist

THAT a thorough mastery of the fundamental principles of engineering science, rather than the mere memorizing of definitions and formulas, is one of the greatest needs in the education of engineering students to-day was the keynote of the presidential address of Dr. D. S. Jacobus delivered at the annual meeting of the American Society of Mechanical Engineers in New York City last week. Dr. Jacobus believes that the elimination of much of the matter from present courses of engineering study and the more thorough teaching of what remains—particularly the writing of good English—will result in the production of graduates who will more nearly approach our ideals. In the remolding of college curricula he maintains that a closer cooperation should exist between college faculties and employers of engineering graduates and that engineering societies could do useful work "if they would go into the problem seriously." Commenting upon the qualities needed in successful engineers, as determined by the canvass of opinion made by the Carnegie Foundation for the Advancement of Teaching, the retiring president of the American Society of Mechanical Engineers conceded the importance of what may be termed the human characteristics, which occupy the upper positions on the list; but he pointed out the grave danger of belittling the requirements for technical knowledge, lack of which, he said, has led many a man to failure. Dr. Jacobus decries the tendency toward specialization along narrow lines, particularly in preparatory schools, and asserts that it is a mistake to aim at high technical requirements in college admission examinations. Extracts from his address follow:

QUALIFICATIONS ANALYZED

Let us analyze the factors in the Carnegie list as given in the order of importance indicated by the replies:

1. Character. integrity, responsibility, resourcefulness, initiative.
2. Judgment, common sense, scientific attitude, perspective.
3. Efficiency, thoroughness, accuracy, industry.
4. Understanding of men, executive ability.
5. Knowledge of the fundamentals of engineering science.
6. Technique of practice and of business.

First of all it is apparent that most of them apply to any profession and that they are not limited to engineering. Again, it might appear that one should succeed in a profession if he possesses the first factors in the list, even though he may not possess those included in the last two items. It would be a dangerous conclusion for a young man to feel that his success is assured if he has character and the other qualities which come near the head of the list, and that it is not necessary for him to have thorough knowledge of the technique of his profession. Such an unfortunate would soon find that the ethical qualities alone will not earn his bread and butter, and that a lack of knowledge in his profession will be an immense handicap.

Eckley B. Coxe was a firm believer that there is a "something" required in the making of an engineer which cannot be gaged by an ordinary examination, and I remember well that he told me he employed some highly paid men who did not know an integral sign from a dollar mark, and that he knew of others classed as the best of graduates he would pay high salaries to keep out of, rather than in, his organization. What is the "something"? What is it that the old-time superintendent has in mind as he shakes his head sadly when asked how some young graduate is progressing. The lad may have character, judgment, and perhaps everything in the Carnegie list, or at least he may think he

has, and yet our old-time friend, often from the land of the heather, knows there is something lacking. And we ask again, what is this "something"?

Would that I could define the "something." It includes such qualities as taking a personal interest in one's work, amenability to discipline, perseverance under adverse circumstances, cheerfulness and amity—the human side. None of these appears separately in the Carnegie list.

Mere Memorizing Not Helpful

We hear and read much respecting teaching methods. Methods are not all; the spirit which unconsciously develops is a most vital factor. I cannot fail to observe that there has been a great change in one respect since I was a boy. In my school days a failure to acquire a subject was laid to the student; now there is a tendency to lay it to the teacher. Much of this is due to the attitude of the parents. A fond mother once told me she thought it strange that no teacher could be found capable of teaching her boy mathematics, not realizing that she herself might be the greatest stumbling block through transmitting the idea that the fault lay anywhere else than with her son. A way never has and never will be found to acquire knowledge without study, and much of the trouble experienced by some students arises through a lack of study or a failure to appreciate the fact that the fault is their own.

Where the teacher is often at fault is in his failure to train the lad to study in a proper way. To memorize is the lowest form of study, and much of our present system may be justly criticized in this respect. A certain amount of memorizing is essential to "train the mind," as our old-time preceptors used to say, but there is much in the doctrine expressed by that lovable professor, John E. Sweet, in the words, "What is the use of teaching a man a mass of material he is bound to forget?"

Recitations and examinations should be conducted so as to bring out more than can be memorized and to take into account the widely varying factors of temperament. It is far easier to lead and have the students follow than to call for initiative and guide them back if they depart from the right path, but the easiest way results mainly in training the memory, whereas the other includes the developing of qualities that are most apt to lead to success.

Fundamentals Must Be Learned

Let us now consider the broad aspect of education. In the replies respecting the Carnegie qualifications, knowledge of the fundamentals of engineering science and technique of practice and of business were placed at the end of the list. If the judgment of those who responded is correct, are we not therefore taking too much valuable time for such training, and would it not be just as well to shorten the college course? It is an open question whether much could not be eliminated from the college course to advantage, provided special attention is given to teaching the fundamentals. Once thoroughly mastered, the student will always carry with him the fundamentals of physics and mechanics, whereas much that relates to special applications will soon be forgotten. Again, the college should graduate its men young enough to preserve the adaptability of mind which the younger man possesses to a far greater degree than an older. If the assumption is made that the fundamentals are thoroughly mastered and the student graduated a year in advance of what he would be should he study along a number of specialized lines, most of those who employ graduates would favor the younger man with a keen knowledge of the fundamentals to the older man with what might be a lesser knowledge of the fundamentals and more knowledge of specialized lines. The question of whether the school course should be shortened depends on how it is shortened. Shortening the time spent in college may not shorten the course of study as a whole.

Age of Graduation Not Changing

As far as can be determined from statistics, the average age of graduation from college has not changed appreciably during the past century, being somewhat over twenty-two and a half years. It would therefore seem that, irrespective of what is taught, there are elements entering a college course which have led to men graduating at about this age. I believe it advisable to have a four-year college course, but I would make the entrance requirements and the course such that the students would be graduated at as early an age as has been and is the current practice.

I have taken the stand and firmly believe that our present entrance requirements do not accurately gage the ability of an applicant, and that it is a mistake to make the entrance requirements too high for an engineering college. High technical requirements may result in the preparatory schools specializing along narrow lines in an endeavor to have the student enter college at an early age, to the sacrifice of a broader education. In addition to the examinations, each and every applicant should be met by a board, and all of the circumstances connected with his case considered. Further, the examinations should be given in a way that will bring out the reasoning powers of the students, which can be accomplished if each man is given an oral examination of some length. Here again we have the harder against the easier way, but I am firmly of the opinion that there is no easy way of doing good teaching.

Too Many Subjects

The aim in teaching should be to produce a man who will be the most useful to his fellow-men and to his country. Just as we give, so we receive. The fruit of usefulness is achievement, and the building up of achievement, success. We should above all consider the human side and aim to produce a broad man with spirit and determination. It is my firm belief that in many cases we could produce graduates who would more nearly meet our ideals by cutting out much from the present courses of study and by teaching more thoroughly matter already in the courses. The course should be broad enough to include some of the so-called cultural studies, and it further should deal with the business side of the profession. Dr. Alexander C. Humphreys was the first to introduce a regular course of economics in an engineering college, the course including accounting, depreciation, shop cost, law of contracts, specifications, appraisals and business methods in general. As an illustration of matter already in the course that it would be well to teach more thoroughly, I can refer to the writing of concise and logical reports in good English. To this might be added speaking on one's feet before a meeting.

To really know a thing one must have more than an abstract knowledge. Much can be gained by having the students make or witness experiments which verify or illustrate the principles. What a student does with his hands in connection with his head he remembers far better than knowledge which he has obtained from text-books or lectures. Laboratory exercises form a useful basis for practice in writing reports. The best results are secured by returning all reports with carefully marked criticisms, and requiring the student to rewrite those that do not come up to the standard.

Having outlined the general principles of engineering education, the question may be asked, how should we proceed to obtain the best results? I believe that much good would be accomplished if those who employ graduates would co-operate in laying out the courses of study. The visiting boards of some colleges are a step in the right direction, but we need something closer and more concrete than is secured through most such boards. The engineering societies could do most fitting and useful work if they would go seriously into the problem. What is needed is a careful consensus of the judgment of many.

Suggestions Summarized

Summarizing, I would make the following suggestions:

1. That there be a closer co-operation between the engineering colleges and those employing graduates and that the engineering societies be encouraged to work along this line.
2. That the technical requirements for entrance to colleges be lowered rather than raised, that preparatory schools be encouraged to give more attention to teaching good English and to giving a broad general education, and that applicants be also judged as to their initiative and general make-up in deciding whether they should be admitted.
3. That the courses be so arranged as to train the initiative and develop the human side; that the students be taught to work in a cheerful and efficient way; that there be proper time for daily relaxation of the mind and that the students be encouraged to use this time to the best advantage.
4. That the professors get down to hard work with their students and know each of them well enough to be thoroughly acquainted with his personal characteristics.
5. That the professors in practical engineering subjects have practical experience so that they can speak with authority.
6. That professors in charge of practical engineering departments be encouraged to undertake practical engineering work, and that their work be so arranged that they can be relieved from meeting classes when the engineering work makes this necessary.
7. That special attention be given to teaching the fundamentals of engineering science, even though this may result in the elimination of certain specialized branches.
8. That greater practice be given in the writing of concise and logical reports in good English, and in speaking on one's feet.
9. That the student be encouraged to confer with the professors, and that regular hours be provided for this purpose, all to the end that the teachers may extend a helping hand where needed and that there be a mutual understanding and trust.

Barrel Pontoon Footbridge Built at Cost of $75

Temporary Crossing of Navigable Stream Required During Construction of New Viaduct —Rope Lines Allow Swingbridge Movement

A UNIQUE and low-cost temporary footbridge to accommodate pedestrians after an old viaduct was removed and during the construction of a new concrete viaduct over the Trinity River at Dallas, Tex., was made in one day by four carpenters, using light timber bents supported by barrel pontoons. The total cost for the bridge, which is more than 50 ft. long with 20-ft. gangplank approaches at each end, was only $75. As the law requires that this river be kept navigable, the bridge is moored at each end by a 1-in. rope. In order to allow a boat to pass, one end of the rope is cast free and the bridge turns downstream.

The general scheme of construction is clear from the accompanying photographs, there being ten rows of barrels, four barrels in each row. The footbridge is 4 ft. wide and 7 ft. above the water, and is constructed of 2-in. plank. A rigid frame retains the barrels in position. The rows are spaced about 6 ft. apart, each row supporting a timber bent, with X-bracing and struts as shown. Longitudinal X-bracing is provided in addition to the timber spacers in the water between the barrels.

When it is necessary to move the bridge to allow an infrequent rowboat to pass, it is easily cast loose at either end, as already mentioned, and the stream carries it to open position in about 10 minutes. Two men can pull it back into place in about 20 minutes. Driftwood and other floating obstructions are disposed of in the same way.

The new viaduct is being constructed by the Gilsonite Construction Company. Part of it is under the direction of the county, and it was at the suggestion of Assistant County Engineer Wickline that this type of bridge was built.

FOOTBRIDGE CARRIED BY BARREL PONTOON

FOUR BARRELS PER ROW HELD BY PLANK FRAME

Time to Go Through Panama Canal

The average time for a vessel to go through the Panama Canal is 11 hours 40 minutes, according to the *Panama Canal Record*. The minimum time recorded is 7 hours 17 minutes, and the maximum is 1 day, 8 hours and 10 minutes. The figures, obtained by observing 158 vessels passing through the canal, show that more than half of the ships were in the passage between 9 and 12 hours. Those requiring more than 12 hours numbered 48.

Highway Engineers Discuss Various Phases of the Motor-Truck Legislation Problem

Symposium in Which Are Expressed Opinions on the Preservation of Highways by Controlling the Vehicles Which Use Them

IN an editorial published in the issue of Oct. 28, page 519, the Engineering Record discussed certain phases of the question of motor truck legislation as a protective measure for highways and outlined the rules and regulations proposed for the State of New Jersey. Comment on this general subject was invited. Among the replies received are the following:

By NELSON P. LEWIS

Chief Engineer, Board of Estimate and Apportionment, New York City

Referring to the proposed code of regulations for motor trucks in New Jersey, as outlined in the issue of the Engineering Record of Oct. 28, and your editorial comment setting forth objections raised by the Motor Truck Club of America, permit me to offer the following comments:

The regulations proposed by the New Jersey authorities appear to me to be in the right direction. In some instances they may have gone too far, and it is unlikely that they will be finally adopted without further study and after hearing both sides. An absolute restriction as to width of vehicles appears to be necessary in order that there shall be no serious reduction in the traffic capacity of public highways, which would inevitably result from the use of vehicles of excessive width.

I am not sure of the wisdom of an absolute limit of 23 ft. 6 in. in the length of motor trucks or of the prohibition of more than one trailer, except possibly within the congested districts of large towns. Trailers can be and some are now so constructed that they will closely follow the tractor and will not cut the corners.

The prohibition of steel tires on trailers appears to be of doubtful wisdom, provided the wheel loads and speeds where steel tires are used are kept within reasonable limits.

The plan of grading the annual fee in proportion to the gross weight and carrying capacity is rational and it might well go farther and make the total width of the vehicle, where such width exceeds 7 ft., an element in the determination of this fee.

A step in advance in American practice appears to be the introduction of the wheel diameter and the speed in determining the weight to be permitted on each of the rear wheels.

Full discussion of these rules is very desirable, and it must be borne in mind that vehicles must be adapted to the roads as well as the roads to the vehicles.

Speaking before a meeting of the American Road Builders' Association in New York City recently, Mr. Lewis said, in substance:

There is a very serious problem which has grown out of the use of motor vehicles, namely, the increasing weight, the increasing wheel loads and the increasing size of these vehicles. The motor or the tractor can overcome grades with heavy loads which were impossible for the horse-drawn vehicle, and highway officials responsible for the maintenance of our city streets and of the country highways leading out of them are greatly concerned at the damage inflicted upon road surfaces by these loads. The only effective remedy appears to be the enactment of laws which will absolutely prohibit the use of vehicles having more than a specified load per inch width of tire, and that load should probably be less for steel tires than for rubber tires.

The width and length of such vehicles is a matter of serious concern, especially on city streets. Where roadways have been designed to accommodate a certain number of lines of traffic and the number of lines is reduced through an increase in the width of the vehicles, the capacity of the roadway is reduced in still greater proportion, and, if this increase in width is allowed to proceed, very costly street widening will become necessary. In this case also it would appear to be necessary to prohibit absolutely the use on our highways of vehicles having more than a certain specified width. The state legislature of Pennsylvania in 1913 passed a law prohibiting the registration of motor vehicles exceeding 90 in. in width of load and vehicle combined, except that motorbuses having a total width of 100 in. for carrying passengers may be used within the limits of cities of the first, second and third classes. This law also prohibits loads in excess of 24,000 lb. for vehicle and load combined and in excess of 18,000 lb. gross load on any axle, or 750 lb. per inch width of solid tire.

Fortunately the tendency of the manufacturers of motor trucks appears to be in the direction of more moderate loads. Of 221 manufacturers producing commercial vehicles at the beginning of the present year 133 confined themselves to those of less than 3 tons capacity. Of the 88 manufacturers offering trucks of more than 3 tons capacity twelve appear to have increased this capacity in their models for this year. Only three decreased the capacity of their trucks, one from 4 to 3½ tons, one from 6 to 4 tons, and one from 7½ to 5 tons. Of twelve newcomers in the field only one offers a truck with a capacity of 6 tons and two of 5 tons, while the rest provide for smaller loads.

The imposition of an absolute limit upon wheel loads and upon the dimensions of vehicles seems necessary to preserve our highways, both in the city and country.

By FRANK F. ROGERS
Commissioner, Michigan State Highway Department

We have your letter calling our attention to the article and editorial in the Engineering Record relative to the tentative rules for the regulation of motor truck traffic in New Jersey. We have read the articles referred to and are fully in accord with any movement to prevent the rapid destruction of roads and pavements by the regulation of such traffic. We thank you for the opportunity of commenting on the situation.

It would seem to us that the use of steel tires on trailers would not be relatively more destructive to the pavement than similar tires on horse-drawn vehicles. The matter of wheel loadings is one which is vital to the situation. In view of the increased traffic and the expectation of further increases in the future, we believe that the wheel loadings expressed in the tentative rules are not excessive.

Worthy of especial emphasis is the fact that no lugs or staggered block tires should be permitted, as these very greatly increase the impact delivered to the pavement. We would consider it advisable to allow more than one trailer to a truck. In fact, it would be better to encourage this than to permit single trucks to carry loads of 8 or 10 tons.

The matter of speed regulation seems to have caused considerable discussion. One thing is certain; there must be regulation of the speed of motor trucks, especially when heavily loaded. Just how to effect this regulation is a matter which must be worked out.

By A. R. HIRST
State Highway Engineer, Wisconsin Highway Commission

We have received your letter of Nov. 1 and have carefully read the two items in your issue of Oct. 28. Your editorial has discussed the proposed regulations so thoroughly that we can add nothing thereto.

The matter of regulating motor trucks has not yet become a problem with us. The only point in this state where there is an appreciable amount of truck hauling outside the limits of cities is in Milwaukee County, which has a very large mileage of concrete highways, which have so far suffered absolutely no damage.

It appears to us, however, absolutely necessary to fix some limits to the wheel loads of motor trucks; otherwise their development will be such as to keep just a little in advance of the paving development. In other words, it will be another phase of the continuing struggle between the armor-maker and the projectile manufacturer. It seems to us that, in fixing this limit, it is more logical to use as an index the possibilities of paving than existing practice in the manufacture of automobiles.

While there is and always will be progress in paving, the possibilities of the most practical types are pretty well understood, and it seems to us that it is much easier to adapt the automobile to the paving than the paving to the automobile. So long as these regulations are reasonable and impartially enforced, it would seem to give all manufacturers an equal opportunity and to avoid working a hardship on any except possibly for a short time on those who are manufacturing extreme types.

By EDWARD N. HINES
Chairman, Wayne County Road Commission, Michigan

I believe that the purposed action of the State of New Jersey toward the use of motor trucks on public highways is timely and necessary, and I would include in any restrictive law of this character traction engines, road engines, steam rollers, or other power vehicles the faces of whose wheels are fitted with spikes, flanges, ribs, clamps, cleats, rings, or lugs.

The tendency of traffic generally is toward greater speeds, wider gage, and heavier loads, and it seems to me that there is a limit beyond which the community should not be compelled to go in building a road that will stand up under every conceivable type of traffic. I believe that the loading and speed should be regulated, and with reference to speed the regulation should cover running light as well as loaded, more especially when trailers are used.

I have seen motor trucks with iron-tired trailers going along at 20 to 25 miles an hour, with trailers swaying from side to side, bounding in the air, and acting as trip hammers on the metaled road. Such practice is destructive both to the trailer and to the road. Trailers of every description should be fitted with rubber tires. It would be desirable to have uniform regulations throughout the country, and a model law might properly be drafted with this idea in view.

By PROF. A. H. BLANCHARD
Consulting Highway Engineer, New York City

If public highways are to be economically constructed and efficiently maintained, it is absolutely necessary that adequate legislation should be passed by state legislatures covering the utilization of highways by horse-drawn vehicles, touring cars, motor trucks, trailers, motorbuses and traction engines. These regulations should cover the operation of all types of vehicular traffic, permissible loads per linear inch of width of tire, and width, length and height of vehicles. Such regulations should be enforceable by state authority and not be left, as is the case at present in New York State, to the control of town and county officials.

Few people realize the traffic to which our trunk highways will soon be subjected. As an illustration might be cited information furnished by the Public Service Commission of the State of New York to the effect that over one hundred motorbus routes are today in operation within the state. In some cases the motorbuses carry as many as forty passengers, have a horsepower rating of 75, weigh, loaded, as much as 8 tons, and have an overall width of 90 in. It is well known to the traveling public that when meeting motor trucks and motorbuses having widths of nearly 8 ft. it is necessary, in order to avoid a collision on a 16-ft. roadway, to turn out on soft shoulders. Accidents resulting therefrom are daily occurrences. [Extract from address before the Poughkeepsie (N. Y.) Automobile Club, Dec. 4, 1916.]

By W. R. D. HALL
Statistician, Pennsylvania State Highway Department

Pennsylvania is contemplating changes in her motor-vehicle law, particularly with reference to legislation along sane and reasonable lines in the commercial-truck subject. At this time, however, we are not in a position to give you any comment on this subject, as we are making a digest of laws and regulations from other states dealing with it and wish to select that combination which seems best applicable to conditions in our own state.

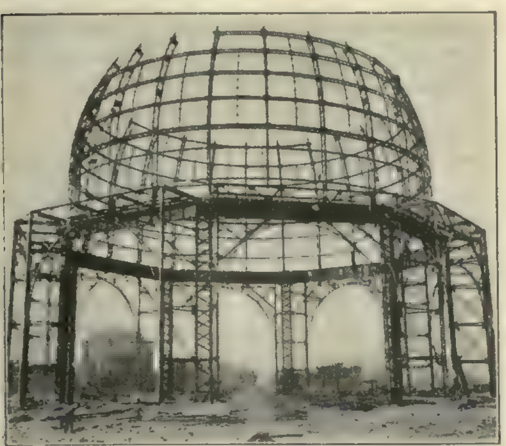
When we have done this I will be pleased to send you a copy of our conclusions, which we hope to have embraced in an act to be submitted to the next legislature.

Safety Belts Were Used in Wrecking Steel Dome

Palace of Horticulture, 175 Feet High, at Panama-Pacific Exposition, Cut Down by Torches with Slight Loss of Steel

THE Palace of Horticulture, which visitors to the Panama-Pacific International Exposition in San Francisco will remember by the weird-colored lights which moved within its huge glass dome at night, was sold as it stood for $5,000. The General Welding & Cutting Works, which purchased the structure, stripped off the glass and woodwork, and when nothing remained but the steel skeleton used oxyacetylene torches to cut it down. Dismembered sections were allowed to fall freely as they were cut away.

SAFETY BELT FACILITATED WORK



STEEL SKELETON, PALACE OF HORTICULTURE

The dome proper was 150 ft. in diameter and 100 ft. high above the supporting arches, or 175 ft. from floor level to top of dome. When the structure was stripped down to the steel skeleton, four men equipped with life-belts and oxyacetylene torches were put to work, starting at the top of the dome. In ten days they had entirely dismembered the dome proper. The removal of the entire steel frame, which was accomplished by a crew of only eight men, was completed in about three weeks. The steel totaled about 600 tons in weight, of which 350 tons was included in the skeleton of the dome proper.

Plan for Wrecking

The plan first proposed for the wrecking involved the cutting off of vertical members so that the circumferential bands would fall in a single piece. The Department of Safety of the California Accident Commission, however, suggested that it would be better to cut out sections of the circumferential bands between uprights, taking one section at a time. They insisted further that the workmen should be provided with the safety belts. It was pointed out that the dismantling of the structure in this way would not only be a safer procedure but would probably involve the loss of less material due to breakage.

Only 2 Per Cent of Steel Damaged

This proved to be the case, as the short sections which were allowed to fall were comparatively light, and it is estimated that not more than 2 per cent of the steel was damaged in falling. This was in large measure owing to the fact that the area into which the pieces fell from the dome was a soft earthfill, and the fallen pieces were removed promptly so that sections falling later would not strike them. Of course, the members of the supporting frame which could be handled by tackle after being cut free were taken down that way. As a result of the precautions to safeguard workmen not a single accident was reported on the work, although it was considered an unusually high risk.

Because of the high prices of steel and greatly delayed deliveries on the Pacific Coast, the structural shapes salvaged from the Palace of Horticulture are finding a ready market, it is stated. Some of the larger shapes are bringing as high as $40 per ton.

John R. Brownell is superintendent of the Department of Safety of the California Accident Commission and J. J. Rosenthal is safety engineer.

Difficult Construction for Intricate Design of Ripon Siphonic Spillway, California

Concrete Costs $25 a Yard in Place—Loose Sand Increases Excavation Cost—Curved Forms and Sharp Angles Expensive

IN THE CONSTRUCTION of the Ripon siphonic spillway, near Ripon, Cal., difficult formwork and correspondingly slow and expensive construction resulted from the use of curves of small radii, angular sections and projections, small concrete sections and heavy reinforcement bent to curves. Mill work was resorted to in most of the curved siphon sections, and only one carpenter and his helper could work at a time. Progress on the steel and concrete work was consequently slow. After each pouring the concrete had to be allowed to set before work on those forms could be resumed. To accelerate construction, work was begun at each end of the structure, which kept the small gang employed constantly. Had it been possible to carry on excavation continuously the construction cost would have been materially less.

Location

The Ripon spillway is located at the end of the main distributary canal of the South San Joaquin Irrigation District, approximately 3 miles northeast of Ripon. It was designed automatically to discharge all water in excess of the capacity of the main canal and any desired amount through a radial steel gate operated by a geared hand control and concrete counterweight.

This steel gate has a wooden watertight face bearing and a discharge opening approximately 11x6 ft. On each side of the gate is an automatic siphon 2x3 ft. neat dimensions, individually primed. One is at the high-water elevation of the main canal; the other is at a water stage 0.07 ft. higher, discharging through a curved outflow into the main section of the spillway. The discharge from the steel gate and the two automatic siphons is carried in a transition ditch section, laid on a 5-per cent grade 110 ft. long, into a lake which drains to the river.

The upstream 70-ft. section crosses a county road spanned by a reinforced-concrete slab bridge, built with the strengthened side walls of the transition section to serve as abutments.

Road Kept Open to Traffic

The road had to be kept open to traffic at all times, which necessitated the diversion of traffic about 30 ft. to the south and prohibited the excavation of that section crossed by the temporary travel. Also, in excavating the headworks, the dirt had to be dragged lengthwise with the structure up a steep grade and there loaded. A material saving would have been effected could access have been had at this point as well as each end when work was begun.

The excavation of the entire structure was in loosely compacted sand, which sloughed away on exposure. This caused sand slides to fill an already completed excavation, which, of course, delayed the work. In other cases, loose sand retarded the pouring of concrete. With the exception of the downstream floorbeam in the flume section, no ground water was encountered in building the superstructure. In sinking the pile foundation for the flume section, ground water was found at a depth of only 2 ft. below the pile heads.

Form Work Slow

The form work was quite tedious, as it was necessary in a number of cases to build a small portion of the structure and let it set. The center wall of the siphon was built first. The 14-in. terra-cotta pipe was embedded at the same time, and the partition wall between the priming siphon and the main siphon was built to an elevation of about 3 ft. above the pipe. The remainder of this partition wall between the two siphons was built on its edge outside the works and allowed to set. It was then placed in position with block and tackle and concreted in. The wall against which it was placed was rabbeted and trimmed neatly to scale so that it went exactly into position and had ample concrete on all sides to make it airtight.

The slightly inclined portion of the siphon on the lower end has quite a complicated form, as it is curved in two directions. The forms were warped in by eye, but in such a manner that each normal cross-section is a 2 x 3-ft. rectangle.

Concrete-Pile Foundation

The downstream 40-ft. section is supported on reinforced-concrete piling. It is 4 x 8 ft. in inside dimensions and is carried on an 8-in. floor. The piles are arranged in three bents of four piles each, capped with a 12 x 12-in. reinforced-concrete beam 9 ft. 6 in. long. The bents, spaced 12 ft. on centers, consist of 12-in. piles spaced 34 in. on centers, cast in place. A contract was let for the pile forms in place with the core removed. These forms were sunk with an ordinary well-drilling outfit, the core being removed with a sand pump slightly in advance of the casing.

Upon removal of the sand pump with the casing at the required depth, the casing was immediately sealed. This was accomplished by tamping a jute sack half full of slightly

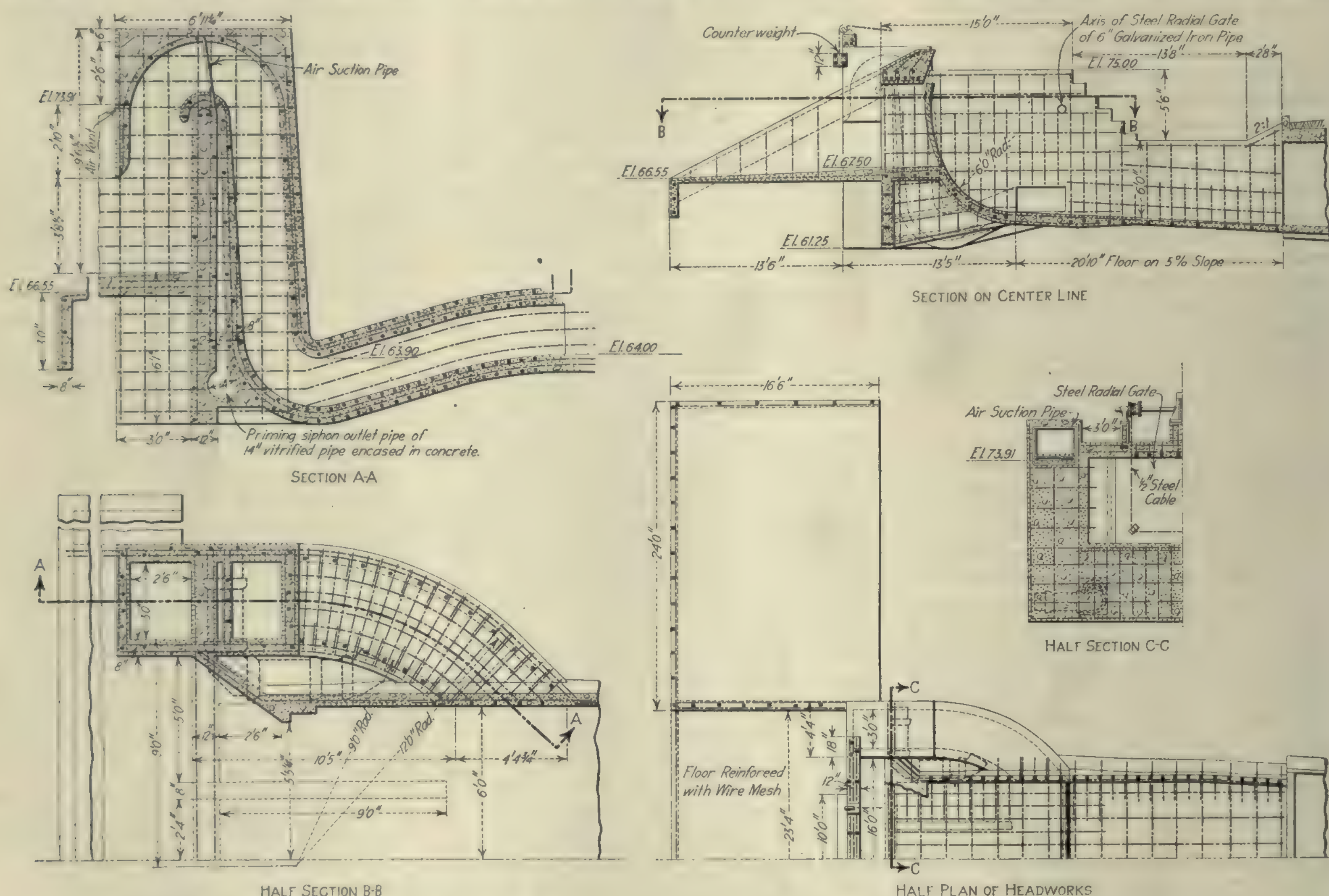
COST REPORT ON RIPON SPILLWAY

Item	Material	Labor
*Excavation	.....	$235.46
Forms	$169.85	269.85
*Steel	317.16	98.73
*Concrete	782.61	282.25
Form metal	21.89	.....
Nails	12.63	.....
Tools	18.75	.....
Milling forms	.....	16.79
Stripping forms	.....	27.79
Cleaning lumber	.....	18.18
Backfilling	.....	92.06
Camp labor	.....	15.86
Miscellaneous labor	.....	24.90
Hauling water wagon	.....	17.38
Gate labor	.....	55.43
Gate materials:		
Steel face	400.00	.....
Wooden runners	14.04	.....
Bolts	2.90	.....
Lifting apparatus	150.00	.....
Flashboards	4.00	.....
I-beams	4.32	.....
Gate axis	13.55	.....
Hauling gate	1.92	.....
Air intakes	10.36	.....
Placing siphon lips	.....	7.68
Placing priming outflows	.....	10.31
Priming outflows	18.40	.....
Well boring	.....	343.75
Cook-house debit	187.63	.....
Rental equipment	50.00	.....
Superintendence-engineering	.....	350.00
Total	$2,180.01	$1,866.42
Grand total		$4,046.43

*950 cu. yd. excavation; 7.06 tons steel; 161.4 cu. yd. concrete.

moistened 1:2:4 concrete to the bottom of the casing. During the interval between the withdrawal of the sand pump and the final tamping into place of the concrete, ground water sometimes forced the sand up into the casing. This caused a part of the depth to which the casing was sunk to be lost to concrete, as is seen in the records of the pile costs. After sealing, the wells were allowed to stand five days, when they were bailed out, the reinforcement placed, and concrete poured. The reinforcement in each pile consisted of heavy mesh, cut to length and bent circular to fit the pile, and five ½ x 5-in. twisted bars to bond the pile and cap.

The 10 ft. of soil through which the casings were driven was coarse sand. Underneath was a stratum of well-compacted fine river-bottom silt, varying in depth from 12 to 24 in., under which was a coarse sand containing some gravel. Ground water was encountered at a depth of about 2 ft.



SECTIONS THROUGH RIPON SIPHON GIVE IDEA OF DIFFICULT CONSTRUCTION IN BUILDING FORMS AND PLACING REINFORCING

Materials were either bought in Ripon or unloaded from cars at that point. Cement was purchased f.o.b. Ripon. The hauling was contracted for at $10 for a car of 640 sacks.

Lumber was purchased in Ripon and hauling was at the rate of $5 per day. Unloading and hauling rock were contracted for at the rate of 60 cents per ton for 105.77 tons and 100 tons at 70 cents per ton.

The high cost per meal (43.2 cents) was due to the small crew boarding regularly at the cook shack. However, this expense was justifiable considering that if there had been no cook shack on the job it would have been necessary to board the men at the hotel and to hire a line wagon at an additional expense. The cook-house debit of $187.63 was therefore an economic waste.

The cost per yard of concrete in place was about $25. The total cost per sack for cement was 60 cents. Rock cost $1.97 per cubic yard and sand 30 cents. A Smith hand mixer of 2½-cu. ft. capacity was used. The pile foundation cost $1.59 per linear foot, this figure including labor and extra work.

The time record for sinking piles showed that on one bent of four piles it required an average of 14 man-days to sink one casing to an average depth of 16 ft., with 10 ft. average depth of concrete. To sink a casing 20 ft., with an 11 ft. 6 in. depth of concrete, took, on an average, 29 days. In sinking casings 30 ft., with a depth of concrete of 22 ft., the time averaged 42 days. In the latter instance a casing froze on large gravel and had to be withdrawn. That took 24 man-days extra.

The work was done by the South San Joaquin Irrigation District, of which A. Griffin is chief engineer.

Use Pictures in Organization Chart

To familiarize those who come in contact with the Illinois Highway Commission with the personnel and scope of the organization, a new 12 x 17-in. chart has been issued and sent out with the November issue of *Illinois Highway*. The distinctive feature is the use of small photographs, ¾ and 1 in. in diameter, of the engineers holding the twenty more prominent positions. The organization was described in the Engineering Record of March 18, page 393.

Advice to Young Engineers

Sir Maurice Fitzmaurice Says Choose the Small Place on a Large Job Rather Than the Large Place on a Small Job

SIR MAURICE FITZMAURICE, in his presidential address before the Institution of Civil Engineers on Nov. 7, repeated advice he has frequently given to young engineers as to the proper choice between two types of employment. As between work on a large job with small salary and on a small job with larger remuneration, he would advise the former. He succinctly states the problem and his advice as follows:

"I have on one or two occasions been asked by a young engineer whether, of two posts offered to him he should take that of one among many assistants on a large work with a small salary or that of resident engineer on a small, unimportant work at a considerably higher salary. Without hesitation I recommended the former position. I knew that on the large works he would see a little of almost every class of work, that even the temporary works of the one were probably more important than the permanent work of the other, and that the fact of being on a large work would be of great assistance later on, and would stand to him all his life. He would also have the advantage of daily intercourse with other engineers, and the emulation and friendly rivalry between them would lead to efforts on his part to hold his own. There also exists on large works a feeling, which I can only describe as engineering atmosphere, which may have a real influence on the life of a young engineer."

Reinforced-Gypsum Roof Decks a Modern Development in the Structural Field

Theoretical Formulas Are Proposed for the New Combination of Materials and Allowable Working Stresses Are Based Upon Tests

By VIRGIL G. MARANI
Consulting Engineer, Cleveland, Ohio

SCIENTIFIC THOUGHT directed to economical construction and the conservation of owners' interests has developed the necessity of engineering as well as architectural skill in the use of materials and the layout and design of the modern utility building. In applying the principles of engineering efficiency to the design and construction of modern buildings, every material used, from the foundation to the finished roof deck, should be selected with due consideration of the function it is expected to perform, its durability, practicability and economy.

The ideal material to be used for roof-deck construction must, in addition to its usefulness as a weather protection, possess the following properties:

1. *Fire Resistivity and Incombustibility*—In case of fire and the consequent change of temperature, the roof deck must not flame or support combustion, nor expand, warp, buckle or spall.

2. *Low Heat Conductivity* — Materials with low heat conductivity are not so likely to condense moist air within the building upon their exposed under surface. This requirement also insures a warmer roof surface in the winter, and consequently a proportional saving in the design of the heating system. In the summer cooler interiors are made possible.

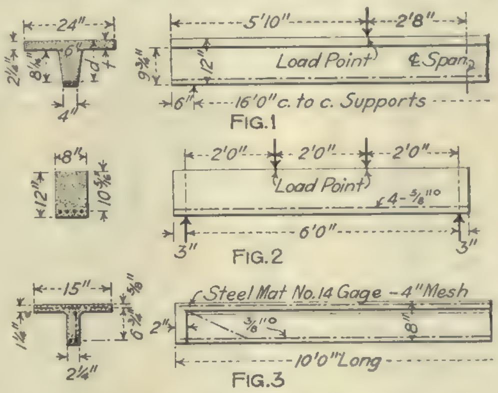
3. *Light Weight and Strength*—Consistent with the strength required as determined by test and standard engineering practice, light weight is important. A reduction of a few pounds of dead load per square foot of roof deck results in considerable saving in the necessary roof trusses and support, structural frame, walls, foundations and footings. Light weight is also an economic factor in the cost of erection (hoisting and placing), and also in the freight and teaming charges to the job, all of which are cost items to the owner.

USE OF GYPSUM TILE

Ordinary gypsum roof tile, reinforced with steel, 3 in. thick and 30 in. long, weighing 13 lb. per square foot, have been used for 10 years or more for the roof decks of cotton and textile mills, foundries, laundries and similar buildings where much inconvenience and trouble is often experienced from the condensation of the moist air upon the under side of the cool roof-deck surface. The success of gypsum for roof decks in buildings where moist air was in excess dated from its inception, and suggested exhaustive and elaborate chemical and physical tests to determine to what extent specially prepared gypsum could be reinforced (as in the case of concrete) and whether a construction of this material could be economically marketed, either as a factory-built unit in spans up to 16 ft. or more or to be poured in molds and erected at the job.

As a result, there has been developed a new structural gypsum termed "Structolite." This is a quick-setting gypsum cement (setting in 15 minutes) capable of being removed from the molds in 4 hours after being poured. It attains full working strength in 24 hours, weighs 77 lb. per cubic foot (about one-half as much as concrete), and its ultimate compressive strength averages 2000 lb. per square inch.

There has also been developed and placed upon the market a reinforced-gypsum roof-deck tile made of this structural gypsum which is believed to possess in a high degree the ideal requirements for roof-deck construction. Tests have been conducted for the manufacturers, the United States Gypsum Company, by Willis A. Slater, research assistant professor of applied mechanics, at the laboratory of the University of Illinois, and constants for use in theoretical design formulas obtained.

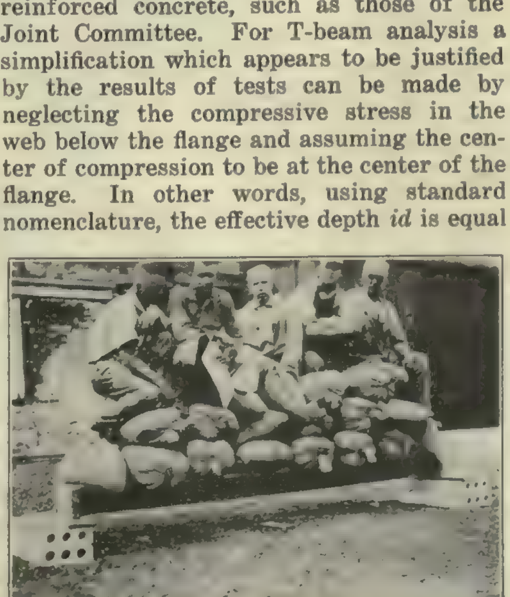


DETAILS OF THE VARIOUS BEAMS TESTED

Standard 4-ft. and 5-ft. tile (Pyrobar), with reinforcement curved at the ends, are made in factory-built units, and this "Structolite" has recently been applied to a roof span of 10 ft. by casting the reinforced units at the building site. Results of tests and a description of the design of the latter units are here given.

DESIGN FORMULAS

The stresses in reinforced-gypsum beams may be computed by the usual formulas for reinforced concrete, such as those of the Joint Committee. For T-beam analysis a simplification which appears to be justified by the results of tests can be made by neglecting the compressive stress in the web below the flange and assuming the center of compression to be at the center of the flange. In other words, using standard nomenclature, the effective depth *id* is equal to $d-t/2$. When the computation for kd shows that the neutral axis falls within the upper flange the computations are made as for a rectangular beam in which $p = A/bd$, instead of $p = A/'d$.



10-FOOT TILE LOADED WITH 3500 LB.

The modulus of elasticity for gypsum appears, according to the results of tests, to average about 1,000,000 lb. per square inch. This gives a ratio $n = E_s/E_g = 30$ for use in formulas. Working stresses here proposed are believed to give safety factors of two when the tile is saturated and not more than 24 hours old, and not less than four when the gypsum is dry and steel reinforcement of high elastic limit is used.

PROPOSED WORKING STRESSES FOR REINFORCED GYPSUM

	Pounds per square inch
Compression in gypsum	350
Shear in gypsum	20
Bond between gypsum and steel	30
Bearing of gypsum on looped bars or anchor plates	300
Tension in steel	16,000

The accompanying table gives allowable stresses based upon tests of water-soaked specimens, and should be applied only to roof deck slabs.

RESULTS OF TESTS

The results of the series of tests already mentioned are presented in the accompanying tables. In Table 1 is given the results of two tests of reinforced-gypsum T-beams of 16-ft. span between supports. As indicated in Fig. 1, the reinforcing rods were not turned or looped at the ends, so that no provision was made for anchorage other than the bond between steel and gypsum. The specimens were alike, reinforced by three ⅝-in. corrugated round bars of area 0.92 sq. in. and tested at the age of 20 days by the application of two symmetrical loads.

TABLE 1—TESTS OF 16-FOOT T-BEAMS

		Beam 1	Beam 2
Load of first crack, pounds		5,250	6,300
Observed steel stress at first crack, pounds per square inch		19,000	22,000
Maximum load, pounds		7,850	6,300
Computed stresses at maximum load, pounds per square inch	Vertical shear in gypsum	87	70
	Bond	74	60
	Tension in steel	29,200	24,400
Observed stress at maximum load, pounds per square inch		28,600	23,000
Observed compressive stress in upper face gypsum at maximum load, pounds per square inch		507	454

No indication of approaching failure of the gypsum by compression was found in these beams. Failures occurred as a result of diagonal tension only.

With a good grade of gypsum such as is found in many parts of the country it has been possible to develop regularly from 1500 to 2000 lb. per square inch in compression specimens of height equal to twice their diameter. This is equivalent to, say, from 2000 to 2700 lb. per square inch for the usual cubes. In certain cases a strength of 3200 lb. per square inch has been developed.

A rectangular reinforced-gypsum beam

TABLE 2—TEST OF RECTANGULAR BEAM. CALCULATED STRESSES AT MAXIMUM LOAD OF 23,980 LB.

	Pounds per square inch
Compression in gypsum	1,580
Vertical shear in gypsum	146
Horizontal shear in gypsum	187
Bond	191
Tension in steel	29,200

10-FOOT TILE LOADED WITH 2000 LB.

of 6-ft. span, Fig. 2, was also tested, with results given in Table 2. Four ⅝-in. corrugated round reinforcement was used, a total of 1.22 sq. in., and the test was made at the age of 10 days. Failure occurred by diagonal tension when the first crack appeared.

10-FOOT BEAMS DESIGNED

Using the information gained from these investigations, which included tests for compressive strength, modulus of elasticity, bond strength and tests upon numerous rectangular and T-shaped beams of spans of 6 ft. and 16 ft., the gypsum T-beam roof slab of Fig. 3 was designed for the Walker Manufacturing Company, Racine, Wis. This is the first long-span gypsum roof-deck slab in the United States which was poured and erected at the job. A description of this construction will appear in next week's issue.

Before acceptance of this construction five sample T-beam roof slabs similar in detail to the designed T-beams were made and tested in Chicago by C. Payne, the designer. Some of these specimens were less than 24 hours old at the time of the test and all of them had been exposed during the previous night to the full effect of a heavy rain. Consequently the gypsum was in such condition as to make the tests especially severe.

Each roof beam was placed upon a solid support giving a bearing of 2 in. at each end of the beam, leaving a clear span of 9 ft. 8 in. The distributed load was piled from the center toward the bearings in increments of 150 lb. Table 3 shows the test loads applied.

SAFETY FACTOR OF FOUR

These reinforced roof slabs were designed to carry a uniformly distributed live load of 50 lb. with a safety factor of four.

TABLE 3—TEST OF 10-FOOT T-BEAMS

Sample No.	Load applied	Load per square foot	Deflection, inches	Remarks
1	2,200	200	0.034	At these uni-
2	2,400	218	0.070	formly distrib-
3	2,200	200	0.034	uted loads
4	2,200	200	0.034	there was no
5	2,400	218	0.070	sign of failure

After the foregoing tests the total loads were increased to 3500 lb., but other than the manifestation of horizontal shear cracks there was no sign of failure. The illustrations show these gypsum roof slabs loaded to 2000 and 3500 lb.

The weight of these long-span reinforced-gypsum roof slabs is 17 lb. per square foot. When the effect of a continuous rather than a beam ceiling is desired, the same slab can be made in an H-section with a bottom flange similar to the top flange. A roof slab of this form weighs about 24 lb. per square foot, and has the same carrying capacity for live load.

*[An article describing the methods used on the roof deck construction of the Walker Manufacturing Company, at Racine, Wis., will appear in the next issue.—*EDITOR.*]*

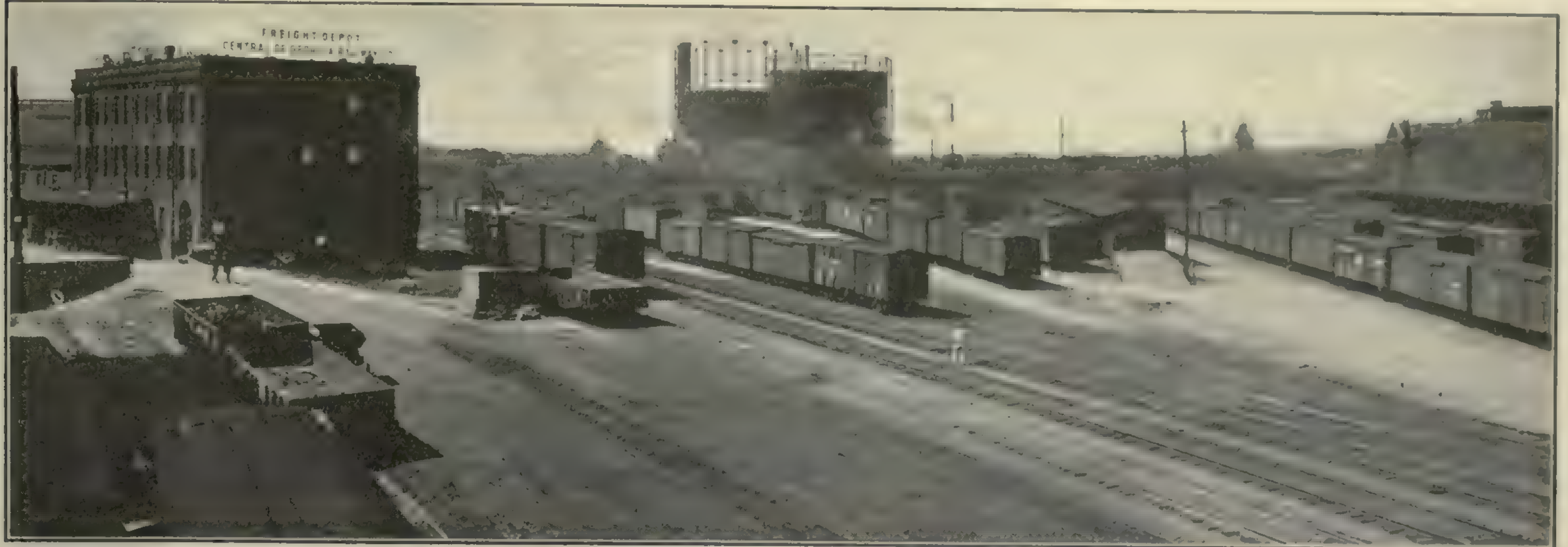
Would Replace Atlanta's Two Passenger Terminals with One on New Site

Barclay Parsons & Klapp Would Combine Previous Plaza Schemes with Elimination of Almost All Tracks from Heart of Business District

COMPLETE ABANDONMENT of the two existing passenger terminals and, except for two through tracks, of all railroad facilities between the terminals, which are about half a mile apart, is among the features of the somewhat radical plan proposed by Barclay Parsons & Klapp, consulting engineers, of New York City, as the best solution of the terminal problem at Atlanta, Ga. Prior to the retention of these engineers by the city other plans had been promulgated which, recognizing the undesirability of the railroad barrier between the two stations, in the heart of the business district, proposed to eliminate the remaining grade crossings and cover the entire railroad area between Forsyth and Washington streets, converting this area into a park. By this plan the old Union Station could be remodeled and somewhat enlarged, while the newer Terminal Station would remain unchanged. The New York engineers, in a comprehensive report recently rendered, which is the basis of this article, hold that these plans do not go far enough, in that the existing stations cannot be sufficiently enlarged on their present sites, that the covered area could not be properly ventilated except by electrification of the tracks at a prohibitive cost, and that this scheme would leave the freight yards and roundhouse west of Forsyth Street as

CENTER OF ATLANTA'S BUSINESS DISTRICT

PROPOSED STATION WOULD BE ADEQUATE FOR TRAFFIC OF ALL ROADS AND WOULD FACE DIRECTLY ON PLAZA



THESE RAILROAD YARDS ARE ALMOST IN HEART OF BUSINESS DISTRICT—PROPOSED STATION WOULD BE ON SITE OF ROUNDHOUSE DIMLY SEEN IN MIDDLE BACKGROUND, AND ALL OF FOREGROUND WOULD BECOME PART OF PLAZA

a permanent nuisance barely outside of the best business district. They recommend the building of a new union station for all eight of Atlanta's railroads about 900 ft. northeast of the Terminal Station, on the site of the present freight yards, the replacement of these freight facilities by others to be built along Elliott Street, the retention of two tracks only, in single-track tunnels, from Washington Street to the north end of the new terminal layout, and the filling in of the entire railroad area around these tunnels. They estimate the cost of the improvement, inclusive of the passenger station but exclusive of the trackwork and the auxiliary buildings of the new terminal, at $6,500,000.

Atlanta's Streets and Terminals

For an understanding of the situation the report calls attention to the street map of the city, part of which is here reproduced. The city's street system is very irregular. The principal thoroughfares are Whitehall-Peachtree and Marietta-Decatur, which intersect approximately at right angles. The existing tracks, roughly parallel to Decatur Street, form a railroad barrier through the very heart of the business district. As the Pryor Street and Central Avenue crossings are at grade, street traffic over the barrier depends mainly on the three viaducts at Forsyth, Broad and Whitehall streets, and the congestion is increased by the fact that Forsyth and Broad streets merge with the Whitehall-Peachtree trunk a short distance each side of the railroads. Along the railroad are unattractive wholesale houses, and the track depression itself is insanitary. Just west of Forsyth Street the tracks flare out into freight terminals which embrace several freight houses, team tracks and a roundhouse—all almost in the center of the city.

For passenger traffic there are two stations, the Union and the Terminal. The former, which is between Pryor Street and Central Avenue, was built in 1871, and is believed to have outlived its usefulness. It has four tracks only, and there is hardly room for more. It is used by the Nashville, Chattanooga & St. Louis Railway and the Georgia Railroad. In 1904 the Terminal Station, on Mitchell Street west of Madison Avenue, was built. This station, while modern in most respects, the report criticizes for shortness of tracks and platforms; presence of sharp approach curves, necessitating much switching; lack of satisfactory facilities for handling baggage and mail, and other objectionable features. Furthermore, while the building could be readily enlarged, the trackage could not. Consequently the conclusion was reached that it should be abandoned as a station.

Earlier Plaza Schemes

In 1912, before Barclay Parsons & Klapp were asked to study the situation, Haralson Bleckley proposed to the city that the tracks between Washington and Forsyth streets be covered, and in 1913 Capt. R. M. Clayton, chief of construction of the city, and C. E. Kauffmann, engineer of bridges and estimates, prepared a comprehensive design on the Bleckley plan, together with an estimate calling for $3,000,000. A bill was presented to the state Legislature to enable the city to carry out the scheme, but it failed to pass. This plan made it possible to add one or two tracks to the Union Station.

While the New York firm considers this plan excellent structurally, it does not believe it practicable to cover the existing tracks and operate the trains by steam. It is held that even if the system of ventilation were ordinarily effective it would not always be so, and that at times the smoke would be extremely objectionable to the traveling public and to the occupants of the abutting buildings. The ventilation problem would be worse at stations—in fact, it is believed no station could be ventilated unless its tracks were outside of the covered zone. The drafts necessary to ventilate the tunnel would constitute a serious menace in case of fire. On the other hand, electrification of the tunnel would entail a prohibitive cost on the railroads. In any event trees could not be grown on the concrete roof except with a prohibitive thickness of earth, and so the park would lose much of its effectiveness. Furthermore, the nuisance of the freight yards just west of Forsyth Street would continue.

Advantages of Newest Plan

By the plan recommended in the report the ventilation problem and that of the cramped terminals are solved, while the plaza feature of the Clayton-Kauffmann plan is retained—on a larger scale, in fact. Also, the freight terminals just west of Forsyth Street are moved westward out of the business district and the offensive engine house is eliminated. One of the accompanying drawings shows the proposed layout. The existing facilities to be displaced are shown in dotted lines. The new union station would be located about 900 ft. northeast of the present Terminal Station, on the site of the roundhouse of the Western & Atlantic Railroad. The station would have twenty through tracks, and ten platforms from 800 to 1000 ft. long. The displaced freight facilities of the Western & Atlantic, Central of Georgia and Seaboard Air Line railways would be relocated on 5 acres of land between Elliott and Hulsey streets, to the east of the four tracks and right-of-way at present owned by the Southern Railway.

Tunnel for Two Tracks Only

Two or three tracks only, each in a separate tunnel, would be carried through from Washington Street to the north end of the new union station layout, affording at once

OLD UNION STATION, SURROUNDED BY STREETS AT GRADE, CANNOT BE EXPANDED

an entrance to the station for passenger trains from the east and interchange facilities for freight. With separate tunnels it is held that trains would drive the smoke out ahead of themselves. Aside from these tunnel tracks, all tracks, industrial as well as those of the present Union Station, would be abandoned in this area; retaining walls would be built along the right-of-way lines and the whole area would be filled in and converted into a park. The tunnel tracks would be depressed a maximum of about 12 ft. to a new profile with grades not exceeding 0.5 per cent, so that Pryor Street and Central Avenue could be carried over on easy grades, while Forsyth, Broad and Whitehall streets could be lowered slightly as compared to the height of the present viaducts.

The new plans terminate the tunnel and the plaza over the tracks at Central Avenue instead of at Washington Street, to which the Clayton-Kauffmann plan extended the covering. Otherwise the plaza of the new plan includes all of the area contemplated in the Clayton-Kauffmann scheme and a much larger area west of Forsyth Street and south along Madison Avenue. Spring Street would be extended to run past the new station and join Madison Avenue near Mitchell Street, and it is believed many of the street-railway cars now using one of the three viaducts could be rerouted to run past the station, especially if a suggested short extension of Madison Avenue and a one-block diagonal connection from Spring Street were made to connect this new route direct at each end with the Whitehall-Peachtree trunk. Cone Street would also be extended across the plaza to Madison Avenue.

Freight Layout Only a Suggestion

The new freight layout along Elliott Street is not offered as the detail solution of this phase of the problem. The report points out, however, that there is room between Elliott and Hulsey streets to replace the supplanted freight houses and team tracks according to the desires of the three railroads concerned on relatively low-priced land, while the cost of the remaining properties between the passenger and freight layouts would not be prohibitive in case future growth made the expansion of either layout desirable.

While the trainshed of the Terminal Station could not be utilized in the proposed improvement, the report proposes that the headhouse be moved east about 90 ft. and converted into a museum or other public building.

As the plans have been drawn no side tracks are left to the industries along the proposed tunnels. The consulting engineers believe that these industries, mostly wholesale houses, are out of place in what should be exclusively a retail district, and should be relocated elsewhere. At the same time they concede that it would be feasible and not necessarily undesirable for those east of Pryor Street to remain, provided their sidings were separate tunnels.

Estimated Cost of Project

Exclusve of the cost of tracks, signals and auxiliary buildings for the new passenger layout the estimated cost of the project is $6,500,000. The estimate includes trackage as well as land to replace the freight terminals of the three roads supplanted, together with the purchase of the present terminal and necessary land, the construction of the tunnels, adjustment of grades, filling in of ground, development of plaza, construction of new station and moving of present station to proposed location for use as a museum or other public building.

The total cost should, the report states, be divided into two parts—the terminal proper and the plaza. No attempt is made to draw a precise line between the two, but it is suggested that a fair division would be about $4,000,000 for the terminal and $2,500,000 for the plaza. It is recommended that the city finance the entire project, the railroads to pay in rental a sufficient annual sum to take care of the bond interest and sinking fund on the terminal project proper, as well as the cost of operation, the bonds to run for fifty years. If the scheme is carried out the engineers think the city will have an adequate terminal for an indefinite time to come.

Changes Suggested in Traffic-Census Forms

Standards of American Society of Municipal Improvements Held to Be Unsuitable for City Work—Forms Used in New York City Explained

By DANIEL B. GOODSELL

In Charge of Traffic Division, Bureau of Highways, Manhattan, New York City

CERTAIN revisions are necessary to adapt to city use the standard forms for traffic counts prepared by the committee of the American Society of Municipal Improvements (see Engineering Record of Nov. 18, page 621). Presumably these forms are designed to be suggestive and suited to the traffic of trunk line roads. The following criticism, however, is directed from the standpoint of intensive city traffic work, and it is hoped that it will encourage further discussion. The most serious faults with the committee's standard forms are the arrangement of the headings on the small card and the rather confusing vehicle classification on the two cards.

VEHICLE TRAFFIC OBSERVATIONS BOROUGH OF MANHATTAN

WEATHER.......... LOCATION.. DATE..............

TEMPERATURE.............. BOUND.................. SIDE.......... OBSERVER..........................

Time	One Horse Iron Tire			Two Horse Iron Tire			Three Horse Iron Tire			Four Horse Iron Tire			Total Horse Drawn Iron Tire	Small Auto Trucks			Large Auto Trucks			Total Auto Trucks	Automobiles	Rubber Tire Horse Vehicles	Street Cars	Motor Busses	Special Vehicles
	E	½L	L	E	½L	L	E	½L	L	E	½L	L		E	½L	L	E	½L	L						
	1.00	1.75	2.50	2.00	3.75	5.75	2.75	6.00	9.25	2.50	5.00	7.50		0.75	1.50	2.00	4.00	6.00	8.25		1.75	0.50		6.5	

FIG. 1—FIELD CARD IN EACH SQUARE OF WHICH IS PLACED THE NUMBER OF VEHICLES WITH THE CORRESPONDING WEIGHT

A Better Classification

The first form (small card) is suited to recording a traffic very limited in its classification and should at least have a blank line under both the rubber and iron tire divisions to record unclassified vehicles, such as traction engines, trailers, motorbuses, or other heavy units.

A better classification would seem to be as follows: Horse-drawn, iron tire (subdivided); horse-drawn, rubber tire; automobiles (subdivided); auto trucks (subdivided); autobuses; street cars; unclassified. This is the classification used in Manhattan and it would seem to fit road traffic as well.

If it is desired to ascertain with reasonable accuracy the number of vehicles per foot of width per minute, an interval of less than 1 hour is necessary unless the number of vehicles is very small. City work will require 15-minute periods for traffic of 100 tons or more per foot of width per day of 10 hours, and trunk-line roads would require the same. For comparison with other cities the writer believes that a 10-hour period is better than the 11-hour period shown on the forms, as the 10-hour is commonly used.

No space is assigned on the small card for a record of grade or width of roadway, which should be here for convenience in computing the tonnage per foot of width.

The connecting link between the first and second forms, a table of weights of the classes of vehicles shown, should have at least been referred to and its importance emphasized.

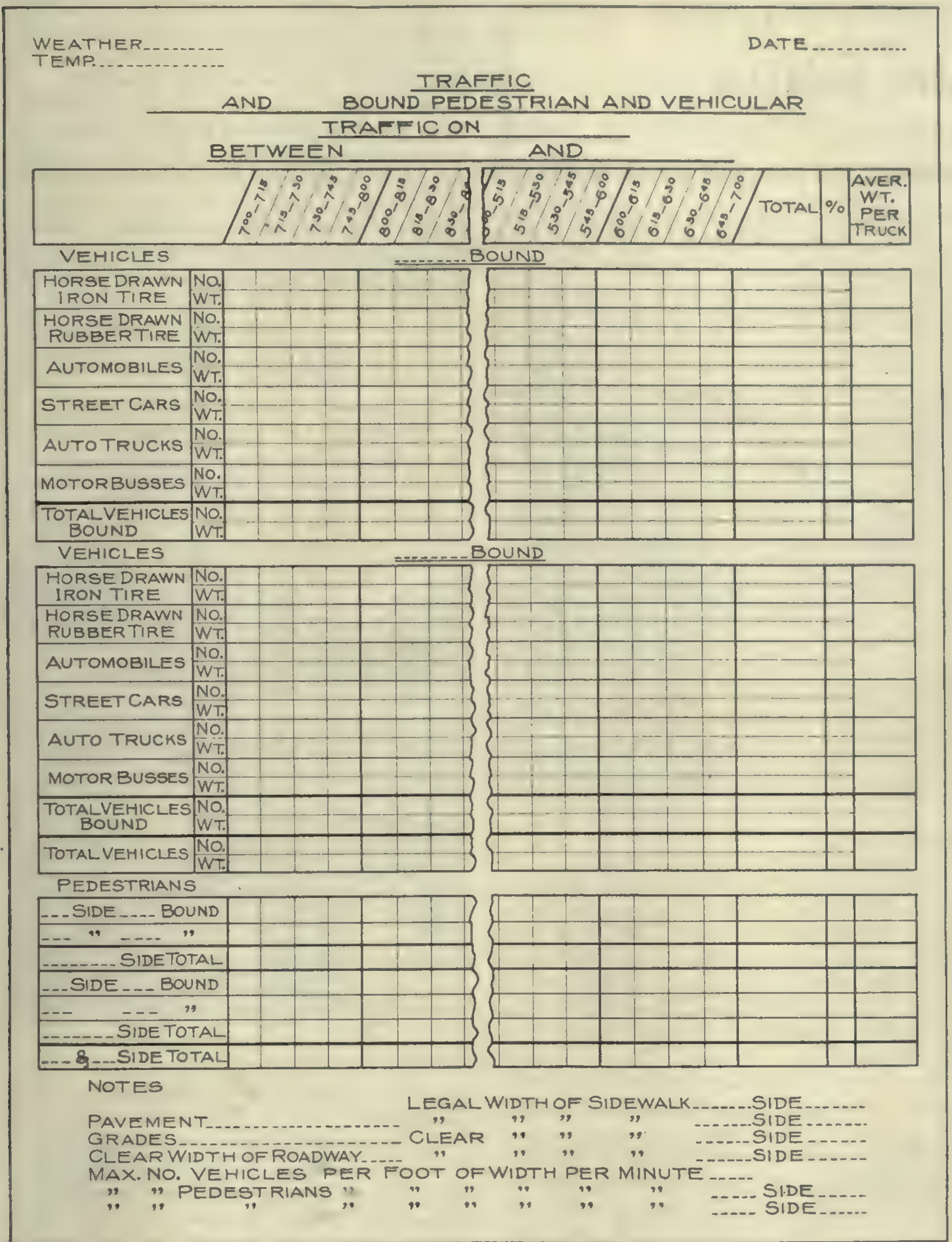
No provision has been made on either form for noting the flow of traffic. This phase of census taking may be important in determining the width of a proposed roadway. A separate card is apparently intended to be used for each direction, and if this be so the two cards of the opposite directions should be in the form of a folder.

The classification of vehicles on the large card is made into "horse and motor," whereas the small card is "iron tires" and "rubber tires," an inconsistency likely to be confusing because they overlap. The large card contains space which is likely to be little used, as this use depends on the number of observations which are made on the same street. Most engineers are obliged to be content with one census. The card should not, in any event, be made more than seven lines deep, allowing for each day in the week. A blank space should be left at the bottom for a sketch showing dimensions of the street at the place at which the census was taken.

The headings "Vehicle Data" and "Tonnage Data" should be "Vehicle Census" and "Tonnage Census," and a suitable heading for the columns on the right, which have no heading, would be "Congestion." All these headings should be printed in bold letters and capitalized.

Two columns are left blank on the right-hand side of the small card, presumably for computing tonnage; the space is too small and, moreover, three are needed. For convenience in summing up, the side headings of the small card should have been placed at the top and the hours at the side, as the sums under the vehicle classification are used more frequently.

The forms are probably not intended for strictly city use and are certainly not fitted


WEATHER........ DATE..........
TEMP............
TRAFFIC
AND BOUND PEDESTRIAN AND VEHICULAR
TRAFFIC ON
BETWEEN AND

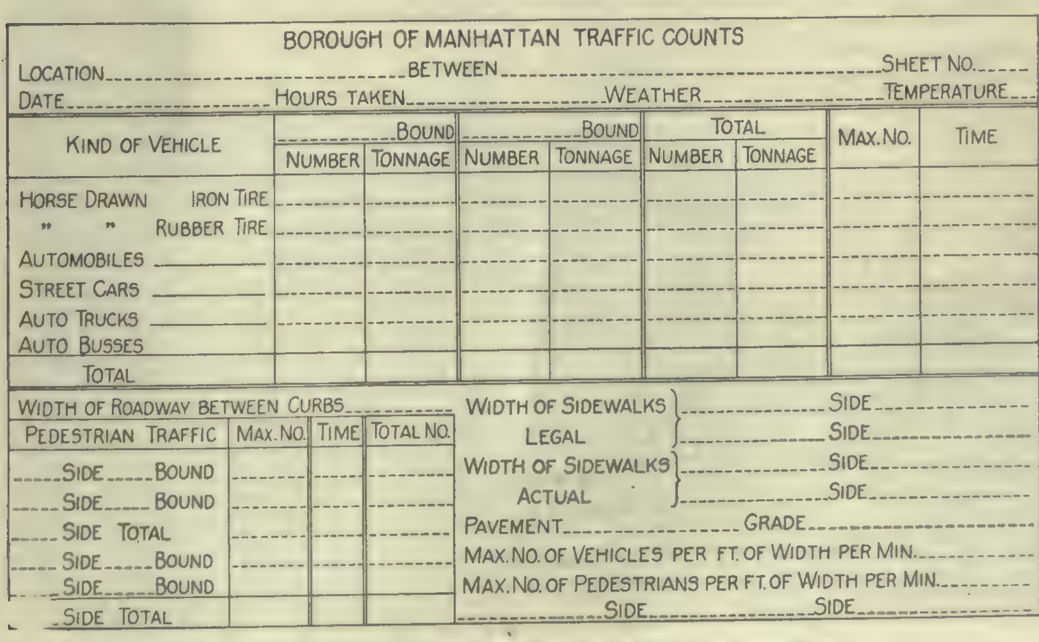
		7:00–7:15	7:15–7:30	7:30–7:45	7:45–8:00	8:00–8:15	8:15–8:30	8:30–8:..	..–5:15	5:15–5:30	5:30–5:45	5:45–6:00	6:00–6:15	6:15–6:30	6:30–6:45	6:45–7:00	TOTAL	%	AVER. WT. PER TRUCK
VEHICLES ....BOUND																			
HORSE DRAWN IRON TIRE	NO.																		
	WT.																		
HORSE DRAWN RUBBER TIRE	NO.																		
	WT.																		
AUTOMOBILES	NO.																		
	WT.																		
STREET CARS	NO.																		
	WT.																		
AUTO TRUCKS	NO.																		
	WT.																		
MOTOR BUSSES	NO.																		
	WT.																		
TOTAL VEHICLES BOUND	NO.																		
	WT.																		
VEHICLES ....BOUND																			
HORSE DRAWN IRON TIRE	NO.																		
	WT.																		
HORSE DRAWN RUBBER TIRE	NO.																		
	WT.																		
AUTOMOBILES	NO.																		
	WT.																		
STREET CARS	NO.																		
	WT.																		
AUTO TRUCKS	NO.																		
	WT.																		
MOTOR BUSSES	NO.																		
	WT.																		
TOTAL VEHICLES BOUND	NO.																		
	WT.																		
TOTAL VEHICLES	NO.																		
	WT.																		
PEDESTRIANS																			
...SIDE.... BOUND																			
... " .... "																			
........SIDE TOTAL																			
...SIDE... BOUND																			
... ... "																			
.......SIDE TOTAL																			
...&...SIDE TOTAL																			

NOTES
LEGAL WIDTH OF SIDEWALK.......SIDE.......
PAVEMENT.................... " " " ....SIDE.......
GRADES.......................CLEAR " " " ....SIDE.......
CLEAR WIDTH OF ROADWAY..... " " " " ....SIDE.......
MAX. NO. VEHICLES PER FOOT OF WIDTH PER MINUTE.....
" " PEDESTRIANS " " " " " " .....SIDE.....
" " " " " " " " " .....SIDE.....

FIG. 2—OFFICE FILE SHEET FROM WHICH TOTALS ARE COMPUTED

for it. Pedestrian-traffic census should invariably be taken where street-widening projects are contemplated.

The writer presumes that these forms are designed to be suggestive and suited to the traffic of trunk-line roads or that of a small city. His criticism is directed from the standpoint of intensive city traffic work, and it is hoped that it will bring out further discussion. The most serious faults from his point of view are the arrangement of the headings on the small card and the rather confusing vehicle classification on the two cards.


BOROUGH OF MANHATTAN TRAFFIC COUNTS
LOCATION............................BETWEEN..................................SHEET NO......
DATE....................HOURS TAKEN....................WEATHER....................TEMPERATURE....

KIND OF VEHICLE	.........BOUND NUMBER	.........BOUND TONNAGE	.........BOUND NUMBER	.........BOUND TONNAGE	TOTAL NUMBER	TOTAL TONNAGE	MAX. NO.	TIME
HORSE DRAWN IRON TIRE								
" " RUBBER TIRE								
AUTOMOBILES								
STREET CARS								
AUTO TRUCKS								
AUTO BUSSES								
TOTAL								

WIDTH OF ROADWAY BETWEEN CURBS..........

PEDESTRIAN TRAFFIC	MAX. NO.	TIME	TOTAL NO.
.....SIDE.....BOUND			
.....SIDE.....BOUND			
.....SIDE TOTAL			
.....SIDE.....BOUND			
.....SIDE.....BOUND			
.....SIDE TOTAL			

WIDTH OF SIDEWALKS LEGAL ....SIDE..............
..............SIDE..............
WIDTH OF SIDEWALKS ACTUAL ....SIDE..............
..............SIDE..............
PAVEMENT..................GRADE....................
MAX. NO. OF VEHICLES PER FT. OF WIDTH PER MIN...........
MAX. NO. OF PEDESTRIANS PER FT. OF WIDTH PER MIN...........
..............SIDE..............SIDE..............

FIG. 3—CARD UPON WHICH SUMMARY OF DATA IS RECORDED

FORMS FOR NEW YORK TRAFFIC

In order to illustrate the points to which attention has been directed, the forms in use by the Bureau of Highways, Manhattan, are shown. They are not believed to be ideal, by any means, but have been found to be reasonably convenient with the exception of the large sheet. Fig. 1 illustrates the field card. In each square is placed the number of vehicles with the corresponding weight. These are then transferred to the large sheet, Fig. 2, from which the totals are computed. Fig. 3 shows a summary card. The final report is made out in three parts under the headings "Vehicle Traffic," "Pedestrian Traffic" and "Congestion." Under the latter there is shown the traffic peaks for vehicles and pedestrians.

The whole matter of standard traffic forms is of such increasing importance that it deserves careful attention at this time, and the writer therefore offers the suggestion that a joint committee be appointed from the American Society of Civil Engineers, American Society of Municipal Improvements and the American Road Builders' Association to draft and promote the use of standard forms for recording city street and country road traffic and to suggest the weights to be used in estimating the tonnage.

Finder Locates Fires on Single Observation

With Instrument Used Last Summer in Oregon and Washington Site of Forest Fire Is Projected on Topographic Map

A FIRE FINDER used with success the past summer by the 125 lookout men in the National Forests of Oregon and Washington located fires in a few minutes without the necessity of waiting until a second course upon it is reported from another station. It consists of a metal plate 24 in. in diameter, bearing a topographic map of the country visible to the observer. On the outer edge of the map a graduated circle is laid out. The instrument is securely mounted and the map oriented so that the true bearing may be read from the graduated circle on the outer edge of the topographic map. To the center of the plate an alidade is pivoted, consisting of a straight edge and two sights. The plate and alidade may be mounted on a short track, which permits sliding the plate when necessary to avoid a post or window frame in sighting a fire. A simple vertical vernier is attached to the sights, so that the vertical angle of the fire under observation may be determined.

When a fire is discovered the lookout man turns the alidade and reads the true bearing of the fire from the graduated circle, after which the vertical angle is also noted. By referring to the topographic map it is also possible to draw a profile map of the country along the line of sight. Then, by drawing the line of sight as indicated by the vertical angle, the profile is cut at the point at which the fire is burning.

The instrument was invented by W. B. Osborne of the Portland office of the U. S. Forest Service.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Cast-Iron Rocker Shoes

SIR: Inclosed you will find a small photograph of a cast-iron rocker which may be of interest in connection with Mr. Kelley's recent letter (Engineering Record, Dec. 2, page 688) regarding cast-iron rocker shoes. This view was snapped by the writer during the tearing down of the old Congress Street Bridge.

This bridge was built in 1872. The rocker in question supported a 64-ft. pony truss

A ROCKER "FROZEN" WITH RUST

used as an approach to the main spans. The flat bar lying directly in front of the rocker was left by a workman. Otherwise the débris fairly represents the condition of the seat when uncovered. The bridge as a whole was well cared for and in excellent condition, but evidently the shoes were as usual neglected. When torn down it was found impossible to move either the rocker or the truss members on the pin, and it was evident that there had been no "rocking" for many years.

To show that the rockers were not alone in their failure to act as intended, it may be said that the 2-in. rollers under the main 240-ft. spans were rusted tight and in many cases had worn to a flat surface more than 1 in. wide. LEROY W. CLARK,

Assistant Professor of Rational and Technical Mechanics, Rensselaer Polytechnic Institute.

Troy, N. Y.

Camera on Engineering Work

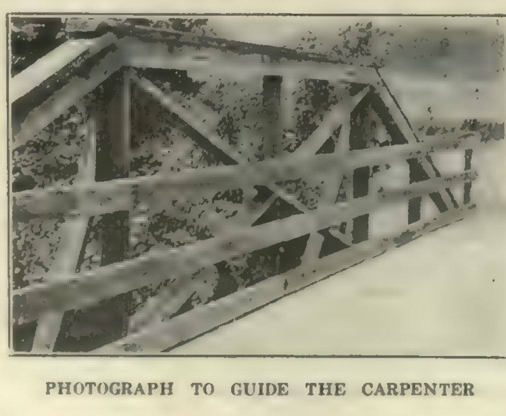
SIR: The contribution of H. Colin Campbell on the camera's use on engineering work in your issue of Dec. 2, page 670, deserves indorsement. Engineers do not realize the latent possibilities of even a cheap hand camera.

I believe, however, from my own experience that Mr. Campbell has not quite touched the vital point. Engineers do not take telling pictures having proper composition as well as adequate exposure not only because they lack artistic sense but also because they have a very definite and proper objection to lugging around even so small a camera as one taking a picture $3\frac{1}{4}$ x $4\frac{1}{4}$ in. in size. More annoying than "galluses" is the camera strap that refuses to stay on the shoulder, and this is particularly true in the case of an engineer who has to go in out-of-the-way places, climbing up and down all sorts of improvised ladders, where a camera slung from the shoulder seems fairly possessed to bring about a tumble. Even worse are the reflecting cameras of larger size, such as the $3\frac{1}{4}$ x $5\frac{1}{2}$-in. (3-A). The 5 x 7 and larger sizes are simply impossible.

In photography, as in hunting, you see the finest shots when you have no gun. The only remedy is to go always armed; and to this end it has been the practice of the writer for five years past to carry continuously a small camera taking a picture $2\frac{1}{4}$ in. square. This camera is of the highest grade, carrying a Zeiss-Tessar lens and a high-speed shutter. It fits conveniently in a hip pocket and its weight and size are never annoying. With this camera thousands of pictures have been taken by the writer with great success, many of them from the observation platforms of moving trains, this being rendered possible by the use of full aperture (F4.5) and a fast-working shutter.

So far as reflecting cameras are concerned, they are unapproached, particularly for critical studies and high-speed work. There is, however, only one size as made in this country which is compact enough to suit engineering needs; that is the 1-A Graflex. A camera of this size, equipped with lens of F4.5 aperture, has been of invaluable service to the writer.

But I believe that in yet another respect Mr. Campbell does not go far enough and misses the crux of the question. Photographs, to be of any service, must be available at any time. To this end all the writer's photographs have been placed on cards and indexed. The back of the card carries a small manila envelope in which is placed the negative, or negatives, if more than one print is on a card. Classified under different heads, they are available for instant reference and have rendered invaluable service. Enlargements of these small films have been made up to 2 ft. square, a magnification of about eleven diameters.

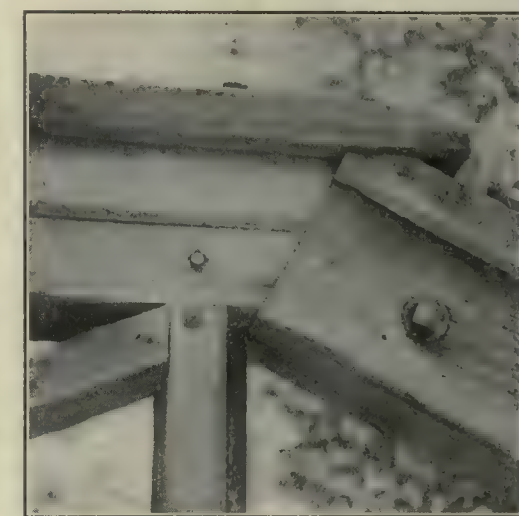


PHOTOGRAPH TO GUIDE THE CARPENTER

Isolated pictures of one kind or another, even though of the best exposure and of the most artistic composition, are of little engineering avail, except as souvenirs. To obtain more than a few pictures the engineer must be prepared to take photographs whenever and wherever subjects in which he is interested may be found. A multitude of pictures taken in this way are of no engineering use unless classified. No way of accomplishing these two desired ends other than the foregoing has occurred to the writer.

NATHAN C. JOHNSON,
Consulting Concrete Engineer.
New York City.

SIR: Apropos of Mr. Campbell's article in the Engineering Record of Dec. 2, on the use of the camera in engineering operations, I wish to offer the following as illustrating



DETAIL OF A JOINT VISUALIZED

one particular kind of service on the part of the camera:

When having a number of wooden bridges of 30 and 40-ft. span constructed by different foremen, most of whom were not skillful carpenters, I took pictures of the special features that I wanted used from a bridge that I had already built. The new men readily understood how to make the joints and put on the braces, when they would have had difficulty in understanding a blueprint.

I will say further in regard to the type of top chord and end post shown that we are not troubled by their warping. The top member overlaps on sides and ends and protects the joints underneath from holding water.

For making pictures of details I use a little portrait lens that slips on over the regular lens. It in no way affects the operation of the lens, except that the distance must be measured carefully according to the tables of distances sent with the lens. After the negative is made any number of blueprints may be made as from a drawing. Thus directions may be given to workmen in this manner often at less expense than if drawings were made. And a picture will show more to the average foreman than half a dozen drawings.

Allow me to say that I find the Letters to the Editor and the Hints for the Contractor sections the most interesting and helpful parts of your magazine to the man dealing every day with the "little things" in construction work. R. T. BROWN,

Engineer, Board of Road Commissioners, Davidson County, North Carolina.

Lexington, N. C.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Steel Sheeting Driven Cheaply Under Water with Two Rigs

By GEORGE W. McALPIN
Junior Engineer, Government Dam 35, New Richmond, Ohio

BY SETTING sheeting and driving it down to water with one derrick boat and following the piles down to grade with a second rig, rapid progress has been made at Government Dam 35, on the Ohio River, in driving 14-in. arch-web Lackawanna steel piling. Each of the derrick boats was equipped with swinging leads supported in driving on 10 x 12-in. runway timbers about 30 ft. long, spaced 6 in. apart.

The runways were similar to those used for driving round piles at the same dam, described by the writer in the Engineering Record of July 1 last, page 25. One end rested on a timber suspended by chains over the front end of the derrick boat, the other being carried on the sheeting already in place by a cross-timber bolted on 10 x 12-in. blocks at that end of the timbers. Piles were driven the length of the runways, the latter lifted and moved forward with the pile line as the boat moved, and again set in position with the cross-timber resting on the last pile driven.

Trouble with the piling creeping ahead at the top was overcome by inserting in each interlock as the piles were set a hook of ¾-in. round iron so that it caught under the bell of the pile being driven, and was carried down with it. These hooks were placed so as to spread the piles. In addition to them, ordinary railroad spikes were inserted at the top of the interlocks after each pile was driven, in such a way as to hold the piles closer together.

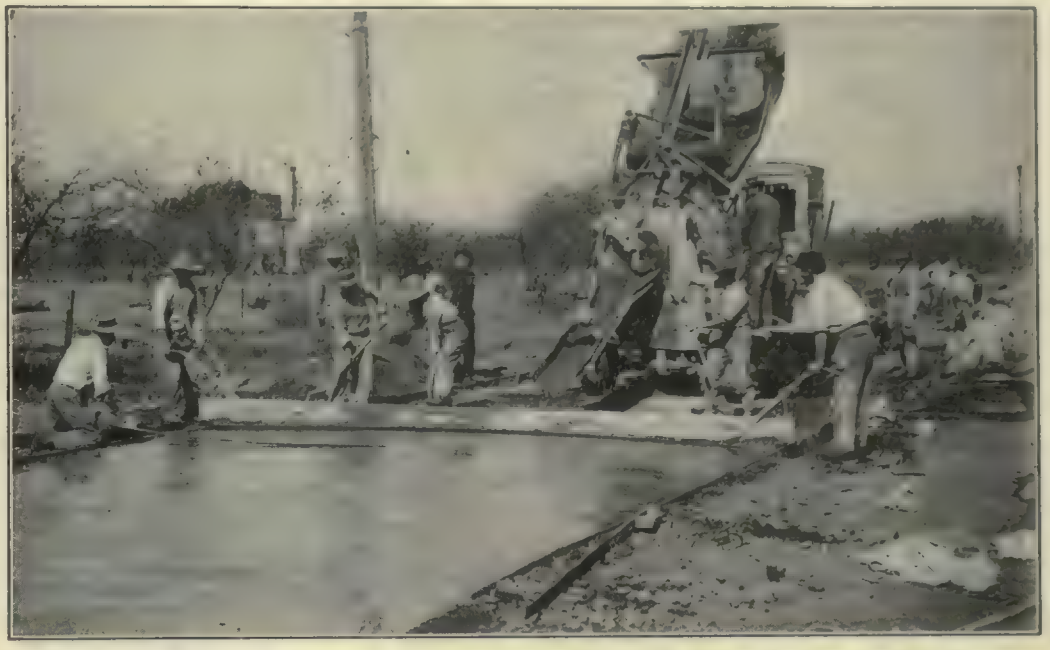
The follower used by the second boat was a pile of the same section as those being driven. To its lower end were riveted plates cut from the web of an old pile, making a slot to hold it in place. The sheeting was driven into sand and gravel to a penetration averaging 30 ft. Under these conditions the two boats placed and drove to grade an average of 20 piles per 8-hour shift, the cost of driving being about 20 cents a foot, or about one-half cent a pound.

FIRST BOAT SETS AND DRIVES PILES TO WATER, SECOND FOLLOWS THEM TO GRADE

Plow Handle Tamper and Lengthy Floats Finish Concrete Road

By LESTER H. MORRIS
Inspector, Saratoga-Mountain View Road, Cupertino, Cal.

THE plow handle tamper adopted as a standard tool for concrete-road construction by the California State Highway Commission and one of the long, flexible redwood floats also in general use in the state are shown in action in the photograph. The tamper was invented by Stanley Hall, foreman for a contractor on state road work, three years ago, at a time when the commission was using several different methods of finishing concrete roads with indifferent results. The tamper consists of a pair of plow handles made of 1-in. pipe attached to a striking template shod with iron and sufficiently heavy and stiff not to bend when used to drag a mass of concrete to the required crown.



LONG FLOAT AND COMBINED TAMPER AND STRIKE BOARD FINISH SURFACE QUICKLY

To get the best results with this tool the concrete is mixed so dry as to flow slowly down the chute of an ordinary paving mixer. The chute is swung sidewise, distributing the concrete swath somewhat higher than the required surface. The man on one end of the tamper rides his handles, while the other, assisted by the three spreaders with their shovels, drags his end sidewise on top of the side form. After the other end of the tamper has been pulled ahead in the same way, the concrete is pounded with an up-and-down motion until the water flushes to the surface. The results secured by this method are so good that little finishing is required with the long redwood floats. Two of these are employed, one a foot longer than half the width of the pavement and the other 2 ft. 3 in. long for finishing at the sides. The long float is so light and flexible that it fits any crown without disturbing the surface left by the tamper. These floats are inexpensive and easy to renew, and their use eliminates the necessity for a bridge. One operator can finish the surface of a 4-in.-thick concrete road as fast as it can be laid by using a mixer of the two-bag-batch size.

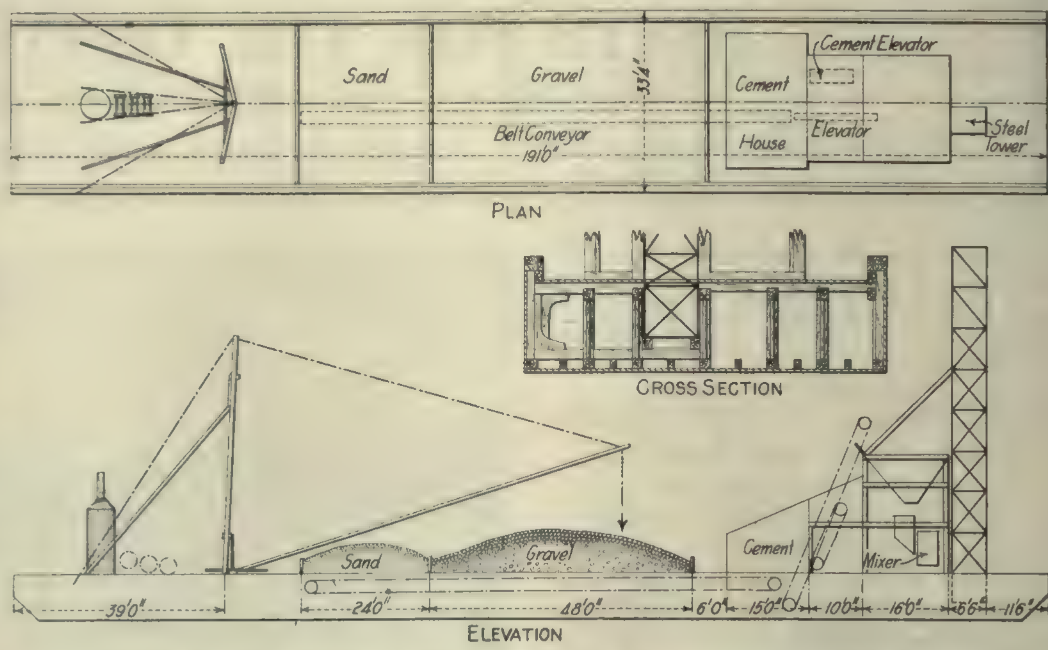
Many miles of concrete road laid in this way have been opened to traffic for from six to nine months before being surfaced with a ⅜-in. carpet of oil and screenings. Expansion joints are left at intervals of 16 to 30 ft., and are usually filled with an asphalt compound before the carpet is applied.

Mixer Boat Has Sand and Gravel Storage on Decks

IN BUILDING the floating concrete plant in use on the Thames River bridge at New London advantage was taken of the length of an old car float secured in New York harbor to place a mixer and tower on one end and a derrick on the other, and still provide ample space between on the deck of the boat for sand and gravel storage. In this way topheavy bins were not required to make sure of continuous running. Small sand and gravel bins over the mixer are supplied by a bucket elevator. This in turn is loaded by a belt conveyor passing lengthwise of the sand and gravel storage space under the deck. Cement is raised to the charging platform by an elevator from a one-car cement house behind the mixer. The speed of this conveyor is timed so that it supplies cement almost exactly at the rate of mixing.

The plant is arranged for pouring 300 yd. in 10 hours, at which rate the chutes are full continuously. It usually runs a little faster than this and has placed 282 yd. in eight hours on the Thames River bridge, described on page 737 of this issue. It was built and used first, however, on the bridge at Portland, Me., described in the Engineering Record of March 4, 1916, page 319, from where it was brought down the coast to New London by a tug last spring.

The Holbrook, Cabot & Rollins Corporation contracted for both bridges, and work on the first, as well as on the second bridge, was in the charge of L. S. White, superintendent.



TOPHEAVY BINS AVOIDED BY DECK STORAGE ON LONG FLOATING CONCRETE PLANT, MATERIALS BEING REHANDLED TO MIXER BY CONVEYORS

Handy Trailer Furnishes Hot Oil for Small Jobs

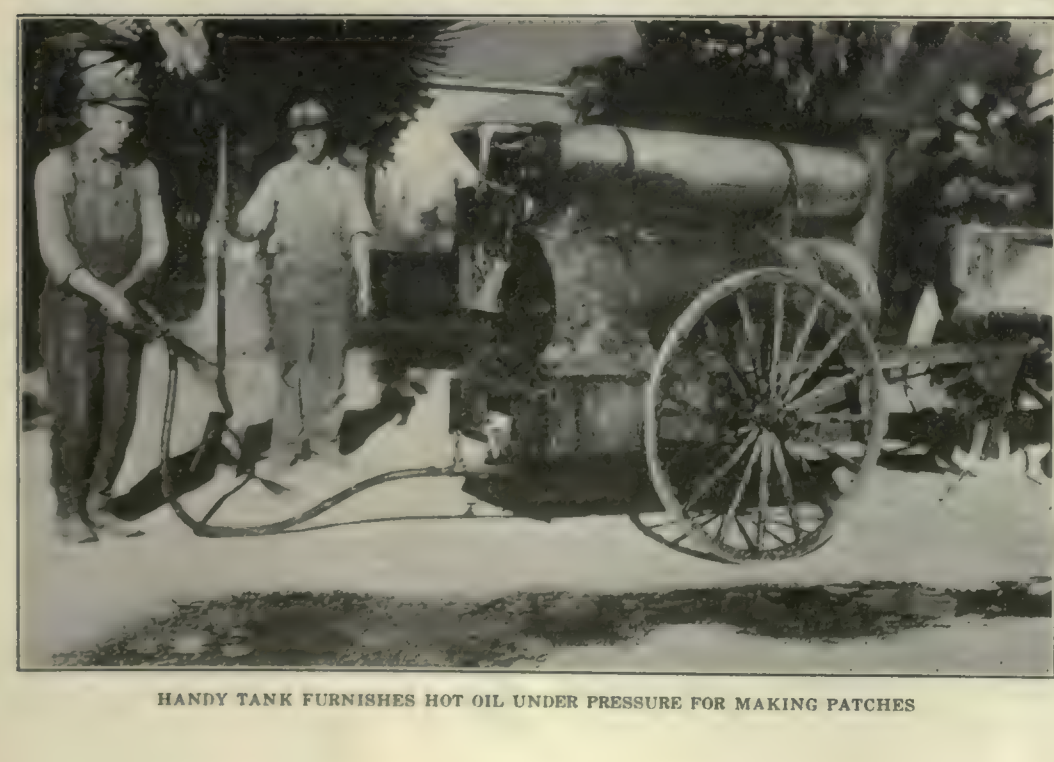
IN MAINTAINING the 120 miles of oiled pavement which have been put down in Riverside, Cal., it was found that there was often need for comparatively small quantities of oil that could be applied hot. After some study, a 100-gal. tank was mounted on a firebox and the whole supported on a pair of wheels. This could be attached as a trailer to the wagon in which equipment and materials were hauled to the job, and hot oil was drawn off in buckets as desired.

This worked so well that a smaller tank for compressed air was mounted on top of the oil tank, and by putting pressure on the oil it can now be sprayed from a nozzle, greatly expediting the work. The equipment shown in the illustration was built in the city's repair shop as the idea developed, and only such material as was conveniently at hand was used. If designed anew, however, a compressed air compartment might as well be provided for within the oil tank.

The tank here shown was strong enough for air pressures of only 100 lb. per square inch. The air tank has two $\frac{3}{4}$-in. pipe connections, each provided with a globe valve. One is arranged to be conveniently connected with the reservoir of the air compressor at the shop before the trailer is sent out. The other is a short connection between the two tanks. Oil is pumped into the larger tank through a $1\frac{1}{2}$-in. pipe at the head end, and discharges through an elbow of the same size on the under side at the rear.

In addition to the globe valve on the discharge pipe there is another at the end of the hose, so that the operator can turn it off instantly when desired. Making for flexibility and convenience of operation, this is said to save much time. In fact, the time saving is such that another tank trailer is to be built on a larger scale, so that it will carry enough oil and air for an entire day's work, thus obviating the necessity of returning to the shop during working hours and making the equipment suitable for continuous service.

The device has been designed by W. V. Darling, superintendent of streets of Riverside, Cal.

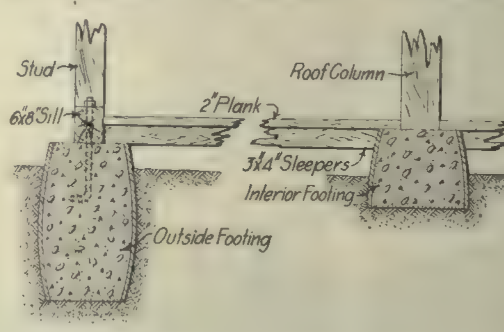


HANDY TANK FURNISHES HOT OIL UNDER PRESSURE FOR MAKING PATCHES

Forms of Old Barrels Lower Cost of Concrete Footings

By C. D. ACKER
Rochester, N. Y.

TIME and expense were saved by using old oil barrels for footing forms recently in constructing a building for the Vacuum Oil Company at Rochester. The barrels



OLD BARRELS AS CONCRETE FORMS

used were 17 in. in diameter at the top and bottom, 19 in. at the center and 34 in. in depth. Around the outside of the building whole barrels were used, deeper footings being required to prevent movement from frost action. The forms for the interior footings were made by sawing the barrels in half at the bilge and placing the halves with the large end down. The interior footings are, of course, protected from frost action by the flooring. This method used by the writer effected a great saving both in material and labor on the forms for these footings. As the barrels selected were old ones, they were left in the ground permanently.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Arch Design Recommended for Galveston Causeway

Careful Estimates of Cost by Arbitration Board Show Arch Design $141,000 Less Than Girder Design

On Dec. 4 the board of arbitration in the Galveston causeway reconstruction controversy made a unanimous report to the board of engineers, consisting of one representative from each of the five interests involved, and recommended the adoption of the 60-ft. arch design submitted by William Mueser, of the Concrete-Steel Engineering Company, New York City. The alternate design of 30-ft. curved girders submitted by J. L. Harrington of Kansas City, Mo., was estimated to cost, with recommended changes, $141,000 more than the arch plan. Through the courtesy of F. Merritt, chief engineer of the Gulf, Colorado & Santa Fé Railway, and chairman of the board of engineers, a copy of the report has been furnished to the Engineering Record, and the following abstracts show the estimated saving resulting from the arch type and the recommended changes. The reasons for these proposed changes and the details of the design will be published in a later issue. A description of the damages to the causeway in the Galveston storm will be found in the issue of Aug. 28, 1915, page 271.

60-Foot Reinforced-Concrete Arch Plan

As noted on page 185 of the issue of Aug. 5, and page 335 of the issue of Sept. 9, the arbitration board was composed of Prof. A. N. Talbot of the University of Illinois, chosen by the three railroad interests; Prof. George F. Swain of Harvard University and the Massachusetts Institute of Technology, chosen by the interurban railway and the county, and Lincoln Bush, consulting engineering, of New York City, selected by the other two members and acting as chairman.

The report of this board, made after careful estimates and investigation, says: "We hereby determine and adjudge that the arch type of structure submitted by the Concrete-Steel Engineering Company, with certain modifications in details which will be hereafter referred to, is the type of structure which should be adopted.

"We estimate that the cost of the arch plan as submitted to us, including all overhead charges of every kind, but excluding the cost of repairs to the 2300 lin. ft. of Galveston approach, will be $1,344,000."

The board then recommends that certain modifications be made in the arch plan as submitted, the total estimated cost of these changes being $32,300, including additional arch reinforcement, widening the pier bases and richer concrete for piers, abutments and retaining walls. This added to the original estimate totals about $1,376,000. Thus the cost of the work is $16,000 in excess of the $1,500,000 limit, when $140,000 is allowed for the repairs to the Galveston approach. The latter sum, however, according to opinion expressed at the arbitration hearings, could be materially reduced.

Girder and Slab Plan

The board of arbitration estimates the cost of the 30-ft. girder and slab plan to be $1,431,000, but says: "Certain modifications, however, would have to be made in this plan to meet engineering requirements that we consider essential. These modifications include a considerable addition to the number of piles, increasing the size of the transverse diaphragms, lengthening the piers, and the addition of reinforcement and concrete in certain parts of the structure. The estimated cost of these items is about $86,000, bringing the total cost of this plan up to about $1,517,000. This estimate will make the total cost of the work $1,657,000, provided that the $140,000 is necessary for the repairs to the Galveston approach.

The report concludes with the following: "In other words, the cost of the girder plan is estimated at $141,000 more than the cost of the arch plan, and considerably in excess of the $1,500,000 limit.

"In connection with the above estimates we desire to suggest to the board of engineers that it consider carefully the desirability of substituting creosoted wooden piles for concrete piles. If this substitution were made, we estimate that it would afford a saving in the arch design of $76,000.

"From our analysis and study, from an engineering point of view, of the two plans presented, and from our estimates of cost, we determine that the arch design is the least expensive and that it represents the better structure and the one most suitable for the conditions."

Year-Old Corporation Active in All Parts of World

American International Corporation's Business of Wide Variety—Large Engineering Projects Undertaken

The American International Corporation, organized Nov. 15, 1915, with a capital stock of $50,000,000 has, according to the preliminary report of the president just issued, earned in excess of organization and operating expenses an estimated surplus of $2,231,495. The appreciation which has accrued from the corporation investments is not included in that figure except so far as the securities have been placed or otherwise disposed of. A dividend of 75 cents per share on preferred and common stock has been declared.

1230 Propositions Submitted

From the date of organization to Dec. 1, 1916, 1230 propositions were submitted for consideration, of which 916 have been declined and 313 have not yet been disposed of. Twenty-nine of the proposals were from Africa, 4 from Alaska, 73 from Asia, 10 from Australia, 41 from Canada, 47 from Central America, and 256 from Europe. From Mexico 26 propositions were received, from South America, 347, United States, 326 and West Indies, 71. Transportation propositions formed the majority with a total of 332; of the other proposals 185 were for mining, 143 for agricultural development, 127 for public utility works and the remainder of a more general nature.

The corporation has financed or acquired interest in the Pacific Steamship Company, the Allied Machinery Company of America, the Latin-American Corporation, Rosin & Turpentine Export Company, International Mercantile Marine Company, United Fruit Company, American International Terminals Company, New York Shipbuilding Company, and Carter, Macy & Company, tea importers. The organization has also financed contracts for sewer work in Uruguay and railroad work in China. Investigations in Russia are now being made under the direction of Frederick Holbrook, of Holbrook, Cabot & Rollins.

Fire-Protection Convention Next May

Washington, D. C., has been selected by the officers of the National Fire Protection Association as the place for the annual convention next May. The meeting will last three days, beginning May 8.

Maintaining Cheaper Types Feature of Road Congress

Highway Officials of Middle West Discuss Federal-Aid Problems, Gravel and Macadam Roads and Standardized Bridges

Construction and maintenance of earth, gravel and macadam roads, federal aid and standardized bridges were the topics most discussed at the third annual session of the Northwestern Road Congress in Chicago, Dec. 7 and 8. The registration was about 160, but nearly twice that number were in attendance. Although no exposition was held as part of the congress, several states had photographic reproductions of their work, and a number of material companies and the Portland Cement Association had exhibits on another floor of the hotel. The convention itself was the main attraction and all sessions were enthusiastically attended. The officers elected for next year are as follows: President, A. D. Gash, chairman Illinois Highway Commission; vice-president, Frank F. Rogers, Michigan state highway commissioner; secretary-treasurer, T. R. Agg, Ames, Iowa.

Federal aid and the national road policy under it was the burden of the annual address of John A. Hazelwood, chairman of the Wisconsin State Highway Commission.

States Report Needs

Ten-minute reports from the Middle West states on the history of the road movement, present conditions and needed legislation were conspicuous for the multiplicity of ways by which state highway organizations have taken advantage of such laws as are on the books and are trying to get results.

A big bond issue is needed in Illinois, said B. H. Piepmeier. Two counties are spending money from a bond issue, three more have voted for bonds and fifty are seriously considering it. The resulting problem for the state will be a lack of a connected system, apathy toward a general bond issue and neglect of designated but unimproved state-aid roads.

Iowa has enough legislation now, said John Ames, bridge engineer. She spends $13,600,000 a year under state supervision, but the counties handle the money. Rapid progress is being made toward permanent bridges and culverts and one-half of the above sum goes for 14,000 structures. Grading of a permanent nature, and 15,400 miles of dragging at 71.3 cents per mile are the principal improvements. Federal aid is to be extended on the 5000 miles of through routes on substantial grading and graveling. Frank Rogers of Michigan said that federal aid is to be spent on those parts of the 5000 miles of lines which would not otherwise be improved during the next five years.

Minnesota, said J. H. Mullen, cut off the state highway department's funds last year. The counties, however, liked the work of the state's engineers so well that they were practically all retained and allowed to report to the state, although the counties paid their salaries. Kansas has a state highway department with its hands tied for lack of funds, said Mr. Henderson.

Earth-Road Hints

John H. Mullen, in his paper on earth roads, stated that light crowning permitted persistent dragging, thus maintaining a hard crust. Dragging during construction will prevent longitudinal waves. Hard finishing for the back slopes of ditches more than pays the cost.

Oiling is only a maintenance proposition; that it is a failure as anything permanent was

especially emphasized by B. H. Piepmeier in his paper on that subject. He recommends for a first oiling ½ gal. for 15 ft. in the spring and ¼ to ⅓ gal. for a road 10 ft. wide in the fall. This will suppress the dust, waterproof the surface and give a smooth road for 90 per cent of the yearly traffic.

In the discussion H. Frank Holman, Moberly, Mo., explained the results of oiling for three years. He also warned against expecting permanent results. He estimates the expense as $300 per mile.

C. E. Nagel, bridge engineer, Minnesota, explained a system of cheap concrete bridges of cored-out slabs of uniform spans on simple concrete pile bents. The type has been used with success in the Philippines, said Mr. Davis, who was formerly with the Public Works Department. Since placing eight years ago no failures have been reported. The heavy equipment necessary is a serious objection, said M. H. Torkelson, bridge engineer of Wisconsin.

The method of constructing and maintaining gravel roads in the latter state was described in detail by J. I. Donaghey.

In Minnesota, said Mr. Mullen, a team patrol system is employed, each team handling 4 to 10 miles. The patrol system permits of lighter construction. Mr. Mullen advocates 800 to 1600 loads per mile and adding 100 loads per year, as he says that much is lost.

Maryland Macadam Maintenance Nearly Ideal

H. G. Shirley's explanation of his macadam-road patrol system in Maryland was the sensation of the program. Light oils instead of water for original construction, for waterproofing on the bottom course, and asphalt on the upper layers for adhesion, are points emphasized in construction. The practice of picking patrolmen from the likely workmen on the original construction and the subsequent method of handling them outside of politics merits repetition in other states, seemed to be the general opinion. Vigorous maintenance is practised during the first year. After rains the patrolman marks low spots with kiel, never permitting any holes to develop deeper than ½ in. A traveling inspector looks over the physical condition of the patrolman and his outfit. He gives no orders but if his report, which goes to the resident engineer, who has three to four counties, and then to Mr. Shirley, is not satisfactory he is dismissed. Levels are being taken every six months of many controlled cross-sections to determine external wear so this amount of material can be put back.

Concrete Roads and Motor Trucks

In maintenance work Mr. Shirley is using stone as large as 1½ in., rolled down with a minimum of oil (¼ to ½ gal.) by a 10 or 12-ton roller. On the ton-mile basis an oil-macadam road near Baltimore carrying 4000 tons per mile per day is carrying traffic cheaper than any other road in the state, with one exception. It cost $1100 to maintain and the cost per ton-mile is 0.15 cent, while the average in the state is 0.3 cent.

A. N. Johnson, in describing concrete-road construction, said that if water cost $5 a barrel better concrete would result. He recommended that construction be stopped in the early fall and mentioned belt finishing and the roller scheme used in Macon, Ga. He believes in placing a narrow single way slab on one side of the center of a roadway.

Milwaukee County is not worrying about destruction of its concrete roads by tractors, trucks and trailers, as the destruction of the machinery is too rapid, said H. J. Kuelling. An automatic mixer timing device by means of which the discharge chute cannot be operated until the requisite turns have been given, was noted.

Monolithic brick pavements were described by E. B. Schmidt. No one offered any remedies to P. C. McArdle's inquiry as to how to maintain a grout-filled brick pavement which shows tendencies, after several years, to buckle.

Chicago Sanitary District Using Too Much Water

Report States Level of Lakes Would Be Lowered by Increased Diversion to an Extent That Would Harm Navigation

Charges that the Sanitary District of Chicago has persistently violated federal regulation of the drainage-canal flow from Lake Michigan and contemplates still further diversion to the injury of lake commerce are contained in the annual report of the chief of engineers, U. S. Army, made public last week. It is alleged that the contemplated diversion of 10,000 sec.-ft. instead of 4167 now permitted would lower the lake level 5 in. and prevent navigation by deep-draft vessels in harbors on which $90,000,000 has been expended.

Some method of disposing of sewage other than dilution, it is thought, should be adopted. Although the Secretary of War has fixed the limit of diversion at 4167 ft. per second and has repeatedly refused to grant an increase, the Sanitary District has for many years, the report states, been withdrawing a much larger amount of water. It has been shown that since 1910 the average daily flow through the Chicago River into the canal has been in excess of 7000 cu. ft. per second, which represents a daily average withdrawal from Lake Michigan of nearly 690,000,000 cu. ft.

The continuous withdrawal of this volume of water, it is feared, will result in the permanent lowering of the surface of Lakes Michigan and Huron to the extent of 5 in. or more and of Lake Erie to nearly the same extent. This lowering of the water surfaces would reduce the permissible load of large modern vessels, which would mean a loss to navigation of about $1,500,000 a year.

Rogers Pass Tunnel Opened

The Rogers Pass tunnel under Mount MacDonald in British Columbia has been opened for traffic by the Canadian Pacific Railway. It was expected that the work would be completed by Jan. 1, 1917. The unusual method of constructing the 5-mile tunnel was described in the Engineering Record for Dec. 5, 1914, page 604. The cost of the job was $6,500,000.

Minnesota Waterworks Men Organize Branch and Elect Officers

At a meeting Dec. 2 in Minneapolis the Minnesota branch of the American Waterworks Association was organized. After the business had been transacted the problems of the waterworks executive were discussed by G. O. House, general manager of the St. Paul water department. John Wilson, consulting engineer, of Duluth, emphasized the fallacy of extending service connections to the curb line previous to paving and H. A. Whittaker, director of the division of sanitation, Minnesota State Board of Health, detailed state supervision of public water supplies in Minnesota.

The officers elected are: President, F. W. Cappelen, city engineer of Minneapolis; vice-president, G. O. House, general superintendent of the St. Paul waterworks; treasurer, W. R. Young of the Minneapolis waterworks department; directors, William Todd of Austin, Minn., L. A. Gordon of Little Falls, Minn., and D. A. Reed of Duluth. About thirty waterworks men attended the meeting, twenty of whom are members of the parent organization. Two meetings will be held every year, one outside of Minneapolis.

Highway-Engineering Instruction Conference December 29

To discuss highway-engineering instruction in the educational institutions of the United States, with a view to determine how to meet the growing need for road construction engineers, a conference will be held Dec. 29 in the Automobile Club of America, New York City.

Will Open Fremont Avenue Bridge Over Lake Washington Canal February 1

The Board of Public Works of Seattle has fixed Feb. 1 as the date for the formal opening of the Fremont Avenue bridge across the Lake Washington canal and has notified the contractors that the work must be finished by that date. In case the approaches are not completed, the contractors will be required to keep at least a part of the roadway open for traffic. This action was taken by the board after a special committee had reported on bridge construction progress, and recommended that A. H. Dimock, city engineer, be directed to begin work immediately on a draw in the Latona bridge at Sixth Avenue, N. E., to be maintained until the new bridge at Tenth Avenue, N. E., is completed, probably early in 1919.

Will Remove Colorado River Dam Before January 1

The Imperial Irrigation District recently issued instructions to C. R. Rockwood, chief engineer, to remove the temporary dam which was installed in the Colorado River to relieve the water shortage last summer. The work is to be completed before the first of the year and is to conform with the requirements of the War Department and with the terms and conditions of the bond given to the Yuma County Water Users' Association.

New York Section of Waterworks Association Meets December 20

The New York section of the American Waterworks Association will meet Dec. 20 in the Hotel Astor, New York City. After luncheon Prof. Albert F. Ganz of Stevens Institute of Technology will lecture on electrolysis as it affects waterworks men. A general discussion will follow.

Rain Floods California Tunnel

A rise in the Sacramento River Dec. 3, caused by heavy rains, washed out the temporary dam at the north portal of the Anderson-Cottonwood Irrigation District's tunnel near Redding. The tunnel, which is closed at the south end, was filled with water. Cementing of the interior, which was about one-third completed, cannot be resumed until another dam is built and the tunnel pumped dry.

Progress on Alaska Railroad Not Slower Than Expected

Newspaper reports that the completion of the Alaska Railroad through to Fairbanks is likely to be delayed several years beyond the time originally estimated are denied by W. C. Edes, chairman of the Alaskan Engineering Commission. In response to an inquiry from this journal Mr. Edes states that no definite time has ever been fixed for the completion of the line. Inquiries have been answered by the statement that the commission hoped to reach Fairbanks by the end of 1919, although this was largely dependent on favorable conditions and the supply of labor.

"Nothing," writes Mr. Edes, "has occurred this season to discourage us in any way. Like all other enterprises, we have felt the effect of high freight rates and a scarcity of shipping. Possibly we have felt this somewhat more than others, as practically everything used in the construction of the road has to be brought by water from Pacific Coast ports. The past season was also a wet one in Alaska, with numerous storms, which occasioned some changes in our plans.

"By Dec. 30 about 65 miles of new track will have been laid for the season, making 85 miles in all, extending in both directions from Anchorage. In addition to this over 60 miles of right-of-way has been cleared on the line between the end of the track and Fairbanks, and over 35 miles of grading done in disconnected sections. Large additions have been made to

our construction equipment, and large amounts of supplies will be distributed by sled this winter, preparatory to an active campaign as soon as conditions are favorable in the spring.

"I feel that we have reason for congratulation on the result of the season's work."

Will Call Conference to Discuss Navy Department Contracts

The Navy Department, Bureau of Yards and Docks, Washington, is arranging for a conference with a number of building trades associations, contracting companies, and other parties interested, for the purpose of discussing its general provisions, specifications and contract requirements. The bureau is particularly desirous of receiving suggestions for improving its general provisions and specifications with a view to making them conform with generally accepted commercial requirements of that character, having in mind that certain statutory requirements and accepted precedents bind government procedure. Upon application to the bureau, interested parties may obtain current copies of the general provisions and specifications for examination. Those contemplating attendance at the conference are requested to send their names to the chief of Bureau of Yards and Docks, who will inform them as soon as practicable of the place and date of meeting.

Suggests Giving Commerce Commission Control of Water Transportation

The thirteenth annual convention of the National Rivers and Harbors Congress was held in Washington, Dec. 6, 7 and 8. Among the addresses delivered were "The Relation of Inland Waterways to Naval Efficiency," by Admiral William S. Benson, U. S. N., chief of naval operations; "The Military Value of Improved Waterways," by Lieut.-Col. Henry Jervey, Corps of Engineers, U. S. A.; "The Economic Value of the New York State Barge Canal System," by Frank M. Williams, state engineer of New York; and "Some Observations on Water Transportation," by Brig.-Gen. William M. Black, chief of engineers, U. S. A. Thomas R. Marshall, Vice-President of the United States, advocated turning over the control of all water transportation to the Interstate Commerce Commission in co-ordination with the control that body now exercises over rail transportation. He advocated also the enlargement of the commission.

Speculation as to the possibility of river legislation had been rife among members of the Congress of the United States and the delegates to the waterways convention, especially in view of Secretary McAdoo's annual report, which shows that on June 30, 1918, there will be a deficit in the Treasury of $185,000,000. Notwithstanding this gloomy outlook as to the condition of the public finances, the delegates to the convention were greatly cheered by Mr. Henry's address. He took the opportunity to say that he believes President Wilson will give his support to the advocates of river and harbor improvement legislation.

Favors Putting Engineers on Cleveland City-Planning Commission

An ordinance now before the City Council of Cleveland will work radical changes with the city-planning commission if it is passed. The personnel of the present commission is five citizen members appointed by each incoming mayor for his term, the mayor and his directors of law, service, safety, finance, utilities and welfare. The suggested legislation would remove the directors from the commission and substitute for them the city engineer, city architect, park engineer and building commissioner. The reason for the change is that it will put on the commission more men actually in touch with city-planning methods and needs. The tentative appropriation for that body for 1917 is $20,000, as against $15,000 for 1916.

Engineering Society Activities

New York Chapter of the National Fire Protection Association, at the Dec. 11 meeting, heard Alexander Brociner, consulting engineer, discuss the fire menace of railroads in the United States. Mr. Brociner also quoted abstracts on his subject taken from the Engineering Record.

American Association of Engineers will hold a national convention Feb. 8, 9 and 10 in Chicago at the Hotel La Salle. Work of a promotional nature will constitute the greater part of the program.

Oregon Irrigation Congress will convene at the Imperial Hotel, Portland, Jan. 4, 5 and 6. More than 500 delegates representing the practical irrigationists are expected to attend.

Calgary Branch of the Canadian Society of Civil Engineers has elected A. Scott Dawson, chief engineer, department of natural resources, Canadian Pacific Railway, to preside as chairman for the ensuing year. Sam G. Porter, assistant chief engineer, irrigation branch, Department of the Interior of Canada, was re-elected secretary-treasurer.

Engineers' Club of Trenton, at the Dec. 14 meeting, held election of officers. The nominees were: President, F. C. Carstarphen; vice-president, C. R. Fairchild; secretary, J. E. English; treasurer, J. E. Elliott.

Engineers' Club of St. Louis will be officered in 1917 by the following men if the slate proposed by the nominating committee is elected: President, F. G. Jonah; vice-presidents, C. S. Ruffner, Baxter L. Brown and G. R. Wadleigh; treasurer, F. L. Bock.

St. Louis Association of members of the American Society of Civil Engineers re-elected Col. J. A. Ockerson, president, at the recent annual dinner. F. G. Jonah and E. E. Wall are the vice-presidents. Gurdon G. Black was re-elected secretary-treasurer.

Colorado Association of members of the American Society of Civil Engineers, at the Dec. 9 meeting, departed considerably from the usual set program. The executive committee presented for discussion co-operation in the engineering societies, formation of a district organization for District 10, discussion of society proceedings, legislative action and participation in public affairs.

Western Society of Engineers will be addressed Dec. 18 by W. W. Marr, Illinois state highway engineer, on "Types of Road for a County Bond Issue."

What Engineers and Contractors Are Doing

F. G. BENNETT, for the last ten years assistant engineer for the New York Board of Water Supply, has resigned to enter the employ of Seth J. Raynor, consulting engineer, of Southampton, N. Y.

E. L. CANNON has been appointed office engineer for the Seaboard Air Line Railway, with office at Norfolk, Va.

F. A. BANKS, construction engineer for the U. S. Reclamation Service on the Jackson Lake enlargement project, has been transferred to Burley, Idaho, as engineer on the Minidoka project. The Jackson dam on which Mr. Banks was engaged was recently completed at a cost of $800,000.

ALBERT A. LANE, contracting engineer, formerly of Youngstown, Ohio, has removed to Cleveland, where he will continue in the general contracting business.

R. W. HEERLEIN, formerly with the McClintic-Marshall Company, of Pittsburgh, has been made contracting engineer for the Massillon Bridge & Structural Company, of Massillon, Ohio. Mr. Heerlein was graduated from Rensselaer Polytechnic Institute in 1911, after which he entered the service of the New York highway department. A short experience on the Coleman du Pont road in Delaware preceded his appointment to the McClintic-Marshall Company in June, 1912.

GEORGE M. WELLS, resident engineer in charge of the building department of the Panama Canal, has been ordered to Washington on special duty. Upon completion of his work in January, Mr. Wells expects to enter a consulting engineering firm that will soon be organized in that city. He was a member of the first engineering party organized for canal service in 1904 and has been on the canal work ever since.

ALVA O. GREIST recently resigned as vice-president and chief engineer of the Burling Engineering & Construction Company of New York City to become consulting engineer on public utility properties. Mr. Greist has been connected with the W. H. Schott Company of Chicago, the American Public Utility Company of Grand Rapids and the New York Steam Shovel Company.

W. D. KRAMER has left the employ of the engineering department of Indianapolis to join the Kuert Contracting Company in that city. Mr. Kramer will devote his time to flood-prevention work on the White River.

C. E. MORFORD and Charles Mowrey have been appointed chief deputy and chief office deputy respectively in the office of the county engineer of King County, Washington. The appointees will take charge when S. J. Humes, county engineer-elect, is installed in office.

R. H. THOMSON, consulting engineer, former city engineer of Seattle and now member of the city council, recently gave a lecture in Portland on engineering problems of city development. Mr. Thomson's lecture is a part of a course on real-estate development and management given under the extension department of Reed College, Portland.

T. L. BISBEE, assistant engineer in charge of roads in Warren and part of Essex Counties, New York, has returned to Albany for the winter. Mr. Bisbee has been connected with the state engineering and highway departments since 1902. He has charge of the maintenance of 94 miles of state road in Warren County and 27 in Essex County, and will have general supervision of 10 miles which will be under construction next year in the former county.

THERON WASSON has been appointed water engineer for the New Jersey State Department of Conservation and Development, which last July assumed the powers and duties of the old State Water Supply Commission. Mr. Wasson is a graduate of the Carnegie Institute of Technology. During the last three years he has worked on the construction of water power plants and pipe lines in California. He was also engineer for the Linden Water Company and made surveys and investigations for the New Jersey and Pennsylvania joint committee on toll bridges over the Delaware River.

FRANK X. METZER has resigned as assistant superintendent of the Lafayette (Ind.) waterworks, which position he has held since 1904. He has announced no plans for the future.

ARTHUR T. SCHNAIBLE will succeed Mr. Metzer as assistant superintendent of the Lafayette (Ind.) waterworks.

C. C. HUFFINE was recently appointed city engineer of Frankfort, Ind., to fill the vacancy caused by the death of R. H. Boynton. Mr. Huffine resigned as city engineer in 1905 to enter the contracting field, in which he was engaged until his recent appointment. He is a graduate of Wabash College.

GEORGE H. ROYLE of Trenton, N. J., has been appointed head of the new road con-

struction department of the Mercer County Board of Freeholders, in charge of engineering work. William P. Conard has been elected head of the road repair department, and John McCullough, head of the department of bridges and culverts.

GEORGE A. JOHNSON, consulting engineer of New York City, has been engaged by the board of city commissioners, Bayonne, N. J., as engineer in charge of rearrangement and construction of the city sewerage system.

HOWARD MURRAY, vice-president and general manager of the Shawinigan Water & Power Company, of Montreal, has been granted a year's leave of absence. He will be associated with the management of the explosives branch of the Imperial Munitions Board. Julian C. Smith, chief engineer, has been appointed general manager to succeed Mr. Murray.

RAYMOND BAFFREY, president of the Hennebique Construction Company, is in New York City on a furlough. Mr. Baffrey is an officer in the French army and has been at the front since September, 1914. He will return shortly to resume his military duties.

JOHN S. DENNIS, assistant to the president of the Canadian Pacific Railway, has been named by the nominating committee as president of the Canadian Society of Civil Engineers. He is a native of Weston, Ont., and after graduation from the Upper Canada College was engaged on survey work for the Dominion government and later for the Hudson Bay Company's land department. He is a past president of the American Society of Irrigation Engineers.

WALTER HUNT has been appointed city engineer of San Jose, Cal., to fill the vacancy caused by the resignation of Milton Maggini.

G. H. NICKERSON, chief engineer of the Yosemite Valley Railroad, has been retained as consulting engineer by the Crocker Huffman Land & Water Company to plan improvements in the present waterworks of the city of Merced, Cal.

W. LEWIS CLARK has been appointed division engineer on Division 4 of the California Highway Commission, succeeding A. E. Loder, whose appointment as assistant chief engineer of the U. S. Office of Public Roads and Rural Engineering was recently announced in these columns. Mr. Clark has been with the California Highway Commission since its inauguration. In January, 1912, he was made division engineer on Division 7, which position he held until July, 1915. At that time he was transferred to the Sacramento office and made assistant highway engineer, which position he held until assigned to duties with headquarters in San Francisco.

Obituary Notes

EDWARD M. BIGELOW, whose appointment as director of the Department of Public Works of Pittsburgh was announced in the Engineering Record last week, is dead. He was born in 1853 in Pittsburgh and in 1888, after several years' experience in engineering, was made director of the Department of Public Works. He served until 1906 and during his term of office made possible the construction of many of the city's boulevards. When the Pennsylvania highway department was reorganized in 1911 Mr. Bigelow was put in charge. He resigned in 1915. Since then he had been in poor health, and he accepted his recent appointment against the advice of his friends.

ALBERT T. BAILEY, founder and president of the Champion Bridge Company of Wilmington, Ohio, died recently in his seventy-first year.

CHARLES H. HERSEY, president of the Hersey Manufacturing Company, died Dec. 9 at his home in Roxbury, Mass. Mr. Hersey was 85 years old. He designed the engines for Admiral Farragut's flagship in 1857.

FREDERIC HOLLY REED, civil engineer and capitalist, who assisted in building the first experimental electric street railway in this country and later installed trolley lines in various cities, died Dec. 9 in New York City. He was a director in numerous railway, power and lighting corporations throughout this country and in Manila, P. I. He was born Aug. 22, 1865, in Stamford, Conn. Mr. Reed was vice-president and director of J. G. White & Company, and also was vice-president and a director of the Manila Electric Railroad & Light Company, the Manila Electric Railroad & Lighting Corporation, the Manila Suburban Railway, the Philippine Railway Company and the Investors Securities Corporation. He was director of many gas, electric and power concerns, as well as of the J. G. White Engineering Corporation and the J. G. White Management Corporation.

F. C. FISHER, president of the Ferro Construction Company, died Dec. 6 in Chicago. He was born at Lake Linden, Mich., about 45 years ago and was a graduate of the University of Michigan. Mr. Fisher was recently engaged on the construction of the new high-level bridges in Cleveland.

GRANT ROHRER, civil engineer and contractor, of New York City, died suddenly Dec. 12 in his office. He was born in Lancaster, Pa., in 1864, and obtained his first engineering experience in 1885 with contractors on track construction for the Kansas, Nebraska & Dakota Railroad. Two years later he was employed on construction by the Kansas City, Wyandotte & Northwestern Railroad. After a year with that organization, Mr. Rohrer was made assistant superintendent of construction on the Abrams Creek branch of the West Virginia Central & Pittsburgh Railroad, with which road he remained for a year. Mr. Rohrer was engaged in mine surveying in West Virginia for one year. From 1890 until opening offices in New York City he spent most of his time on construction work for the Norfolk & Western Railroad, the Illinois Central Railroad, H. G. Davis Coal Company and R. H. Hood.

Civil Service Examinations

United States—Applicants for positions as electrical draftsmen in the Navy Department at $3.52 to $6 per day should fill in form 1312. From the register of eligibles, vacancies will be filled. Examinations will be held Jan. 3, 1917, for petroleum technologist, salary $1,200 to $1,500; and for transitman, salary $800 to $900 a year. Form 1312 should be filed. Examinations will be held Jan. 9 for leading draftsman, salary $2,400. Applicants should file form 2118.

Examinations will be held Jan. 3 for examiner of surveys, salary $1,200 to $1,500 a year, and for topographic aid, salary $40 to $75 per month. Examinations will be held Jan. 3 and 4 for junior mechanical engineer, salary $1,000; junior fuel engineer, salary $1,200; geologic aid, salary $1,500; junior topographer, salary $720 to $1,200. Form 1312 should be filled in by applicants for all of these positions.

California—Examination will be held Jan. 6 for assistant to the chief engineer of the Board of State Harbor Commissioners of California, salary $3,000. The duties of the position involve the design and supervision of the erection of structures of reinforced concrete, steel and timber, and familiarity with the fabrication and placing of steel reinforcement, the proportioning, mixing and placing of concrete to give the best results, timber framing and the fabrication and erection of structural steel. The candidates must be residents of California.

Examinations Previously Announced

Date.	See Eng. Rec.
Jan. 3. Laboratorian qualified in strength of materials, United States	Dec. 2
Dec. 26. Petroleum economist, United States	Dec. 2

Blaw Company Holds Sales Convention

The annual sales convention of the Blaw Steel Construction Company was held recently in Pittsburgh. After inspecting the plant, Mr. McArthur, chief engineer, Mr. Rawley, general superintendent, and Mr. Loxterman, manager of the service department, spoke briefly on new appliances and new methods in concrete form construction worked out during the past year.

The new Blaw bucket was the topic of conversation in the afternoon, as well as on Saturday, and was described in detail by Mr. McWhirk, who is in charge of the bucket department. As has been the custom in the past, the convention ended with a banquet at the Concordia Club. More than sixty Blaw enthusiasts were present.

Issue Miniature Size Catalog

Departing from the usual custom the Stow Manufacturing Company of Binghamton, N. Y., has issued Bulletin 102 in miniature. The booklet, which is complete in every detail, measures only 3x5 in. It contains more than 100 pages, is well illustrated and its size makes it convenient for ready reference.

Business Notes

Waterworks Manufacturers Association will hold a special meeting of the executive committee Dec. 20 at the Machinery Club, New York City.

National Tube Company provided three motion pictures illustrating the manufacture of National pipe for the entertainment at the meeting of the American Society of Marine Draftsmen last evening. The assemblage was in the Onyx Theater, Newport News.

Terry Steam Turbine Company, Hartford, Conn., has appointed Stephenson & Nichols, Monadnock Building, San Francisco, to represent the firm in parts of California and Nevada.

Troy Wagon Works Company, Troy, Ohio, has appointed the O'Rourke-Miller Motor Company as its representative in New Orleans. A complete line of Troy trailers will be maintained at the new branch.

Asbestos Protected Metal Company, Pittsburgh, has appointed Meyer Davis to take charge of the San Francisco office. Mr. Davis was formerly chief engineer of the company.

Stambaugh-Thompson Company has taken over the business of the Benson-Caldwell Machinery Company, of Youngstown, Ohio. A new department has been opened in charge of Ivan W. Benson to handle contractor's supplies.

Lidgerwood Manufacturing Company, of New York City, has opened an office in the Hibernian Building, Los Angeles, in charge of Charles A. Baechtold.

Purington Paving Brick Company, of Galesburg, Ill., has become a licensee of the Dunn Wire-Cut-Lug Brick Company of Conneaut, Ohio.

Clay T. and John Gould recently established the Conway Fir Commission Company with headquarters at Conway, Wash. The firm will handle building materials and supplies after the first of the year.

Ransome Concrete Machinery Company, of Dunellen, N. J., has just opened another factory at Reading, Pa. This will double the output of the company in the line of small mixers and road paving machinery. The new factory was necessary to take care of increased business.

An unusually large shipment of paving equipment has been made to Torrance & Portal, of Havana, Cuba, who have secured extensive paving contracts in Havana and Cienfuegos. This shipment, made by the Iroquois works of the Barber Asphalt Paving Company, consisted of six cars routed by way of Key West, Florida, carrying two 3-unit asphalt plants, two 2000-gal. and one 1000-gal. steam-heated melting kettles, four tandem rollers, two portable boilers and engines, fire wagons, paving tools, etc.

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The Season's Greetings

IN HARMONY with the spirit of the season and with a sincerity borne of a deep appreciation of the support and encouragement which the Engineering Record has received from subscribers and advertisers, we wish you a Merry Christmas and a Happy New Year—a new year that in spiritual and material progress will surpass all that have gone before, and in extending this greeting we cannot but express the earnest hope, in which we know that every reader will join, that the coming year may see the termination of the terrible slaughter that is devastating Europe and making a mockery of our civilization. If the next holiday season finds the world enjoying peace—a peace that will have some semblance of permanence by reason of international guarantees—then indeed will it be considered a truly festive season.

Longest Simple Span Swung

WITH the successful erection of the longest simple trusses in the world, at Metropolis, Ill., when the 720-ft. span of the Paducah & Illinois Railroad bridge over the Ohio River was swung on Dec. 11, another engineering record is set. Many of the details used in erecting this span are of special interest; they are described on page 774. To eliminate as far as possible the high secondary stresses in the main members due to the use of subpanels, the main members were forced out of line during erection an amount computed to allow for the elongation of the members in the secondary triangles and produce straight end posts and diagonals under dead load plus one-half uniform live load. This loading was taken as the camber loading for which the lower chord would be a straight line. Of special interest, because of the second Quebec Bridge accident, is the detail of a phosphor-bronze bearing block which allows free rotation in two directions at right angles to each other. Instead of a double-pin rocker casting, a compact bearing block with perpendicular cylindrical bearing surfaces was adopted. In view of the expressed determination of the builders of the Quebec Bridge to change the details of the rockers, the successful erection of this record-breaking span on a compact bearing block of phosphor bronze is at least suggestive.

Guessing at Road Costs

HASTY, inaccurate guesses at road costs caused a great deal of trouble in Virginia a few years ago. County officials designated a large mileage of roads for improvement, guessed at the cost, and then persuaded the taxpayers to vote bonds for the construction. The results of such a policy have been set forth convincingly by the American Highway Association. When the people had committed themselves to considerable debts on promises of definite systems of good roads, engineers were at last called into the business. They reported that the roads could not be built for the money provided, particularly where considerable grading was necessary and comparatively expensive types of construction were proposed. This caused so much dissatisfaction and aroused such opposition to road improvements that the Virginia Legislature had to pass laws to regulate such affairs, which require a proper estimate of the cost of roads to be made before bonds are issued to pay for them. As a matter of fact, there should be a law in every State requiring an examination and estimate by a competent person of any proposed road improvements costing more than $500 per mile before such work is undertaken. There is an enormous waste of money on roads every year, due to undertaking more than there are funds to pay for, and, when this is discovered, spending the remaining money is silly scratching of the ground to make a mere temporary change in conditions, which the first hard rain will ruin.

Damages for Extraordinary Traffic

WHAT is "ordinary" traffic for highways in one locality may be "extraordinary" in another, according to the recent decision of an English court which awarded the Abingdon Rural District Council £350 as expenses incurred for repairs to one of its roads damaged by the excessive weight and extraordinary traffic of motor omnibuses belonging to the City of Oxford Electric Tramways, Ltd. The case, according to defendant's counsel, is the first in which liability has been claimed on the ground that the motorbus traffic is extraordinary. In view of the movement for legislation regulating weights and speeds of motor vehicles in the United States, the case is decidedly timely. If it should be regarded as a precedent, some very interesting results would follow. In giving judgment, Mr. Justice Sankey said that whether a particular traffic is extraordinary or not must be a pure question of fact in each case. Nor did he hold that the need of motorbus service should relieve the defendant from responsibility. The Court was unable to see how the demand of a district for traffic which was extraordinary could turn that traffic into ordinary traffic, although it might be necessary. In the case of the Strand, he pointed out, heavy motor traffic could not be placed in the category of extraordinary. At certain hearings on motortruck bills in this country recently the argument has been advanced that state highways and city streets should be built strong enough to carry any traffic that may be imposed upon them. This is an extreme position to take and one which fails to recognize that millions of dollars have been spent on existing roads which cannot be reconstructed at once to meet traffic demands for which they were never designed. This investment must be protected, and the only method of doing it is to restrict the weight, size and speed of motor vehicles or to make the motor-vehicle owners pay, either directly or by taxation, for the damage they do. These principles, obviously, form the basis of the award of damage in the Abingdon case.

Chicago Traction Plan

THE digestion of a $250,000 engineering commission's report at one meal is really more than Chicago newspapers—and their readers—ought to attempt. It is perhaps as well, therefore, that the general plans from the report of the Chicago Traction and Subway Commission should have been given out before the details were in shape. As it has turned out the general plan is none too well digested even yet. Although pages have been printed, none of the editorial writers seems to have sensed the fact that it is one of the biggest projects that the city has ever considered. There are four important fundamental features. The first is the assumption that all of the traction facilities will be unified. The next is the proposal to revamp the present elevated lines into a real rapid transit system. This carries with it the definite separation of the long and short haul traffic, utilizing the surface lines as feeders for the long haul rapid transit. The third important feature is the "pulling out" of the loop in all directions to alleviate the congested business district girdled with the present iron band. Lastly, there is a provision for through rapid transit between the northwest and southwest sides of the city without the necessity for detouring through the central business district. The plan will eliminate the present condition by which thirteen tracks on the elevated lines focus on two tracks in the loop. So far no one has suggested that the meal is not worth the price.

Proving Their Own Case

SIX years ago, when the California highway bond issue was regarded rather doubtfully, advocates of good roads by dint of hard work just managed to secure a slight majority of votes in favor of the $18,000,000 for launching the construction of a system of highways. Such changes as have taken place since then may be considered as

being due directly to the improvements resulting from the expenditure of the first bond issue. In 1916 there came up again the question of another appropriation, this time for $15,000,000, with which to complete and extend the road system. The interest lies in the comparison of the voting in these two elections six years apart. During this time the real meaning of the good roads movement has been brought home to the people. Just what the effect has been is shown by the following facts: There are fifty-eight counties in the State; in 1910 fourteen, including the one with the largest number of votes, voted against the highway bond measure and the measure carried by the close margin of 93,297 for and 80,509 against. In the 1916 election every county voted for the measure and in no county was the plurality less than 2 to 1. In one case it was 19.97 to 1. Two counties, each of which voted about 4 to 1 against the bonds in 1910, voted practically 3 to 1 in favor of the 1916 issue. For the entire State the plurality favorable to the issue at the recent election was 405,132 out of a total number of votes on this issue of 679,346.

The Christmas Spirit

THE spirit of the season permits—yes, it even invites—a departure from the formalism of business and professional procedure. All men are friends to-day. The relation of seller and buyer, of counsel and client, even of employer and employee, becomes hazy. A spirit of good will throws the formal relations into the background.

And who would have it otherwise? Are not the human qualities, after all, the ones that some day must dominate all intercourses between men? In the last analysis it is because of the divorcement from business of the finer sentiments that control us in our home and neighborhood life that there is derangement in society.

When industry and trade were carried on in small units, the owner took a paternal interest in his people. Their welfare was his concern. He was an adviser, a consoler. He was interested in their mode of life, he was anxious that they should progress in the possession of worldly goods. Factory standards were lower, it is true, but the lack of data, not the attitude of the employer, was at fault. With the development of industry the owner could not continue to have an interest in each employee. Moreover—and here is where the employer was at fault—he did not, as a substitute, create machinery to give consideration to the human factor. The views of less far-seeing men set the labor policies. Competition came and with it the demand for lower costs. The less far-seeing men again controlling, it was believed that high wages were incompatible with low costs, and wages were either forced down or low grade men were employed. The attendant ills of bad housing, of poorly nourished children, of child and woman's labor followed.

Fortunately we are getting beyond this stage of industrial development. Industries are creating machinery—in the shape of intelligent employment bureaus, of welfare departments, of savings and home building funds, of educational bureaus—that is looking after the human side and where industry, as a whole, is flagrantly backward the law, backed by enlightened public opinion, is stepping in and forcing good sanitary conditions, safety measures, and workmen's compensation for industrial accidents.

But have we wandered far from our text—the Christmas spirit? No, for the wider spreading of that spirit through business and industry is an augury of yet greater "humanizing" of our industrial life, of a time when human consideration will go side by side with economics and trade promotion methods in determining business policies.

Snow-Fighting Methods Prove Their Worth in New York

WHEN such hostile critics as the New York daily papers commend the work of the Department of Street Cleaning for the prompt removal of a heavy fall of snow such as blanketed the city's streets last Friday, it is safe to assume that a task little short of miraculous has been performed. As a matter of fact, this is exactly what has happened. Until this year Commissioner Fetherston's reorganization of the work of snow removal on a basis of efficiency was a target for sarcastic comment. It was too revolutionary to suit the editorial writers, who, ignoring the evidence of comparative records of work done in the old and the new way, longed for the "good old days" when the job of clearing the city's streets was intrusted to a "practical" man instead of to a commissioner with engineering training and a lot of new-fangled ideas. Commissioner Fetherston was ahead of his time when he inaugurated snow-fighting methods in 1914. Public opinion is now catching up with him. It is reflected in an editorial in the New York *Times*, which contains such appreciations as these: "No such prompt, energetic and effectual battler with snow as Mr. Fetherston. . . . It was great work. . . . One of the best parts of the municipal administration."

Last week's storm, 12 in. of snow in 15 hours, put a heavy burden upon the Street Cleaning Department, which has scheduled the enormous area of 30,000,000 sq. yd. of street surface for snow removal—equivalent to a 60 ft. roadway between New York and Chicago. Nevertheless, it demonstrated the effectiveness of the new snow-fighting system under which the attack is begun with a large force of emergency workers, in addition to the regular department employees, while the storm is still in progress.

Three factors contributed to the success of this season's first work. In the first place, there was an unexpectedly large response to the call for emergency men—9,000 reporting in addition to the department's regular force of 3,000. Second, new possibilities in clearing snow from the streets have been opened up by the motor-driven plow. One hundred and two of these machines were in service last week and cut swaths along the main arteries of traffic wide enough to permit the free movement of vehicles. Third, the use of the city sewerage system for snow disposal proved a big help in cleaning up the streets quickly. Snow which under the old plan had to be hauled miles to river dumps disappeared like magic through sewer manholes.

The man in the smaller cities has little appreciation of the seriousness of the problem created in New York City by a heavy fall of snow. Even in fair weather, when vehicles can move rapidly, the volume of traffic in some sections of the city is so enormous as to be almost unmanageable. Block up New York streets with snow, and traffic movement, difficult even under the most favorable conditions, is completely paralyzed. The economic value of an efficient snow-removal system, especially at this time of the year when the shop delivery services are carrying their Christmas loads, mounts up into stupendous figures.

The snow fighting plan which proved so effective in last week's storm has been studied carefully and perfected in many of its details for the past three years. It has now emerged from the experimental stage and is in working order. Its success was proved last week.

A Blow at National Unity

DURING the campaign just closed we heard many protests against raising the issue of sectionalism. It was pointed out that the strength of these United States was dependent upon adherence to common ideals, upon a determination of the people in every section to put the nation first and to subordinate local issues.

With the general principle enunciated there was, in the country as a whole, hearty concurrence. Hardly has the echo of the protest died away, however, before there is proposed in the Congress of the United States a measure that would tend to emphasize sectionalism by preventing the maintenance of magazines with national circulations. We feel certain that those responsible for the measure—the members of the House Committee on Post Offices and Post Roads, did not appreciate this inevitable consequence of what they propose.

The measure in question forms a clause in the Post Office appropriation bill. It would put the rates for second-class mail matter (periodicals) on a zone basis. Instead of the postage being one cent per pound, it would be, should this measure prevail, one cent per pound for deliveries up to 300 miles; 2 cents for 300 to 600 miles; 3 cents for 600 to 1,000 miles; 4 cents for 1,000 to 1,400 miles; 5 cents for 1,400 to 1,800 miles, and 6 cents over 1,800 miles. According to this schedule the subscriber in California would have to pay an excess rate of 5 cents per pound on his copy of the Engineering Record, and since the copies average 20 ounces in weight the amount to be added to the subscription price would be $3.25 per year. It does not need experience in the publishing business to realize that the number of subscriptions in California would drop off very rapidly.

What is true of the Engineering Record's circulation in California would be true of that of every magazine published in the East, while, on the other hand, the circulation of California papers and magazines on the Atlantic seaboard would be seriously

curtailed. Citizens of the East would know less of Western experiments in government; knowledge of labor legislation, of welfare work in the East would filter only slowly to the Pacific Coast. There would be one reader of publications, issued at a distance, where now there are twenty, one center of enlightenment instead of a score. Likewise the discussion of national aspirations, of national policies would be restricted by sections in accordance with the sectionalized distribution of periodicals—the media of intercommunication. Consequently sectional views of important national issues would be strengthened, to the detriment of that wonderful spirit of national unity which is the marvel of the traveler as he goes from coast to coast.

The sectionalization, too, would be carried through every line of trade, through every profession. The country doctor would be less likely to learn of new methods of disease treatment developed in the big centers; the engineer, the farmer, the banker in one section will go on with obsolete practices while better ones are employed elsewhere; the local merchant, whom the Federal Trade Commission is now trying so hard to educate, will, voluntarily, if you please, cut himself off, on account of the high combined subscription and postage rates, from knowledge of trade conditions elsewhere.

Moreover, the increased rates will apply not only to magazines and newspapers, but to the proceedings and publications of societies—in a word, to every periodical now accorded second-class rates. The "Proceedings" of the American Society of Civil Engineers, the "Journal" of the American Waterworks Association, the publications of scientific, agricultural, medical and similar organizations—agencies of enlightenment, instrumentalities for building the prestige of America and strengthening it commercially and industrially—would have to bear the additional burden.

The Government of the United States has in the past spent millions of dollars in educational work. What else is the main purpose of the Department of Agriculture, the Bureau of Mines, most of the divisions of the Department of Commerce, not to mention the appropriations to the agricultural experiment stations and to the land-grant colleges? Yet here is a blow aimed at what is, excepting only the schools themselves, the greatest educational force in the land.

We are certain that this curtailment of educational facilities, this menace to a force making for nationalism against sectionalism, has not been appreciated by the authors of this legislation. Nevertheless, if the people of the country do not speak, the silence may be construed as consent. Your Congressman will be home during the Christmas holidays. See him and impress on him that you as a reader of magazines and as a supporter of professional societies believe that a serious injury would be done the progress of this country by the proposed legislation.

European nations in the throes of a terrible struggle are invoking every power to keep their citizens intent upon their respective national ideals. National unity alone can save them, if they are to be saved. Moreover, a new thought as to education, as to the development of national strength in trade and in industry pervades these nations. As Frank A. Vanderlip recently said, if we are not awake the descriptions, "New Europe and Old United States," will soon be correct.

While Europe builds up, spiritually and industrially, shall we pull down?

A Distinction Between Mining and Subway Construction

AT THE TIME of the Seventh Avenue and Broadway accidents, resulting in the collapse of street decking over subway construction in New York City, an editor of the *Engineering and Mining Journal* asserted that the civil engineers connected with this work did not know their business and that a "mining expert" should be employed. Dame Rumor has it that one of the Public Service Commissioners, who is neither a civil nor a mining engineer, was so impressed with this contention that he insisted upon the employment of such an expert. At any rate, a mining engineer, H. G. Moulton, was appointed adviser to the commission.

It is not the intention of the Engineering Record to reflect on Mr. Moulton's ability or on his integrity. The one is assumed to be of high grade and the other above reproach. Nevertheless, he has publicly attacked the prevailing methods of subway construction before the American Society of Civil Engineers. Furthermore, as related to this journal by more than one contractor, Mr. Moulton has objected to any type of subway shoring that includes the use of steel falsework. This journal, therefore, cannot pass over the opportunity to refute his contentions, afforded by the publication, on page 760 of this issue, of a description of the most recent and highest development of combined steel and timber street support.

Mr. Moulton, in his discussion before the American Society of Civil Engineers of a paper presented Sept. 20 by Israel V. Werbin on the Lexington Avenue subway work, advocated the use of square set timbering for supporting the walls and roof of treacherous rock excavation. He pointed out that in mining practice small dapped timbers, giving 5 x 7 ft. panels, spaced on 5-ft. centers, had been found safer and more economical than the long needles and posts formerly used on the theory that the greater open space made cheaper excavation possible.

There is no reason to question these assertions so far as mining engineering is concerned. There is, however, this difference—fatal to Mr. Moulton's contentions—between ore mining and subway excavation: When the mining engineer has removed his ore body he is through. When the subway contractor has removed his excavation he is less than half through. A finished structure must be built and backfilled in the subway excavation. If proper clearance for erecting and concreting the structure is not provided, the additional cost will overbalance any saving effected by mining methods in taking out the rock. On section 3 of routes 4 and 36, referred to in this issue, the rock excavation will cost the city $1,175,240, at a unit figure of $5.25 per cubic yard for the bulk of the work. The total excavation for the main cut, including earth, will cost less than half the contract price of $3,741,000 for the finished section. Of the remaining work, the structural steel erected represents $498,150 and the concrete $443,500. The lowest cost given by Mr. Moulton for mining ore according to the system he outlines (and including timbering) is $4 a yard. This does not allow for any overhead, which it is safe to say is a factor included in the price of $5.25 for rock excavation on the section in question. Even granting a saving of $1.25 a yard on this entire rock cut, the cost could have been lowered by mining methods about $277,000 on Mr. Moulton's most favorable estimate. This saving would be largely offset by the increased erection cost for the structural steel alone. Judging from other structural contracts let about the same time, the difficulty of handling and erecting the steel underground, even with the favorable conditions on the contract described, increased the cost from $5 to $30 a ton above prices for similar steel erected in the open. A further increase of $20 a ton, which is a low estimate of the added cost of wriggling long steel beams and columns through a thick-set forest of mine timbering, would mean $126,000 added to this item. Not only would the direct cost increase, but the speed of construction would be far less than at present. Consequently, the overhead cost of the entire work would be increased while the city would continue to pay interest waiting for the lines to be placed in operation.

Moreover, structural steel is not the only item the cost of which would be increased by adopting mine timbering methods. The cost of formwork and of concreting would be proportionately higher. Any one who has kept costs on placing concrete where cofferdam bracing had to be removed is well aware of this fact.

Mr. Moulton's only remaining argument for mine timbering is that of increased safety over present methods. Mines are not free from serious accidents. Neither would mine-timbered subway cuts be proof against them. Subject to vibration and impact, to constant shifting and replacement not necessary in a mine but imperative where a finished structure must be built within it, such a system of timbering might well be more of a potential danger than a safety asset. Certainly it cannot be asserted offhand to be absolutely safer than the system of street support in use on the subway section mentioned. Yet, this journal is informed, Mr. Moulton has condemned this system solely on the ground that it makes use of steel falsework to provide open working space.

This entire controversy is bound to be a point of friction with the contractors and with the engineering staff of the commission. Friction is expensive. The moral is, when an outside expert must be brought in to advise on special problems, he should be an expert in those problems and not in other matters of an inherently different nature.

New Center-Cut Method Avoids Vertical Side Face in Bad Rock on New York Subway Work

31,000 Yards Removed in One Month on Section Notable for Size, Speed of Construction in Congested District, Improved Timbering Methods and Excellence of Street Decking

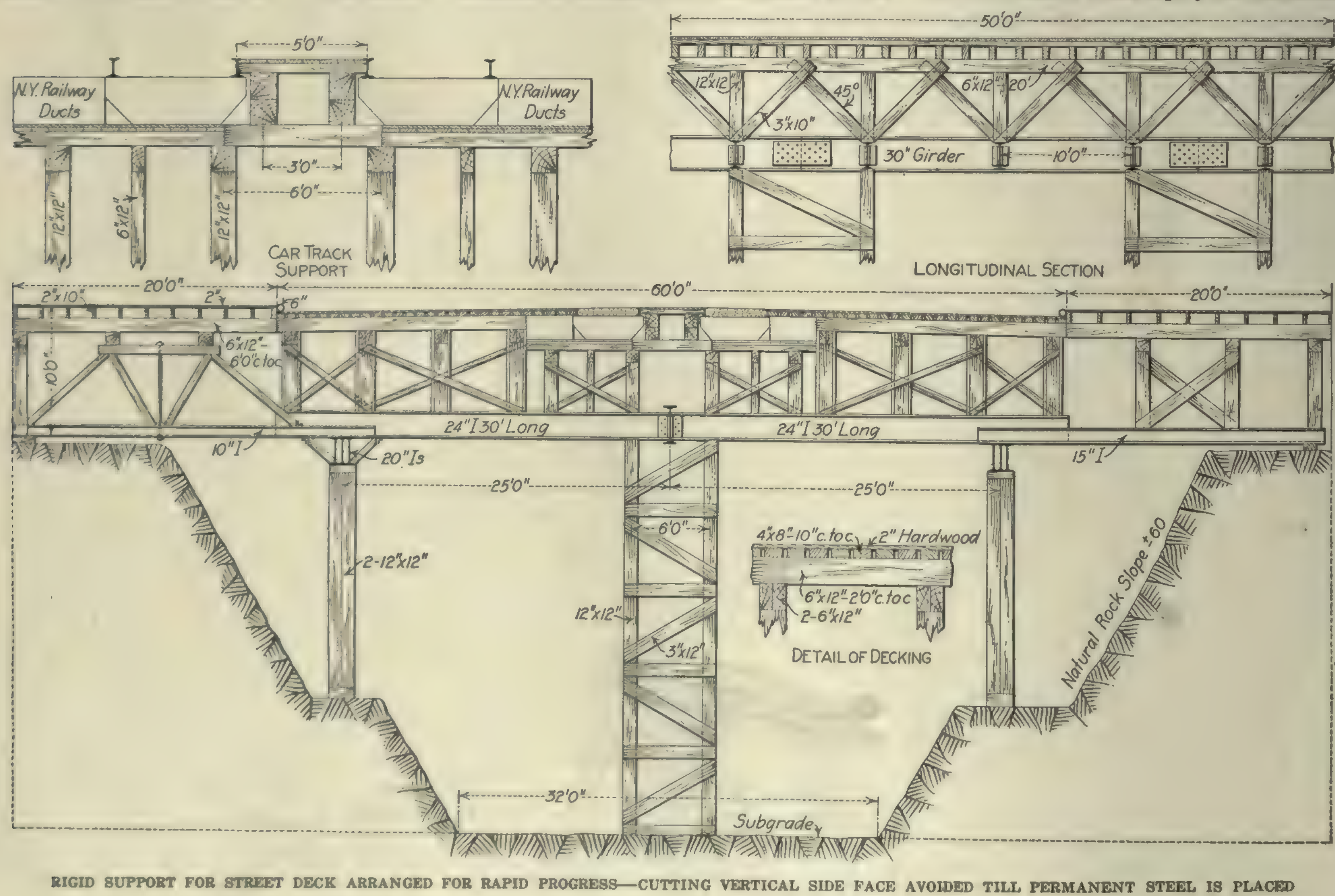
ONE of the largest rock-cut sections in the new subway system of New York City is being built beneath the most densely traveled parts of Broadway and Seventh Avenue at a rate, it is said, never before approached in such construction. New methods developed on this work have made possible the excavation and disposal of 31,000 cu. yd. of rock in one month, the rapid building of the permanent structure and the safe handling meanwhile of treacherous vertical rock faces along the building lines. A decking is being maintained on the thirteen blocks of sidewalk and roadway over this section which is evidently better than some of the permanent paving in adjoining cross-streets. Aside from the shaft plants and the disposal arrangements, which were described in the Engineering Record of Jan. 29, 1916, page 152, the most important factor in the unusual progress of the work has been a well-planned system of construction in which the decking is carried on a horizontal bolt-connected steel framework. After this part of the construction has been placed in a top cut, a center cut two tracks wide, with sloping sides, is made, in which the middle part of the permanent structure is built. The work of underpinning adjoining buildings is carried along as this cut is excavated. The roof over the outside tracks and platforms (a large portion of the section consists of an express station) is then placed, after which the remainder of the rock at the sides is broken out to a previously line-holed face. Only enough is excavated at a time on each side to set up and concrete five or six panels of side wall, although at this stage all buildings have been underpinned to subgrade and any thrust developing from a tendency of the fissured rock mass to move is carried across the cut by the finished roof.

"Keel" Construction Supports Street

The first operation in decking the streets was accomplished by removing the paving alternately on each side, excavating to a depth of $2\frac{1}{2}$ ft. from the surface and placing the timber deck down to the bottom of the 12-in. timbers which run parallel to the street under the roadway and under the car tracks. This decking is unusual in having a 2-in. wearing surface of hardwood plank laid at right angles to the street on 4 x 8-in. timbers parallel to the street and laid with 2-in. spaces between them. These rest on 6 x 12-in. timbers, which in turn are supported by 6 x 12-in. longitudinal timbers lapped by for half the length and bolted together to form a continuous 12 x 12. The strength of this construction, which is designed to carry over a 10-ft. span the 10-ton load on the two rear wheels of the largest-sized trucks, together with the rigidity of the steel underframe which supports the decking, is thought to be responsible for the fact that the street surface on this section has been free from settlement, the car tracks have remained in good alignment and the surface of the roadway remains smooth and even after a year or more of very heavy service.

After the decking was in place, a cut 10 ft. deep was made below it for the full width of the street, the material being taken out at the shafts. On the floor of this cut was laid a "keel" of 30-in. girder beams, placed end to end and fastened together with bolted splices equal in shear to the strength of the beams. This line of beams is continuous. Into the sides of this "keel" are framed with bolted connections 24-in. I-beams 30 ft. long, at 10-ft. intervals. The outside ends of these beams are supported by a triple line of 24-in. I-beams approximately below the curb line on either side of the street. The lower flange of each of the transverse beams is bolted with four bolts to the upper flange of each of the longitudinal beams at the side of the street. The 12-in. longitudinal timbers under the street and car tracks are posted down to this framework with 12 x 12-in. timbers. Bolted diagonal scabs of 3-in. plank from the lower ends of the posts to the sides of the stringers above reduce the chances of their being displaced and add stiffness to the construction.

The sidewalks are supported on trusses on 10-ft. centers which lap by the transverse



RIGID SUPPORT FOR STREET DECK ARRANGED FOR RAPID PROGRESS—CUTTING VERTICAL SIDE FACE AVOIDED TILL PERMANENT STEEL IS PLACED

Photographs by Charles Spero

REMAINING SIDE BENCH BETWEEN STEEL CONSTRUCTION APPROACHING FROM BOTH DIRECTIONS, AND ROCK BROKEN TO LINE-HOLED FACE

24-in. beams and rest on the triple line of 24-in. beams. The bottom of each of these trusses consists of a 10-in. I-beam, and the outside end of each truss rests on rock outside the lines of excavation. In this way the necessity for needlebeams, which would have to be shifted as the main excavation progressed, was eliminated and a rigid construction provided which could support the street loads with timber towers and heavy posts over spans up to 30 ft. As the top of the permanent structure is below the level of these beams, free working space for all the construction operations is provided by this system, and at the same time it is considered so strong as to be in little danger from rock fragments hurled by a blast.

Dangerous Formation Requires Center Cut

Nearly all the material removed in the first cut was rock, the paving in most places resting directly on the rock. The schist which is found in this section of Manhattan dips at a steep angle to the west, and besides having a general tendency to slide along the bedding planes, which is likely to cause material to slide in on the east side of the cut, the joint planes in the formation are practically parallel to the line of the subway, and consequently do not show in the walls of the cut. On this account there is constant danger of masses of apparently sound rock falling in from the west side of the cut. For these reasons it was thought best not to excavate the full width of the cut, which would have left vertical faces on each side that would have been sources of danger no matter how closely the heading could be followed by the steelwork of the finished structure. A center cut down to grade, with sides sloped back to the neat lines at the top and with sufficient width on the bottom to permit building the center portion of the permanent structure, containing the two express tracks, is therefore carried in advance of the rest of the work. Much of the section is so deep, however, that before starting the center cut a second full-width cut of 10 ft. depth is made. The center steel "keel" of the street support is carried on towers to the floor of this cut, while the triple rows of 24-in. beams at the sides are carried on 12 x 24-in. or 16 x 16-in. timber posts resting at safe points on the banks of the cut. As these headings progressed the footings of the buildings on both sides of Broadway were carried down to the subgrade by excavating pits beneath them and filling these pits with concrete. The muck from these pits was disposed of by sliding it down chutes, built on the sloping sides of the center cut, which discharged directly into the wheeled skips used for removing the muck from the main heading.

Where light buildings were not underpinned, concrete walls at the sides of the cut were built to retain the rock beneath them during construction. The tops of these walls, at the level of the steel street support, were secured to each transverse beam by stirrups bolted to the beam and bearing on the face of the wall at the top, so that the thrust was transferred across the cut by the steel falsework.

As fast as the center cut is made, the steel for the two center tracks is erected and the structure concreted. The long "keel" is posted down to the permanent steel as it is set, the posts resting on concrete blocks on the roof girders so that no patching remains to be done when the posts are removed for backfilling. As fast as this part of the structure is completed the usual rubble masonry piers are built on it from stone taken from the cut permanently to support the street-car tracks.

DECKING THAT STAYS IN PLACE

Side Excavation Handled Carefully

When this has been done, the upper half of the sloping bank of rock remaining in place at each side of the cut is broken back to the neat lines to permit placing the remaining roof steel at the sides. Rock enough to allow the placing of from two to five roof beams at a time, depending on conditions, is taken out. Before any of this mass is drilled for blasting, vertical line holes are drilled along the neat line on each side of the cut downward from the top of the bank. These holes are from 6 in. to 2 ft. apart, depending on the condition of the rock, and are drilled with jack hammers using steels up to 14 ft. long. By this means overbreak, which would be very dangerous in this formation, is entirely avoided. These top excavations at the sides of the center cut are carried along as two continuous headings, the steel being set and concreted as each section is excavated. The rock taken out is dropped into the wheeled skips down the wood chutes used to remove the material from the underpinning pits. The outer ends of the side roof beams are supported by light needles until the side walls can be placed. Over the space where this construction is in progress the ends of the transverse street-support beams are carried by runner beams, the forward ends of which are supported from the rock shelf and the rear ends posted down to the floor of the cut behind. Second-hand plate girders 60 ft. long and 4 ft. deep are used for these runners.

Roof Steel Supports Rock While Making Final Side Cut

From the bench at each side, formed by cutting out the rock to place the roof, line holes are extended down to the bottom of the cut, after which the remaining wedge-shaped mass of rock is broken out on each side to the final lines of the excavation. This is done in sections of about the same length as those taken out in placing the roof. The column footings for the side walls are then poured and the side columns set, after which the runners can be moved before the side walls are concreted.

As the structure is completed, short sections of the decking and the street support

on alternate sides are taken up and backfilled in the usual manner.

Wheeled Skips Aid in Handling Muck

The wheeled skips, which were described in the article referred to, are said to have greatly increased the economy of these operations. The four wheels and journals are set into the body of the skip at the bottom, and the bottom plate is only a few inches above the rail. This construction made it possible to build 1½-yd. skips, which stand less than waist high from the floor of the cut, and which are consequently very economical to load. The skips are used not only to convey muck, but to take the place of the platform cars usually required to transport the steel. These skips are operated on a double-track line, with turnouts at shafts located at Thirty-ninth, Forty-first, Forty-third, Forty-sixth and Forty-ninth streets, and laid first on the floor of the initial wide cut and subsequently on the floor of the center cut.

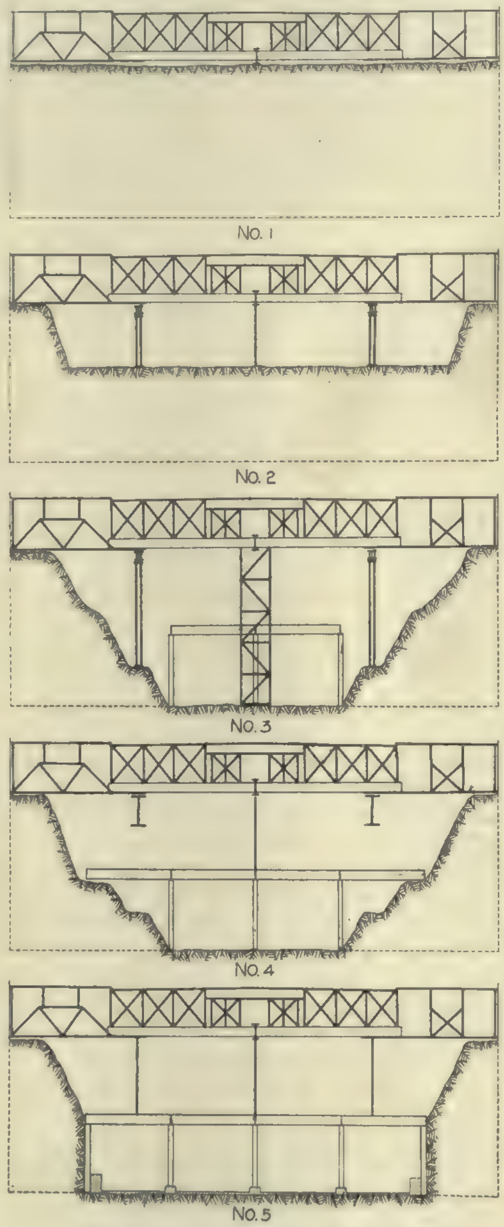
The entire system for supporting the street and attacking the rock excavation made it possible to open up large bodies of rock at the outset and take out more than half of the total excavation required during the first year of the contract. While the rock remaining at the sides cannot be taken out at such a rapid rate, the work is just as economical, as it permits the continuous employment of a full crew. Moreover, the center cut clears the way for the erection of a large portion of the permanent structure, so that the last of the excavation does not have to be finished so far ahead of the remaining work on the contract, in point of time, as is the case where a full-sized cut section is taken out before any of the permanent structure is erected.

Duplicate Air Lines Supply Drills

The main compressor plant, containing seven electrically driven, direct-connected two-stage machines, with a combined capacity of 7000 cu. ft. per minute, is located in the triangle between Broadway, Forty-third Street and Seventh Avenue. From this plant 6-in. air mains are run on each side of the cut up Seventh Avenue and down Broadway. In these lines are made up T's at every second joint, to which lines are connected as needed leading to manifolds, from which smaller lines supply the air hoists and drills. Each of the main air lines is fitted with a U-bend expansion joint at every cross-street, and the two lines on each side of the cut are cross-connected every block. In this way any damaged section of either of the air mains can be cut out by closing the valves at each end of it, and the tools fed from this line can be supplied with air through the cross-connections from the other main. The maximum load on this compressor plant so far has been seventy-three jack hammers, 6000 gal. capacity in air pumps, twelve 6 x 8-in. single and double drum air hoists, and several riveting hammers and wood-boring tools.

The structural steel is handled by the twelve air hoists mentioned and by fourteen 10-hp. single-drum electric hoists. In addition to these hoists, several electric riveting hammers and wood-boring tools are used below ground. It has not been necessary to use any hoists to pull the muck skips. The hauls are short, it has been possible to keep the tracks practically level and the skips roll easily. Under these conditions it has been as cheap to push them by hand.

Practically all the hauling in connection with the contract, except the delivery of the steel, has been done with motor trucks. Indeed, it is not considered possible that horse-drawn vehicles could have removed rock and delivered concrete in the congested district in which the contract is located at the rate required by the rapid progress of the work. The concrete is mixed at a waterfront plant located on the contractor's dock at Fiftieth Street and the Hudson River. It is hauled in 4-yd. loads by back-dumping motor trucks and deposited on the decking over the point of concreting. The truck bodies have square corners, and the dumping



PROGRESSIVE CONSTRUCTION STEPS

1—First cut to set steel deck support; 2—Second cut to reduce side slope of center cut in deep part of section; 3—Center cut made, center steel set; 4—Side roof beams set; 5—Structure finished

mechanism does not tilt them high enough to make the concrete slide out quickly. Under these conditions it has been found best to mix the concrete rather dry, loosen it when the truck is dumped with an air jet of ¾-in. pipe and remix it with more water before shoveling it down the vertical chutes to the forms. Three of these trucks are employed and each can deliver without difficulty 52 yd. of concrete in an eight-hour day over the 1½-mile round trip.

The trailer trucks which dispose of the excavation carry 9 yd. at a load, and the fleet of them has often disposed of 1100 cu. yd. of loose rock in twenty-four hours. These trucks and the five shaft plants were expected to reach a maximum capacity of only 1000 yd. of loose material a day. At three of the shafts the hoisting is done by electric cranes, while at Forty-sixth Street a steam crane is used and at Forty-ninth Street an electric telpher.

Crossing Under Old Subway Partly Built

The contract is practically divided into two separate sections by the existing subway at Times Square. At the time the present subway was built a future extension down Broadway was provided for by constructing a double-track section parallel to Broadway under the Times Square station. This section, which has remained sealed up since the old subway was built, and which is now to be incorporated in the new structure, is directly east of the foot passage under the station at this point. The roof of this old construction will be retained, but the cut will have to be widened and deepened to accommodate four tracks and the station platforms. This work has been left till the last partly because it could not be reached till a block length of excavation at each side from the shafts at Forty-first and Forty-third streets had been completed and partly because of the drainage conditions in the north section of the work. Also, the work will involve the temporary reconstruction of portions of the Times Square station, and it was desirable to have the time interval between the disturbing of present conditions and the completion of the new work as short as possible. The only work done so far at this point, therefore, has been to drive a 6 x 6-ft. drift from the heading on each side into the old tunnel section under the station, which has helped the drainage of the north section of the work.

Poor Drainage Delays Progress

While the sewers below Forty-second Street are capable of carrying the maximum runoff from heavy rains, those above Forty-second Street are not. A new intercepting sewer, required to relieve this situation, is now under construction in connection with the subway work. In the meantime, however, the cut north of Forty-second Street has been flooded on numerous occasions, the work has been seriously delayed and traffic has been interfered with at times on the present subway. Notwithstanding these difficulties, the top cut has been made for the entire section and the center cut has been completed except for one block at the north end. Also, a good deal of the permanent structure has been built in these blocks. However, work is not so far advanced as on the section south of Forty-second Street, where backfilling has begun at the lower end, and the conditions outlined may make it impossible to complete the upper portion of the work before May 8 next, when the time limit expires. This is not so serious as if the lower section had been affected in view of the fact that the operation of the line above Forty-second Street could hardly be expected to develop heavy traffic until the completion of the Sixtieth Street tunnel under the East River. When this section was first contracted for it was expected that the Broadway line would operate over the Queensboro Bridge, in which case trains from that borough could probably have been run across Fifty-ninth Street and down Broadway to Brooklyn before the end of next year. With the change adopted from the bridge crossing to a tunnel this will now be impossible, and therefore the necessity

for completing the lower section, so that operation from Times Square to Brooklyn can be begun, is more urgent than that for the completion of the upper portion of the work.

The work described, section 3 of routes 4 and 36, Broadway-Fourth Avenue Subway, is being constructed by the Holbrook, Cabot & Rollins Corporation, under the direction of George Hallett Clark, for the Public Service Commission, of which Robert Ridgway is engineer of subway construction and Jesse O. Shipman, engineer of the division including the work.

Surge-Tank Problems Solved by New Methods

Simplified Analysis of Oscillations of Water Surface in Standpipe Makes Use of Calculus Unnecessary

By A. G. HILLBERG
Hydraulic Engineer, New York City

SEVERAL WRITERS have dealt with fluctuations in surge tanks for different changes in load on a power station. The majority of the methods developed, however, end with equations giving the top of the first wave and the time needed for it to reach its crest. Most of them have also assumed that the frictional resistance in the long conduit is in a direct proportion to the velocity, or $h_f = nv$.

By using the Chezy formula $v = c\sqrt{RS}$, where S is head lost (h_f) divided by length of conduit (L), it can be proved that

$$h_f = \frac{L}{c^2R}v^2 = nv^2 \qquad (1)$$

It will be found, on examination of the literature on this subject, that all authors have used integral calculus in dealing with the problem. As some engineers have difficulty in using calculus, it might be of interest to know that surge-tank problems can be solved without involving higher mathematics. Furthermore, it is not enough to calculate only the crest of the first wave. In order to know whether the tank is large enough for its purpose several waves should be taken into consideration, and the possibility of further load changes before the wave action has died out should be given attention.

To simplify the problem as much as possible it will be assumed that the elasticity of the penstocks has no influence on the surge. To neglect this influence will not introduce any material error, as greater possibility of error prevails in the assumption of the friction coefficients contingent to the flow in the pressure conduit.

If no friction prevailed, a sudden load increase demanding more water would draw down the level in the tank, thus decreasing the head on the turbines. The governor would then open the gates, permitting more water to flow to the runner. This would draw the water level down still further. When finally the velocity in the conduit had been accelerated sufficiently to stop the drawdown of the water level in the tank, the water would rise in it until the original level had been reached. Thus the wave action would be continued with constant wave length and variations in level.

Friction, however, enters into the problem. It will tend to hold back the water column in the conduit by delaying the acceleration of its velocity, thus increasing the depression of the water level. Later, when the water rises, the frictional force will again retard the velocity change, thus reducing the crest of the wave. Consequently, if no additional change in load occurs, the water level will fluctuate with smaller and smaller oscillations, until finally the new level has been attained.

When the water rises in the tank a certain amount of work is required to lift it. Consequently, the following equation can be established:

$$\tfrac{1}{2}mv_1^2 + W = \tfrac{1}{2}mv_2^2 + F \qquad (2)$$

where m is the mass; v_1 and v_2, the respective velocities before and after a certain interval of time; $\frac{1}{2}mv_1^2$ and $\frac{1}{2}mv_2^2$, the respective kinetic energies; W, the work done in lifting the water, and F, the work done by the friction.

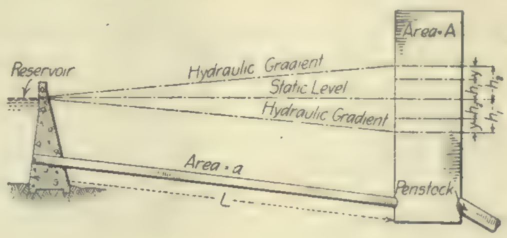
If now, at the beginning of the interval considered, the water level in the tank is h_1 feet below the static level, and afterward it will be changed to h_2 (see drawing), the work done in lifting it will be

$$W = \gamma A(h_1 - h_2)\left(h_1 - \frac{h_1 - h_2}{2}\right)$$

or

$$W = \gamma A(h_1^2 - h_2^2)/2 \text{ ft.-lb.} \qquad (3)$$

Neglecting the velocity head, which is



small as compared with the friction head, the work done by the friction is

$$F = \gamma Q h_{fm} \text{ ft.-lb.}$$

where Q is the total discharge during the interval of time and

$$h_{fm} = nv^2_m$$

If the discharge in second-feet is q, and an interval of time t is considered, or $Q = qt$, the work done by the friction is

$$F = \gamma q t h_{fm},$$

where h_{fm} is the mean friction loss during the time, t. However, $q = av_m$, where a is the area of the conduit and v_m the mean velocity.

For all practical purposes it is close enough to put

$$v_m = (v_1 + v_2)/2$$

when considering that t is a very short interval of time. Furthermore, it is accurate enough to put

$$h_{fm} = (h_{f_1} + h_{f_2})/2$$

But it has already been shown that $h_f = nv^2$, so that

$$h_{fm} = \frac{nv_1^2 + nv_2^2}{2} = \frac{n}{2}(v_1^2 + v_2^2)$$

Consequently the equation for the work done by friction can be rewritten

$$F = \gamma a\frac{v_1 + v_2}{2}\, t\, \frac{n}{2}(v_1^2 + v_2^2) \qquad (4)$$

Introducing the expressions for W and F, equations 3 and 4 respectively, in equation 2 it becomes

$$\frac{m}{2}v_1^2 + \gamma A\frac{h_1^2 - h_2^2}{2} = \frac{m}{2}v_2^2 + \gamma a\frac{v_1 + v_2}{2}\, t\, \frac{n}{2}(v_1^2 + v_2^2)$$

which can be rewritten to read

$$\frac{m}{2}(v_1^2 - v_2^2) + \gamma A\frac{h_1^2 - h_2^2}{2} - \gamma a\frac{v_1 + v_2}{2}\, t\, \frac{n}{2}(v_1^2 + v_2^2) = 0 \quad (5)$$

From this equation it is obvious that as long as $h_1 > h_2$ (that is, when the water level is below the static level) the work done in the tank is positive. After that, when $h_1 < h_2$, this work is negative, thus tending to retard the surge. Therefore by taking h_1 and h_2 from the static level no change in sign need be made after the wave has passed this level.

After the time interval t the water has risen y feet in the tank, so that

$$Ay = atv_m = at\frac{v_1 + v_2}{2}$$

from which

$$y = \frac{a}{A}\, t\, \frac{v_1 + v_2}{2} \text{ feet.} \qquad (6)$$

From the figure it is obvious that for water levels below the static level $y = h_1 - h_2$ feet, while for levels above the static $y = h_2 - h_1$ feet. Therefore $h_2 = h_1 \pm y$ feet. Furthermore, $m = \gamma aL/g$. If these expressions are introduced in equation 5, and it is solved for v_2, the following expression is obtained:

$$v_2 = -\left(\frac{L}{ngt} + \frac{at}{4An}\right) + \sqrt{\left(\frac{L}{ngt} + \frac{at}{4An}\right)^2 \pm \frac{2h_1}{n} + \left(\frac{2L}{ngt} - \frac{at}{2An}\right)v_1 - v_1^2}$$

This equation, however, can be written in a simpler form by putting

$$U = \left[\frac{L}{ngt} + \frac{at}{4An}\right]$$

and

$$S = \left[\frac{2L}{ngt} - \frac{at}{4An}\right]$$

so that

$$v_2 = -U + \sqrt{U^2 \pm 2h_1/n + v_1(S - v_1)} \qquad (7)$$

As mentioned before, the term $+2h_1/n$ should be used for water levels below the static and $-2h_1/n$ for levels above.

The time t should be a period as short as possible, so as to reduce the influence of the approximations. As in many cases one second will give too many computations, intervals of 5 or even 10 seconds can be used without any serious error being introduced.

When the wave reaches its crest $v_2 = 0$ the downward movement will begin. To calculate accurately the time required for the wave to reach its maximum, the last few computations should be made with intervals not exceeding 1 or 2 seconds.

It is, however, necessary to assume the size of the area A or the cross-sectional area of the tank, the area a, or the size of the conduit, having already been determined from other considerations.

If as before h_1 is the distance of the initial level below the static level in the tank and y_{max} is the distance above the static level to the top of the surge, for a sudden full shutdown, making $v_m = v_1/2$, the following formula can be made use of:

$$A = \frac{av_1^2}{g} \times \frac{L}{(h_1 + y_{max})y_{max}}$$

This expression gives results that are from 1 to 3 per cent too large, but close enough for preliminary calculations. It was developed by A. Strickler and published in the *Schweizerische Bauzeitung*, Vol. 64, 1914.

By assuming a series of values of y_{max} the corresponding areas A can be determined and the most suitable selected.

In order to assist in choosing the most suitable interval of time the formulas of R. D. Johnson or L. F. Harza for the maximum surge and the time required for it to

reach its crest should be made use of. Mr. Johnson's formulas read:

$$y_{max} = \sqrt{\frac{aLv_1^2}{Ag} + h_f^2} \text{ feet}$$

and

$$t = \frac{\pi}{2}\sqrt{\frac{AL}{ga} + \frac{n^2v_1^2A^2}{a^2}} \text{ seconds.}$$

Mr. Harza's formulas are

$$y_{max} = \sqrt{\frac{a}{A}v_1^2\left(\frac{L}{g} - \frac{ntv_1}{3}\right)} \text{ feet}$$

where

$$t = \pi\sqrt{\frac{AL}{ag}} \text{ seconds.}$$

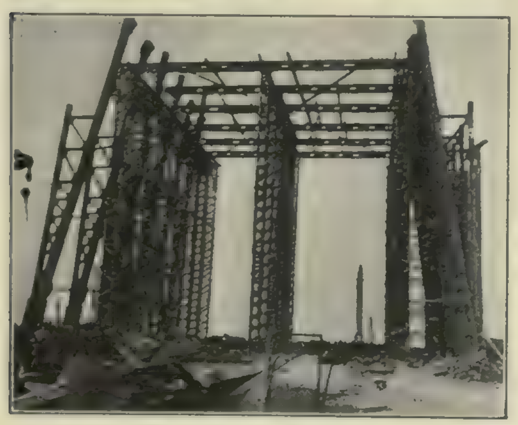
In these four latter equations y_{max} is measured from the initial level to the top of the surge. All other symbols are as before.

For calculating the water hammer in the penstocks, which can be considered as a separate problem from the surges in the tank, the formulas given by Vincent P. Marran in his article "Practical Procedure in Designing Penstocks," published in the Engineering Record of March 20, 1915, page 355, should be used.

Tower of Jewels Salvage Readily Marketed

Exposition Structure Dismantled Without Accident and with Negligible Damage to Material—Wrecking Cost $25,000

DURING the last week in November there was completed the wrecking of the Tower of Jewels, which was the last of the Panama-Pacific Exposition structures to be dismantled. The tower was sold by the exposition company for $9,000 to Weissbaum & Company just as it stood after the close of the exposition. It contained 1800 tons of structural steel and about 2,000,000 ft. b.m. of lumber, but its 435 ft. of height considerably complicated the problem of



90-FOOT COLUMN STUBS, LEANING AGAINST FALSEWORK, WERE FELLED SINGLY

economical dismantling in a way that would not damage the salvable material. The safety of workmen was also considered an important item. During erection of the structure there were three fatal and a number of minor accidents, and it was believed that the work of dismantling would be more dangerous.

Wrecking operations were started April 2, 1916, and the last standing column was taken down Nov. 23. During this time, in which the crew on the job ranged from 12 to 20 men, neither serious nor fatal accidents were reported. The complete cost of dismantling is stated to have been $25,000, including insurance and all overhead.

The wreckers began at the top, lowering most of the material from derrick booms. The steel frame was unbelted or cut with acetylene torch where necessary. The columns which supported the arch 125 ft. high in the base of the structure were stripped and their upper parts removed so that the height of the columns which it was finally necessary to "fall" was only 90 ft.

The work was done in such a way that less than 2 per cent of the structural steel shapes were damaged in handling, and thus the major portion of the steel commanded a high price. The resale of the structural-steel members netted $65,000, in addition to which the major portion of the lumber in the structure was disposed of at from $10 to $12 per 1000 ft. b.m. Most of the steel was sold to a local rolling mill which manufactures structural shapes.

The work was under the supervision of the Safety Department of the State Industrial Accident Commission, of which John R. Brownell is superintendent of safety. Personal attention to this job was given by J. J. Rosenthal, safety engineer. Inspections of the work were made three or four times a week, and the cables, derrick loading and derrick supports were constantly examined and checked up, minor changes being made in accordance with the recommendation of the state officials.

Letters on Hydrated Lime Which Won Prizes

Cite Advantages of Material When Used in the Construction of Bridges and of a Water-Filtration Plant

IN SEPTEMBER the Hydrated Lime Bureau in order to accumulate experiences regarding the use of hydrated lime in concrete offered a series of prizes for short letters setting forth facts developed with the use of the material. It was stipulated that actual experiences must be recorded.

The contest closed Dec. 6 and the judges awarded the first prize ($100) to H. T. Whitney, of Indianapolis; the second prize ($50) to Valentine Godard, of Miami, and the third prize ($25) to F. W. Combs, of St. Louis. The judges were Warren E. Emley, associate chemist, Bureau of Standards; E. J. Mehren, editor of the Engineering Record, and Norman G. Hough, manager of the Hydrated Lime Bureau.

Mr. Whitney described the use of hydrated lime on bridges on the Indianapolis & Frankfort Railroad. Mr. Godard explained how difficulties with a none too satisfactory sand and coraline rock were overcome, while Mr. Combs set forth the extensive use of the material in the St. Louis filtration plant.

The winning letters follow:

By H. T. WHITNEY

Engineer in Charge, Indianapolis & Frankfort Railroad, Indianapolis, Ind.

Hydrated lime is being used by the Pennsylvania Lines in the construction of the reinforced concrete bridges on their new line extending from Ben Davis to Frankfort, Ind.

These bridges include box culverts, spans 10 to 20 ft.; flat-top subways, two sidewalk spans of 12 ft., and street span of 32 ft.; arch spans, 30 to 50 ft.; one arch bridge of three spans, 65 ft. each; one arch bridge of two spans, 55 ft. each—a total of 42 bridges of various types.

With the exception of the small culverts most of the bridges contain from 1000 to 1600 cu. yd. of concrete. The concrete for all the structures of any size is being handled by means of a tower. About ten of these are located at public highways, where a good supply of water could not be obtained except at a considerable expense. The use of hydrated lime enables us to cut down the water and still have concrete flow freely in the spouts.

Several of the flat-top subways are complicated skew spans with numerous corners. The lime has proved very successful in these structures, as it prevented honeycombing and gave a smooth face in parts of the structures that we could not reach to spade. The cost of spading is reduced 50 per cent by the use of lime.

OTHER BENEFITS

The lime makes the concrete more dense and more easily handled after it is deposited in the forms. It is frequently necessary to move a batch to some other part of the form when it has been deposited in the wrong place by the chute. The labor cost for this kind of work has been reduced about 40 per cent by the addition of lime.

On bridges where the reinforcing is closely spaced the lime is of great assistance because it enables us not only to place the concrete easily, but it also prevents the separation of the aggregate when the mixture is being forced between and under the bars with wooden paddles.

Because of the reduction of water in the mixture there is very little rough material deposited on the face, such as will occur when the mixture is very wet and the water seeps through the forms. This feature, together with the material reduction in honeycombing, has reduced the cost of finishing the face after the forms are taken off.

I have no hesitancy in recommending the use of hydrated lime in reinforced concrete. At the present time we are conducting experiments using it in heavy plain concrete, but these experiments are not far enough along to enable me to give you any information.

By VALENTINE GODARD

Resident Engineer for Harrington, Howard & Ash, Miami, Fla.

The city of Miami, Fla., has under construction two similar double-leaf bascule bridges over the Miami River. The lengths are about 300 ft. and the clear openings are 60 and 75 ft. The approaches are reinforced concrete, having arches in one bridge and girders in the other. In the two bridges the total yardage is about 4800, being mostly a 1:2:4 mix. Harrington, Howard & Ash, of Kansas City, Mo., are the consulting engineers and M. F. Comer, of Miami, is the contractor.

The best local sand is not all that could be desired, being too fine and poorly graded as to size, while the coraline limestone used is very irregular in shape, with many cavities to be filled and projections to prevent smooth flowing. If enough water is

added to make the concrete flow, the mixture is too wet to give good strength and there is trouble from the rock occasionally staying in the chutes while the mortar runs out. If the mix is dry enough to give good strength the concrete will not flow and it requires an excessive amount of working in the forms to cover the reinforcing and to give a good surface. At its best the concrete is inclined to be porous and absorb water. The climate is warm with a damp salt air, so that a dense waterproof concrete is required to prevent rusting of the reinforcing steel.

After considering the various waterproofing compounds on the market it was decided to try the use of hydrated lime to overcome the difficulties. Forty pounds of lime was used to each cubic yard of concrete, a very convenient proportion, as half a sack of lime was added to each three-sack batch of concrete. The lime seemed to lubricate the mixture so that with the addition of but a moderate amount of water it would easily flow down the chutes. There was no more trouble from the mortar and the stone separating or from the mixture being too stiff to flow. When in the forms it required little working to thoroughly cover the steel and to give a good surface. The particles of sand appeared to flow over each other easily, so that the resulting concrete was not nearly so porous and the steel was well protected from the corroding influence of the tropical salt air.

The use of hydrated lime has been an unqualified success. It has given smoother flowing concrete, overcome the unmixing of the materials, reduced the amount of working required in the forms, given a better surface, a stronger concrete and protected the reinforcing steel. I am satisfied that it is worth many times its cost. Klyce & Kackley of Miami, consulting engineers on the new $600,000 causeway across Biscayne Bay, observing the beneficial results of its use on the Miami bridges, have specified the use of hydrated lime in the 4000 ft. of reinforced concrete viaduct portion of the causeway.

By F. W. COMBS

Of the McCormack-Combs Construction Company, St. Louis

We submit herein some data and information regarding our experience in the use of hydrated lime in concrete work. Having used this material often in our work, we pick one job, the filter plant at Chain of Rocks for the city of St. Louis, designed by the engineers of the Water Commissioner's Office, Gurdon G. Black, engineer in chief, as the best example in our experience of its effectiveness in waterproofing and in other respects.

The building is 750 ft. long by 134 ft. wide, all reinforced concrete, containing 40 concrete filter boxes, each having a filtering area of 1400 sq. ft. with a capacity of 160,000,000 gal. of filtered water all told per day, built within a basin 800x400 ft., the outer wall of filter building holding a 25-ft. head of water throughout its length.

In the outer wall, and throughout the plant, we used 25 to 40 lb. of hydrated lime to one barrel of cement in a concrete mixture of one part cement to two parts sand to four parts gravel, the wall being 750 ft. by 25 ft. by 1 ft. 10 in. thick and secured a density of concrete practically effective against leaks. The walls and bottom of filter boxes were treated in the same manner, as well as the bottom and walls throughout the entire length, 750 ft., of the influent and effluent conduit, which has dimensions approximately 11x10 ft. Besides giving an acceptable waterproof job, which under the specifications was put up to the contractor to produce, the above mixture produced a fat concrete requiring little working to eliminate porosity, reduced expansion and shrinkage cracks, gave a good surface and greatly facilitated spouting.

We further call attention to two circular tanks 50 ft. in diameter each and holding 175,000 gal. of water each, which were and still are thoroughly tight.

The entire building was poured from one central plant and concrete was easily conveyed through chutes to a distance of 400 ft. and more in a gradual fall of about 4 in 20.

We have used various integral waterproofing compounds, but have found none equal to hydrated lime, properly mixed, for all around effectiveness.

In this work we installed 20,000 cu. yd. of concrete and often used lime where not needed for waterproofing to get a fatty concrete that would not choke chutes in long distance pouring.

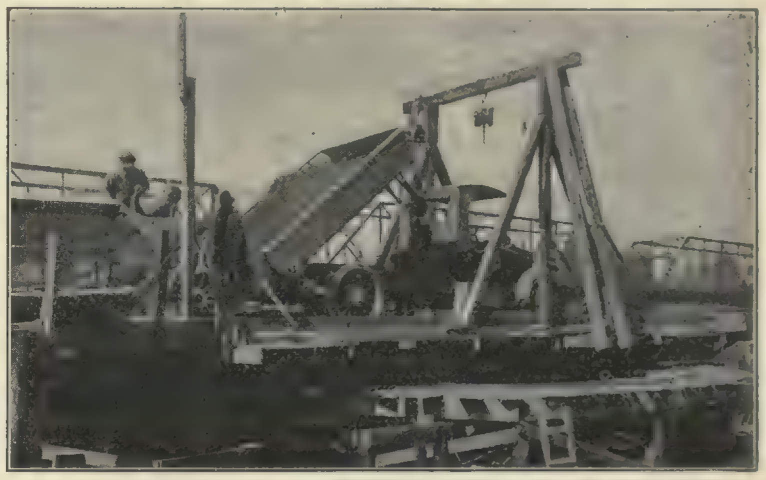
Automobile Maintenance Cost Lowered

The average cost of maintenance and operation of the thirteen automobiles of the operating department of San Diego, Cal., was brought down during the month of October to 3.4 cents per mile, the total mileage being 14,250. These figures are from the monthly report of F. M. Lockwood, manager.

Turntable Dump Saves Time of Motor Trucks

Carrying Dirt from Building Excavation, Trucks Pulled Trailers in Day, While Street Congestion Reduced Speed

THE EFFICIENT operation of a truck fleet, which included the use of gravity loading and the employment of a turntable dump, made possible the disposal of 75,000 cu. yd. of earth in 60 days. James L. Stuart, contractor for this excavation, which was made for the recently opened William Penn Hotel, in Pittsburgh, was able, with the aid of this plan, to complete the excavation 15 days inside of the time named in his bid, and in 30 days less time than the estimate of his nearest competitor. The work is thought to have proved conclusively the value of large units where the speed of travel is restricted. At night, when the three Pierce-Arrow trucks employed could operate without restriction, they were able alone to handle the output of the excavating equipment. In the daytime, however, when their speed was reduced by traffic congestion, it was necessary for each to haul a 3-yd. trailer in order to keep pace with the steam shovels.



Photographs courtesy of the Commercial Vehicle

TRUCKS AND TRAILERS HAUL 75,000 YARDS IN 60 DAYS WITH HELP OF QUICK LOADING AND TURNTABLE DUMP

INDUSTRIAL RAILWAY DELIVERED MATERIAL TO STREET

It was necessary to work 20 hours a day in order to complete the excavation within the required time. A revolving steam shovel inside the lot took out the material, loading it into industrial cars which dumped into large elevator skips, that in turn were hoisted up an incline and dumped into the trucks. The average time required to load a truck was half a minute, and the average round-trip time for the three trucks for the 60 days was 15 minutes. The distance covered within this time was 1.15 miles. During the day a longer time was required for a round trip, but at night the trucks alone operated at a much faster rate, one record of seven minutes having been made. The haul loaded was downhill to a dock at the river front.

TURNTABLE DUMP SAVED BACKING

The specially built, rubber-tired trailers used were bottom-dump, and the trucks were equipped with a hydraulic dumping device, so that even less time was required to discharge than to load. The end of the trestle at the dumping dock consisted of a turntable long enough to hold both the truck and the trailer. When the units had run on the turntable and dumped, it turned

them around so that no time was lost in backing and turning the trucks.

Including stops, the trucks averaged 13 miles per hour at night when the streets were clear. In the daytime, however, no more than 8 miles per hour could be made. Each truck averaged 80 trips, or 92 miles per 20-hour day. Delays from mechanical trouble were avoided by having a night inspector, who went over each truck and kept everything in adjustment during the four hours' rest between the night and morning shifts.

Bid on Concrete Building $67,000 Less Than Steel

Columns of Chattanooga Structure Built of Rich Concrete and Carried to Rock Foundation by Piers Poured in Open Wells

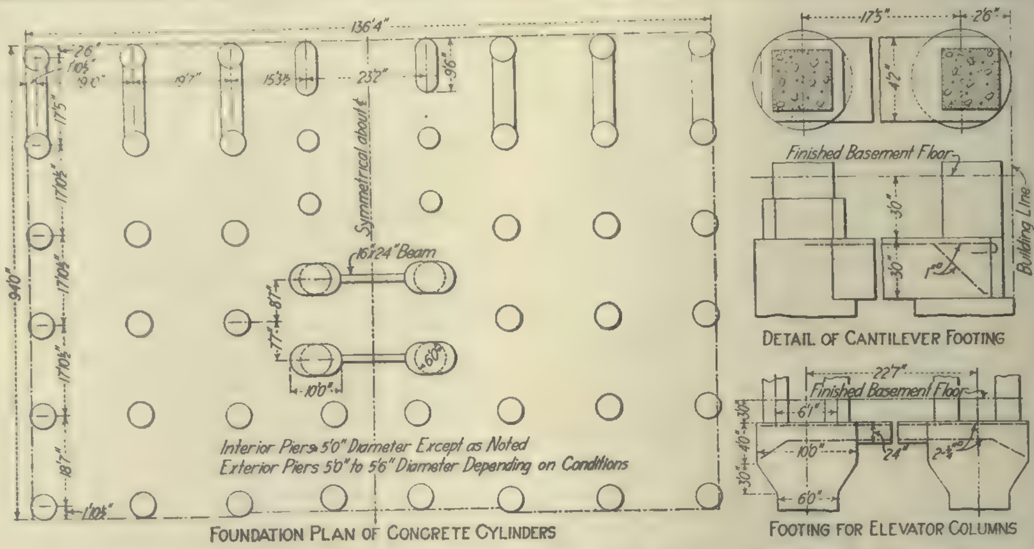
SINKING unbraced open wells through clay soil for varying depths up to 30 ft. to a solid-rock foundation and lining them with concrete was found to be more economical than using spread footings, at the same time eliminating the danger of uneven settlement, according to the consulting engineer for the new twelve-story building of the Volunteer State Life Insurance Company at Chattanooga, Tenn. The specifications for this building were prepared with the purpose of allowing alternate bids on six different types of design. The contract price for the reinforced-concrete skeleton type, using a rich mix and vertical reinforcement for the columns, was $67,000 less than the lowest bid on the structural-steel frame type, using terra-cotta flat-arch floors. Part of this striking decrease in cost was due to the present high prices for steel and part to the relatively low cost of concrete materials and labor in Chattanooga. In order to profit by the low cost a rich mix, with comparatively small percentages of steel without spirals, was used in the design of the columns.

Concrete Cylinders to Rock

The building is 94 x 136 ft. in plan, located at the corner of Ninth Street and Georgia Avenue. At this site a stiff clay soil was found, overlying a sloping rock ledge to depths varying from almost nothing at the basement level at the south or Georgia Avenue end up to 30 ft. below this level at the opposite end. The problem thus arose whether to carry column loads partly on solid rock and partly on spread footings or whether to concrete to solid rock for all columns.

Owing to the nature of the soil, which was found stiff enough to stand vertically without any sheathing or bracing, and to act as a form for concrete, it was decided to dig circular wells to rock, then fill with concrete to a level of 3 ft. below the finished basement floor and carry the square columns on these cylindrical piers. The rock in the bottom of all wells was tested by drilling 4 ft. This scheme worked out economically, the cost being less than spread footings. No shoring whatever was used, except that in certain places a removable steel shield was lowered to protect the workmen against the danger of a cave-in.

The accompanying plan and elevations show the layout of these foundations, also details of cantilever footings along the rear wall and of beams connecting the footings with flared caps, which carry the double elevator columns. The cantilever beams



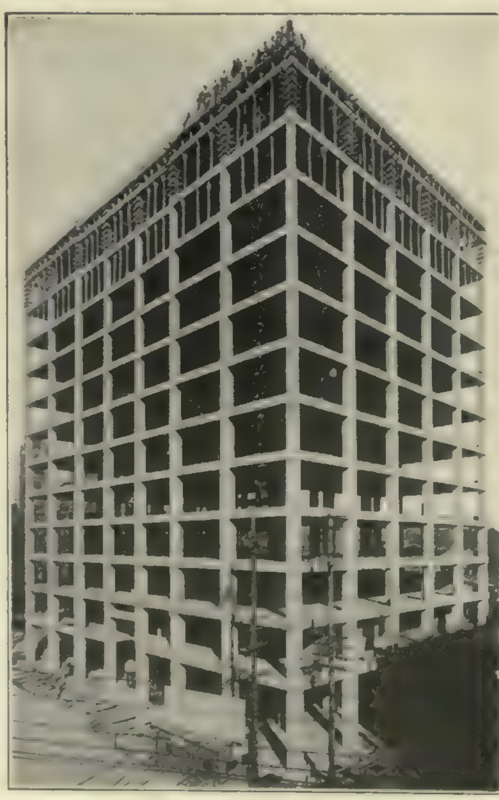
COLUMN FOUNDATIONS OF CIRCULAR PIERS TO SOLID ROCK—CANTILEVER FOOTINGS

were necessary because it was impossible to center the supporting cylinders under the columns along this rear wall without encroaching on adjacent property and disturbing an existing party wall.

Six Different Bids

The specifications were drawn to invite bids for the structure above the foundations on six different types of design—(1) structural steel skeleton with terra cotta flat-arch floors; (2) structural-steel skeleton with reinforced-concrete and terra-cotta slabs; (3) reinforced-concrete skeleton with either reinforced concrete and terra cotta or metal floor slabs; (4) structural-steel frame with reinforced-concrete and metal-floor slabs; (5) structural-steel-concrete construction, "M-system" of the Standard Concrete Company, and (6) Metropolitan Fireproofing Company's system.

The lowest bids for each design were as follows: (1) $139,000; (2) $138,000; (3) $72,000 for the reinforced-concrete frame and terra-cotta floor slabs (awarded contract), and $69,000 with metal floor slabs; (4) $127,000; (5) $147,000, and (6) $155,000. The excess of $3,000 paid above the lowest bid was considered a good investment because the lower bid was based on using metal tile and expanded metal ceilings. The terra cotta was believed to be worth the difference on account of the impossibility of rust and no uncertainty as to its behavior when subjected to fire.



COMPLETING CONCRETE SKELETON OF TWELVE-STORY BUILDING IN CHATTANOOGA

Rich Mix Used

The principal element of economy in the adopted design lies in the use of a rich 1:1:2 mix in the columns up to the tenth floor, with a minimum of about 0.7 per cent of gross area of vertical reinforcement, and no spiral steel. The mix above the tenth floor was 1:1.8:3.7, and in the foundations the proportions were 1:2½:5. The largest columns are 42 x 42 in. in the basement, 36 x 36 in. in the first story with twenty-six 1-in. rods and 14 x 16 in. at the top, with four ¾-in. rods. All column ties are ⅜ in. round on 12-in. centers; the vertical rods lap 15 in. at splices, and dowels are 3 ft. long.

The construction proceeded at a rate of one floor a week, without night work. The foundations were built on a percentage basis before the contract for the superstructure was let. The Southern Ferro Concrete Company, of Atlanta, Ga., is the contractor for the reinforced-concrete skeleton. E. L. Meaders is superintendent, representing the owners, and William C. Spiker, their consulting engineer. The H. D. Watts Company, of Atlanta, has the general contract for the building, which will be the home office of the Volunteer State Life Insurance Company. Barnwell & Barnwell, of Chattanooga, are the architects.

Use Hardeners in Experimental Concrete Road in Louisiana

In an experimental concrete road in Louisiana at Baton Rouge there were applied to various sections hardeners of two types and hydrated lime. The concrete for this 9-ft. slab was a 1:1½:3 mix, and 10 per cent of hydrate lime was used in the last 600 ft. It produced a more dense and homogeneous mass and made the mixture more plastic and easier to work, according to W. E. Atkinson, state highway engineer, in his latest annual report. The curing was done under water and an unusual degree of hardness and toughness was obtained, so that the slab has shown few signs of chipping even on the edges of the pavement. To two 400 ft. of finished surface "Agatax," a liquid preparation, and Trus-Con Ironite Flooring, a metallic powder, were applied.

In a Good Dredge Crew Men Are Trained to Fill Positions Above Them

Attention to Men's Comfort and to Fact That the Average Man Will Not Stay Without Prospects of Advancement Increases Efficiency

By ARTHUR M. SHAW
Consulting Engineer, New Orleans, La.

[THIS IS THE SECOND *of a series of articles telling how dredging work is successfully conducted. The first article, published last week, dealt with the proper selection and use of the equipment. The third, to appear next week, will outline ways of keeping in close touch with the work.*—EDITOR.]

ATTENTION must be paid to the human element by anyone who expects to make a success of dredging work, as on it depends to a large degree the efficient operation of any type of dredging machine. This statement applies more closely, perhaps, to dredging work than to other classes of construction because of the smallness of the crews, the specialized duties and relative importance of each man and the less favorable living conditions in the way of isolation. Because of these conditions it pays to select men carefully and to train each man for the position above him, not only to avoid stopping the dredge every time there is a change in the crew but to let each man understand there is a better job ahead of him which it will pay him to stay and work for. Good meals and comfortable quarters, to which a reading room is an inexpensive but highly profitable adjunct, are also important considerations from this standpoint.

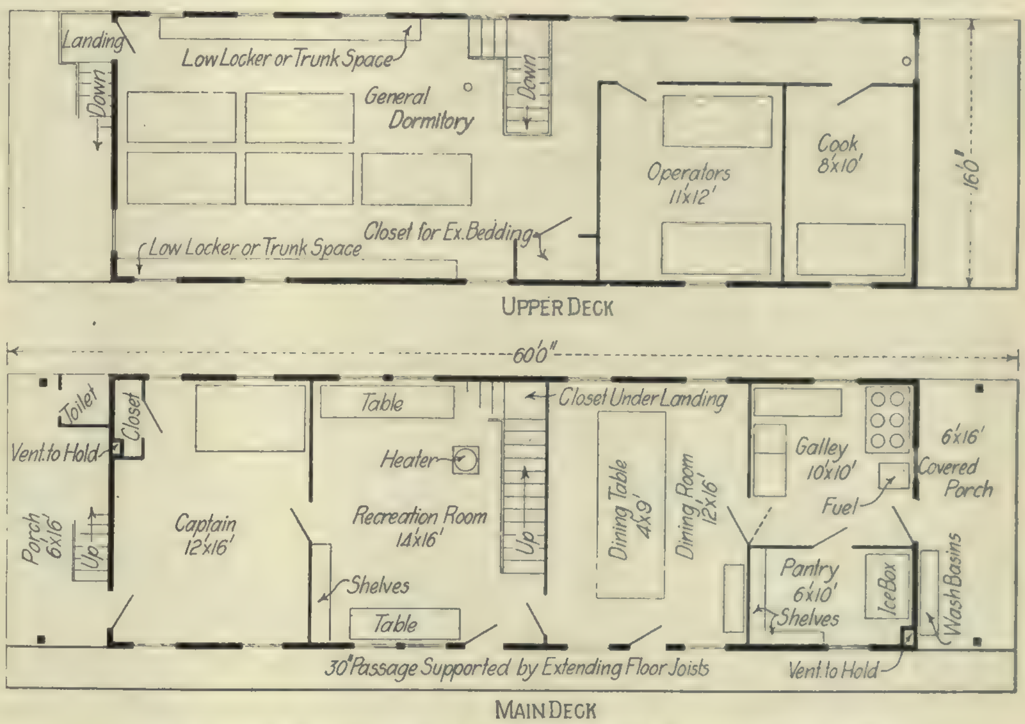
EACH MEMBER OF DREDGE CREW IMPORTANT

Special conditions, such as class of available labor, character of work and size of the dredging unit, largely dictate the organization to be adopted. The organization on an individual dredge will also be affected by its relation to other units under the same control. An isolated plant will require a higher grade man in direct charge than will one which is working in the vicinity of other dredges, all under the general supervision of a competent superintendent.

On a small dredge such as was described in the article on page 730 of the Engineering Record of last week, working as an independent unit, the writer has found the following organization well adapted to handle ordinary work, running on double shift: One superintendent, two operators, two firemen, two deckhands, one cook, one motorboat man and other labor as required for handling fuel, etc.

The superintendent has no fixed routine, but in addition to having general supervision of the plant and its operation he makes the more important repairs, acts as timekeeper and occasionally relieves the operators for short runs. So much depends on the ability and energy of the man in charge of such a plant that the greatest care should be exercised in his selection. He should not only be a good machinery man, with broad experience in making emergency repairs, but he should have good administrative ability. The handling of a small crew of men on a dredge may not appeal to most people as requiring administrative ability of a high order. Such a man, however, must not only keep account of his supplies, repairs required, time of men, amount of work done, condition of equipment, etc., but he must also act as buffer between employees and employer, control to a certain extent the menus served to the men, watch their health and often settle their personal differences, sometimes by moral suasion and at other times by force. He should be so familiar with the limitations and possibilities of breakdowns of his equipment that the occasion will be rare on which he will not be ready with new parts to replace any which may break, so that operation may be resumed with the least possible delay.

In addition to an ability and inclination to do their work efficiently, the operators should have, or acquire, such qualifications as may fit them for advancement to the position of superintendent should the occasion arise. In fact, every man in the organization, with the exception of the cook, should receive training and practice in the next position above that in which he is regularly engaged so that he will be in line of promotion. By following such a plan a dredging outfit need seldom be shut down because of illness or disability of any of the crew. Carrying such extra operators and other help does not add materially to the labor cost. It will often result in a better spirit among the men if those who have qualified for a higher position are recognized by a slight advance in wages and considered as extra operators, etc. This extra compensation should cover any apprentice work which they might do and short runs to relieve regular men, but as soon as they are advanced permanently the raise to higher pay should take effect. Any man who has not the ambition to advance is not worth keeping on the force.



NINE MEN MADE COMFORTABLE ON SMALL BARGE BY TWO-STORY HOUSE

The fireman, in addition to the ordinary duties attached to such a position, should take general charge of such machinery as may not be under the direct observation of the operator. At least one of the firemen should be qualified as an extra operator.

The deckhand is the general utility man. He assists in all repair work, helps in the care of machinery and does most of the cleaning up around the dredge. He should be given charge of the tool equipment and required to see that all tools are returned to their proper places as soon as the work on which they have been used is completed. While acting as helper on repair jobs he should gain a fair knowledge of blacksmithing, care of tools and other details which will be valuable to him as he advances.

GOOD MEALS WORTH CAREFUL ATTENTION

With proper conveniences, one cook should be able to prepare all meals for a crew of the size specified. He should provide wholesome food with ample variety. He should appreciate the difference between a generous and a wasteful table. A large stock of canned goods and dry vegetables should be kept on hand to provide against the inevitable breakdown in the supply line; but the cook should realize that food supplies may be obtained from other sources than tin cans. Where fresh vegetables and other supplies can be secured locally, the cook should be given reasonable latitude in making purchases to vary the menu. He should be required to render an account of the number of meals and lunches served each day. If the writer were not aware of the futility of putting such a clause into the specifications, he would also stipulate that the cook should have "a sweet and gentle disposition and an even temper."

Most floating dredges and some land dredges are served by power-boat tenders. These are usually gasoline launches and are used for hauling fuel and supplies and for towing. One man, with such assistants as he may require, should have entire charge of these boats and be responsible for their being in condition to give efficient and dependable service.

QUARTERS MERELY FOR EATING AND SLEEPING NOT SUFFICIENT

No attempt should be made to handle work of importance without providing comfortable and pleasant quarters for the men.

This should go farther than giving them just room enough for sleeping and eating. While the ordinary dredging job will not justify the installation of the elaborate libraries or clubrooms which have been furnished in some notable contractors' camps, some comfort and entertainment can be provided for the men even in the smallest camps and houseboats. Where, as is frequently done, camps for floating dredges are built on barges which have been discarded from other service, cramped quarters are likely to result. In such cases the necessary space may be provided by the construction of two-story camps. A barge 16 x 60 ft. will give ample facilities if the house has two stories. Although a wider barge would be preferable to insure stability and for other reasons, a barge of the above-mentioned dimensions will be sufficiently stable for use in all but open waters. Barges having a width greatly exceeding one-fourth their length are difficult to tow.

Double-Deck Barges Advantageous

Double-deck barges are hard to handle in a heavy wind, but the advantages which they offer are considered sufficient to outweigh such objections. The house should be built the full width of the barge and 48 ft. long, leaving an open deck 6 ft. in width at each end. A walk should be constructed along one or both sides of the barge for its entire length. This may be carried on an extension of the floor joists. The lower floor should be divided into a kitchen, pantry, dining room, reading room and captain's quarters. The stairway to the second story should come up from the reading room. The second story may be divided into separate rooms for the cook and operators, with a large dormitory for the other men, or, in hot climates, may be left as a single large room. The latter plan provides better sleeping conditions on account of allowing free passage of air. By placing a double row of double-deck bunks down the center of the dormitory, all windows may be left unobstructed and the space below them used for storing trunks or placing lockers, with room for hanging clothing on the wall between the windows. The double-deck bunks now on the market are both comfortable and serviceable. They are easily kept free from insects, an impossibility with wooden bunks.

Men Will Provide Own Literature

The reading room should be furnished with comfortable chairs, a large table for magazines and one or two writing desks. The management may well supply a reasonable amount of reading matter, such as a daily paper and one or two magazines, though if furnished with suitable facilities the men will provide themselves with such reading matter as they may require. The assortment of literature brought in by such men is interesting in its diversity. Included in such a list may be found poetry, light fiction, magazines, correspondence-school text books (especially those pertaining to mechanical drawing), machinery and tool catalogs and almost invariably catalogs of mail-order houses. Magazines, either new or back numbers, are especially favored.

In addition to the essentials, the captain's room should have a desk in which may be kept his time books, report forms and other supplies pertaining to his position. If he shows any aptitude at making drawings, a small drawing board with T-square, triangles and scale should be supplied. These implements, even in the hands of a novice, often enable him to give a clearer idea of repair parts which may be required than could be given by a bare written description.

An emergency cabinet should be kept in the captain's room and he should be instructed in its use. A very good outfit, packed in a metal case, may be secured for about six dollars.

By giving proper attention to the arrangement of its equipment, the kitchen may be made small. All reasonable conveniences, however, should be provided. Cheap stoves are a continual source of expense and annoyance and an element of danger. The heavy stoves such as are used in ocean-going vessels will be found more satisfactory than the cheaper substitutes.

A little attention to the comfort and welfare of the men forming a dredge crew is amply repaid in better service secured and greater freedom from continual changes in personnel. While it is true in some instances that men do not "appreciate decent treatment," as some employers complain, it is a fact that the average employee, especially of the grade of men making up a dredge crew, will give consideration to the efforts of his employer to improve the conditions surrounding the work.

Road Resistance Tested by Motor-Truck Runs

Results of Experiments Show Relative Values of Many Types of Surfacing for Delivery-Wagon Service

As the result of tests of the resistance offered to a ½-ton electric truck by different types of surfacing on level urban roads A. E. Kennelly and O. R. Schurig, in Bulletin 10 of the research division of the Massachusetts Institute of Technology, present the following enumeration of pavements in the order of their desirability for vehicle operation from the point of view of tractive resistance at a speed of 12.4 miles per hour: (1) Asphalt, (2) wood block, (3) hard, smooth macadam, (4) brick, (5) granite block with cement grouted joints, (6) cinder, (7) gravel, and (8) granite block with sand-filled joints. The experiments, which were first reported to the American Institute of Electrical Engineers, were such as to represent average conditions for ½-ton delivery-truck service with solid-rubber tires. Runs were made over selected stretches of road at nearly constant speed regulated by the controller, and successively in both directions for each controller point, thus covering a range of speeds. In reporting the results the authors state that tractive resistances are most conveniently expressed as equivalent percentage grades. In other words, a level road of definite tractive resistance may be regarded as a road of zero tractive resistance, but rising x units in 100 units of road length, or having an equivalent grade of x per cent.

Typical results for all classes of urban roads are summarized graphically in Fig. 1 and numerically in the table. It appears from these summaries that there are three principal elements which determine the tractive-resistance-speed curve for unit weight of a given vehicle, within the range of conditions covered by this test:

1. A constant resistance (see curve 1, Fig. 2) the magnitude A of which depends on the lack of resilience of the road surface and wheel tire material—that is, on the energy losses due to displacement of tire material and road-service material. This constant element A would be encountered upon a smooth level road of the particular type considered, in the absence of impact, air and wind resistance.

2. An increasing resistance with increasing speed, due to impact losses (Fig. 2, curve 2), which results from lack of smoothness of road surface. Losses of this nature are usually known to vary approximately as the second power of the velocity at impact.

Air Resistance

3. An increasing resistance with increased speed, due to air pressure against the front of the vehicle (Fig. 2, curve 3). This resistance is known to depend, roughly, on the second power of the speed. The sum of three curves of items 1, 2 and 3, for the case of asphalt roads, results in curve 4. The constant resistance, item 1, may be briefly called the displacement resistance, item 2 the impact resistance, and item 3 the air resistance. The displacement resistance is low for hard pavements and high for soft pavements of low resilience. The impact resistance is very marked in granite-block pavements. The air resistance, at any definite velocity, is the same for all curves, because the air-resisting parts of the truck were left unchanged throughout the tests. For the particular type of road represented by Fig. 2 (asphalt road in poor condition) at a speed of 12.4 miles per hour, the displacement resistance is equivalent to a grade of 0.84 per cent, the air resistance to a grade of 0.11 per cent, impact resistance to 0.20-per cent grade and the total to 1.15-per cent grade.

The displacement resistance of a road varies not only with the type and surface quality of the road, but also with the type,

Summary of Tractive Resistances of Different Urban Roads at Different Speeds
(All tractive resistances are expressed in equivalent per cent grade)

Road		Equivalent Grade, Per Cent		Per cent increase in tract. resist. from 10 to 12.4 mi. per hr.	Comparative Tractive Resistance Referred to Asphalt Roads	
Type	Condition	At 10 mi. per hr.	At 12.4 mi. per hr.		At 10 mi. per hr.	At 12.4 mi. per hr.
Asphalt	Good	0.93	0.97	4	1.0	1.0
Asphalt	Poor	1.03	1.16	11	1.11	1.20
Wood block	Good	1.10	1.15	5	1.18	1.18
Brick	Good	1.12	1.21	8	1.20	1.25
Brick	Slightly worn	1.14	1.27	11	1.23	1.31
Granite	Good	1.83	2.16	18	1.97	2.23
Granite, cement joints	Good	1.16	1.37	18	1.25	1.41
Macadam, waterbound	Dry and hard	1.06	1.17	10	1.14	1.20
Macadam, waterbound	Fair, heavily oiled	1.63	1.76	8	1.75	1.82
Macadam, waterbound	Poor, damp, some holes	1.65	1.89	15	1.78	1.95
Tar macadam	Good	1.17	1.27	9	1.26	1.31
Tar macadam	Very soft	1.67	1.76	5	1.80	1.81
Tar macadam	Many holes, very poor, soft	2.38	2.75	16	2.55	2.85
Cinder	Fair, hard	1.25	1.39	11	1.35	1.43
Gravel	Fair, dusty	1.37	1.50	9	1.47	1.55

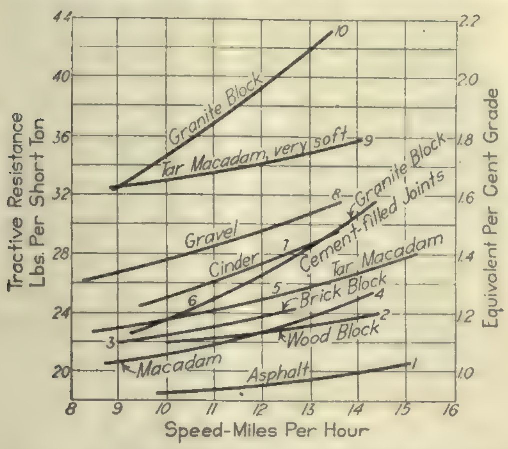


FIG. 1—SUMMARY OF TRACTIVE RESISTANCE TESTS FOR VARIOUS TYPES OF SURFACING

dimensions and quality of the tires on the wheels of the vehicle. In the tests here reported the same tires were used throughout, and they remained in substantially the same condition.

The impact resistance of a road depends not only on the type and surface quality of the road and the sizes of its irregularities, but also on the type, dimensions and quality of the wheel tires, the weight of the truck, and the quality of its springs.

The air resistance per unit weight of truck depends upon the weight, dimensions and shape of the vehicle, as well as on the direction and velocity of the wind and the velocity of the vehicle. It is assumed that at low wind and vehicle speeds, like those here considered, only that component of the wind which is in the direction of the vehicle's path needs to be taken into account, and that the mean of the wind resistances in opposite directions, along the road, is zero.

The following studies are suggested for future experimenters along the line of this investigation: (1) Researches on vehicle tractive resistances on country roads; (2) tractive resistances to vehicles with different wheel tires; (3) tractive resistances of urban roads at low speeds from 0 to 10 miles per hour; (4) tractive resistances at speeds higher than 15 miles per hour; (5) tractive resistances for heavy-duty trucks

SUMMARY OF CONCLUSIONS

The displacement resistance varied from 0.85 per cent equivalent grade, for a hard, smooth asphalt or bituminous concrete, to 1.6 per cent for a very soft tar-macadam road, and was practically constant, for all speeds considered, on any given road.

The impact resistance increases with the velocity, with the total weight of vehicle, and with increasing road surface roughness. In these tests the impact resistance of good asphalt or Bitulithic or other smooth pavement was practically negligible, and reached its highest values on granite-block roads with sand-filled joints, and on badly worn macadam pavements. The rate of increase of impact resistance with speed was most marked on the roughest roads.

At the vehicle speed of 12.4 miles per hour the air resistance for the vehicle tested, assumed to be dependent only on the speed, was roughly 0.11 per cent equivalent grade—that is, from 4 per cent of the highest to 12.5 per cent of the lowest total tractive resistance.

The equivalent grade at 12.4 miles per hour of a badly worn city macadam road was found to be nearly three times as great as that of the best asphalt road tested.

Increasing the gross weight of the vehicle by 12 per cent, through load, was found to have no effect on tractive resistance within the observed speed limits for smooth roads in good condition; but on rough roads a distinct increase in tractive resistance with this extra weight was observed.

The presence of a layer of dust, say 1 cm. thick, on a fair macadam road was found to increase the equivalent grade of tractive resistance, at all tested speeds, by about 0.15 per cent.

A freshly tarred, and therefore very soft, tar-macadam road was found to have an increased tractive resistance equivalent, at substantially all tested speeds, to about 0.5 per cent. The tires in this case sank about 0.8 in. into the road bed, the gross car weight being 4710 lb.

The total range of tractive-resistance equivalent grade covered in the tests was from 0.93 per cent on the best asphalt road, at lowest speed, to 2.7 per cent on the worst macadam road, at nearly the highest speed.

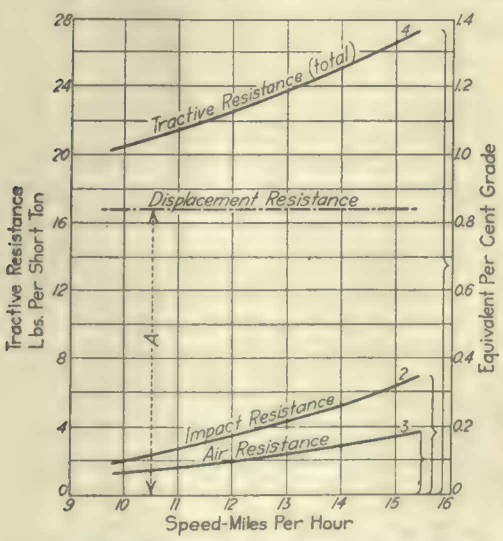


FIG. 2—ANALYSIS OF TYPICAL TRACTIVE RESISTANCE INTO ITS ELEMENTS FOR ASPHALT ROAD IN POOR CONDITION

Retaining-Wall Formula Corrected

An error due to inadvertence on the part of the draftsman was made in Case 3 of Table 1 of T. A. Smith's article on retaining-wall formulas appearing on page 564 of the issue of Nov. 4. The value of A should be $7y/2 + 2t$ instead of $y/2 + 2t$.

Tractor and Trailers Haul 136 Tons of Ore in 5½ Days

Thirty-Two-Mile Round Trip Over Rough Road Through Utah Mountains Made Twice a Day with Loads Under Perfect Control

ANOTHER demonstration of the fact that motor-traction equipment may be relied on to solve the transportation problem where large tonnages must be transported through territory in which railroad construction is extensive was afforded recently, it is reported, in the Big Cottonwood district of Utah by the gasoline trailer outfit shown in the photograph. This equipment was used in an eleven-trip demonstration, during which 272,660 lb. of ore was hauled 16 miles from the Cardiff Mines to Sandy, and 27,080 lb. of coal was hauled to the mine on the return trip. The ore bins at the mines where the trucks are loaded are 3050 ft. above the smelters at Sandy, 16 miles distant, and the greater part of the rise occurs in the last 9 miles of the trip, the lower 7 miles of the road being across a fairly level valley. Two round trips a day were made over this route, with a total of 3 hours to spare for inspecting and oiling the equipment. During the demonstration the gasoline consumption averaged 21 gal. per round trip, and the oil used averaged 2 quarts.

OUTFIT AVERAGED 10.4 MILES PER GALLON OF GASOLINE HAULING ORE IN ROCKIES

It is stated that in spite of the great rise, including one grade of 16 per cent, and in spite of the fact that as much as 4300 lb. of coal was hauled on several of the return trips up grade, it was not necessary during any of the demonstration trips to add water to the radiator on account of heating. The equipment with which the demonstration was made consisted of one Knox tractor equipped with a 5-ton ore body and two rubber-tired Troy trailers, each with a capacity of 5 tons.

Equipment of this type is now being used exclusively by the United States Transportation Company, which hauls the ore from these mines on contract. Teams had formerly been used for this purpose, and it is stated that single-unit motor trucks had been tried before the present equipment was decided on. The tractor outfit handles a much larger tonnage with one power unit.

Unified Traction Plan for Chicago Will Pull Out Sides of Elevated Loop

Nine-Year Program, Involving $100,000,000, Laid Out by W. B. Parsons, Robert Ridgway and B. J. Arnold, of Traction and Subway Commission

UNIFICATION of all traction facilities in Chicago, revamping of the present elevated system into a complete rapid-transit system, and a "pulling out" of the loop in all directions are probably the three fundamental considerations which have governed the $250,000 Chicago Traction and Subway Commission in its study. William Barclay Parsons, Robert Ridgway and Bion J. Arnold are the members of the commission; Henry M. Brinckerhoff is the chief engineer, and Herbert Evans is the secretary. Only the general plans and conclusions are available; the great mass of supporting data will come later in a supplemental report. The following abstract is taken from the advance proofs of the commission's report. The work of construction is divided into three consecutive periods. At the end of the ninth year, when $100,000,000 shall have been spent, the results will be as follows:

Results of Immediate Construction

1. Conversion of the elevated lines now giving principally local service into structures capable of furnishing extended high-speed express service.
2. Amplification of main lines and terminals, giving two and one-half times the present maximum rush-hour capacity.
3. Rapid-transit routes giving transfers between all outlying parts of the city without the present necessity of passing through the Loop district.
4. Two-way operation on the Union Loop and on all other rapid-transit routes, with direct transfer to all parts of the city.
5. The expansion of the Loop district in all directions.
6. The elimination of five grade crossings on the elevated structures.
7. Improved stub terminal rush-hour service from three sides of the Union Loop.
8. Extensive outlying territory given rapid-transit service directly or by transfers from the surface lines.
9. Subways carrying most of the West Side surface cars underground through the Loop district to Michigan Avenue, thus removing them from the surface of the street and thereby reducing congestion.
10. Surface-car subway from the south, reducing congestion on State Street and Wabash Avenue and connecting with the West Side subway, providing a much-needed service directly connecting the main railroad stations.
11. All transfer facilities as they now exist to be maintained and in addition transfer facilities between surface and rapid-transit lines are to be given for an additional charge over the present single fare or considerably less than the sum of the two fares now paid.

Limitations of Loop District Removed

It will be seen that while all the facilities to the district now known as the Loop have been preserved, the limitations due to transportation in this district have been removed, and that its extension has thereby been facilitated in three directions—north, west and south. Not only does the new system provide for greatly increased through running, but facilities for delivery have been provided into new districts north and west of the river and south of Van Buren Street, into which the business of the so-called Loop is now tending to spread and which spreading will be encouraged if satisfactory facilities are afforded. The expansion of this district will be of benefit not only to the localities named, but to Chicago as a whole.

Present and Proposed Loop District

The area now directly served by the Union Loop tracks is about 1½ sq. miles. The system of tracks proposed in this report will at once broaden the downtown district in three directions to over five times the present area. The straightening of the river would open new thoroughfares and would materially assist in solving Chicago's transportation problems.

Starting with present traffic conditions, the study of the city's future transportation needs has been made in an effort to so adjust the plans for immediate improvements as to meet future probable developments and stimulate growth in desirable directions.

On the elevated lines, for a complete twenty-four-hour period, tickets were issued to all passengers at points of origin and collected where they finally left the system, thus tracing the entire trip of each passenger, including the transfer from one line to another. The patrons of the lines co-operated to such an extent that 499,826 passengers were separately identified on a single day, or 93.5 per cent of the total travel on the day in question.

What Traffic Checks Show

The traffic checks show that 60 per cent of the total elevated-railway passengers are handled between the hours of 6 to 9 a. m. and 4 to 7 p. m.; that 63 per cent of the total passengers in twenty-four hours are hauled to and from the Loop district, while 25 per cent of the total travel originates and ends on the individual lines. Only 12 per cent of the total all-day and rush-hour elevated passengers ride through or transfer across the Union Loop, the percentage of total traffic during the rush periods being less than this figure. The average length of journey is found to be 6.48 miles, which is a much longer distance than the average haul on the elevated and subway lines in New York; the former being 4.16 miles and the latter 5.57 miles (calculated from 1915 ticket sales).

On the surface cars, checks were made covering the principal lines on which more than three-quarters of the total surface traffic is carried, and including the tracing of all passengers individually to the points where they first transferred, and of all large transfer groups through points of transfer to their destination.

A combination of the haul on originating lines with the transfer haul indicates that the average journey of the passengers carried on the surface lines for a single fare was 4.16 miles. This also is in excess of the length of the average ride in other large cities.

A canvass was made of the industrial and commercial establishments having more than 100 employees as to their residential and occupational locations. Of the total of 350,007 employees located, 23.9 per cent are found to live within walking distance of their places of employment. Deducting this percentage from the total and assuming that the remaining 76.1 per cent ride twice daily to and from their places of employment, it is found by a comparison with the total rush-hour traffic of the surface and elevated lines that we have definite information upon 50 per cent of the traffic. The importance of this is shown by a study of the charts developed, which indicate clearly the districts to and from which transportation is distinctly lacking and the districts that must be reached by circuitous or indirect routes. It is believed that this determination of 50 per cent of the rush-hour business is so truly representative as to be a very safe basis upon which to analyze the present traffic conditions as to origin and destination.

Results of Location Canvass

The results of the various investigations covering the characteristics of the traffic on the surface and elevated lines, as well as the residential and occupational location of rush-hour travelers, clearly point to the fact that the present prevailing transportation characteristic of Chicago is that of a city with a central delivery district of relatively small area and a number of minor delivery districts widely separated from this principal district.

Into the Central district, which has an area of 5 sq. miles, 48 per cent of the 350,007 workers located are delivered daily. As this district is only 2½ per cent of the total area of the city, the degree of concentration is seen to be very marked.

Extending this area progressively north, south and west, so as to include various districts of increasing size, it is found that into 23 sq. miles bounded on the north by Diversey Parkway, on the south by Twenty-sixth Street, and on the west by California Avenue, 63 per cent of these rush-hour travelers are delivered, this district being 11.5 per cent of the city area.

Analysis of Median Lines

Following this idea in another connection, an analysis was made of the median lines of residence and of occupation. If on a map of Chicago a line is drawn, located so that there are just as many people living due east of any point along it as due west, the line drawn is the median line of residence. Such a line will be found to be practically parallel to the lake front for the whole distance and from 2 to 3 miles west of it. A similar line drawn so that the number of people working due east of each point is the same as those due west would be the median line of occupation. Everywhere except at the middle the median line of occupation follows the same general direction as the median line of residence, but at the middle it bulges sharply toward the downtown business district until it almost touches the edge of the Loop. This is due to the ever-growing volume of business transacted in the downtown district and to the light manufacturing district increasing so rapidly at its edges.

With this district continually growing, the population is steadily moving westward. In time the bulge may be expected to become greater as the population curve

travels westward, although as the downtown district grows north and south, the bulge will widen out at the ends and become less abrupt.

The bulge in the occupational median shows clearly why so many West Side lines have to focus into the downtown district, while the closeness of the occupational and residence curves at the ends shows why special routing is not generally required in those localities.

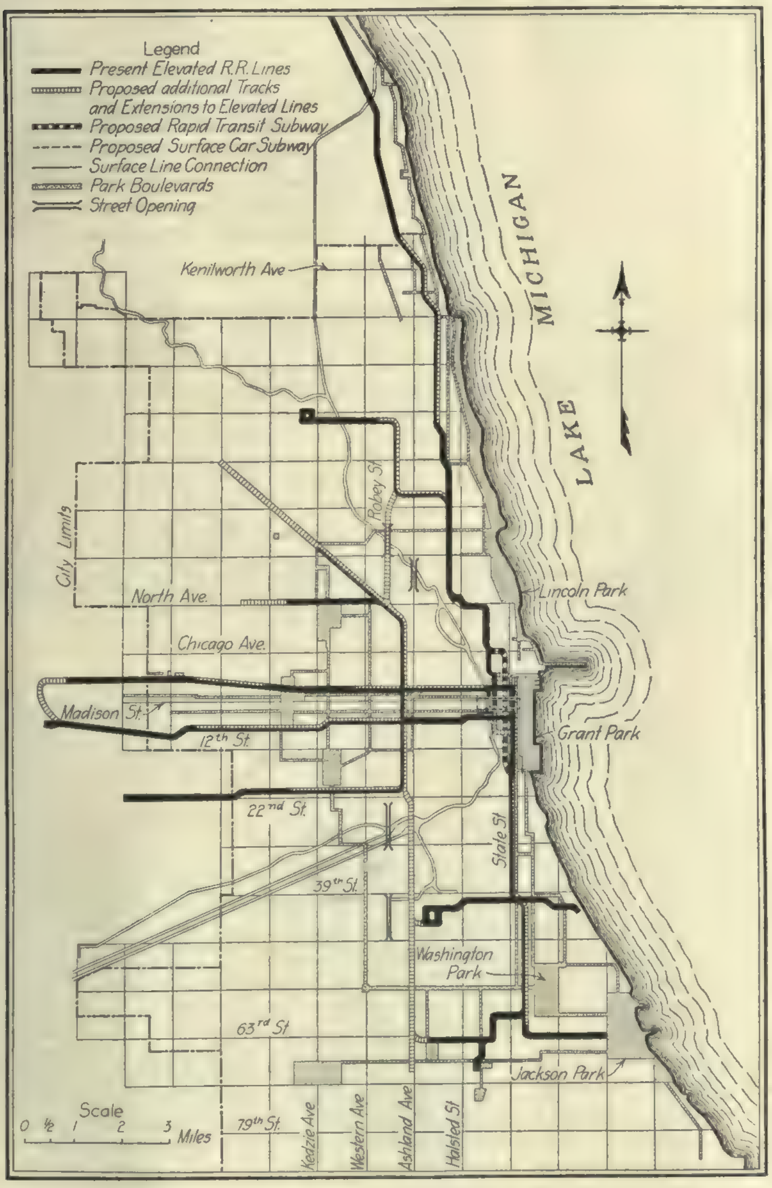
An analysis of the occupational distribution north and south of a median line shows this line passing in a general way east and west through the center of the Avenue, and State Street, and also north and west of the river. Of the 115,085 employees located by the survey in this original Loop district, 36 per cent were found outside of the elevated Loop structure.

The term "Loop district" refers to the area south and east of the river and north of Polk Street, while the term "Central business district" applies to the wider area which at present extends from Division Street to Twelfth Street and from Lake Michigan to Racine Avenue. The Loop district is rapidly expanding into the Central business district, and that district will in the future expand beyond the limits stated to the lakefront as practicable by subways in the Loop district.

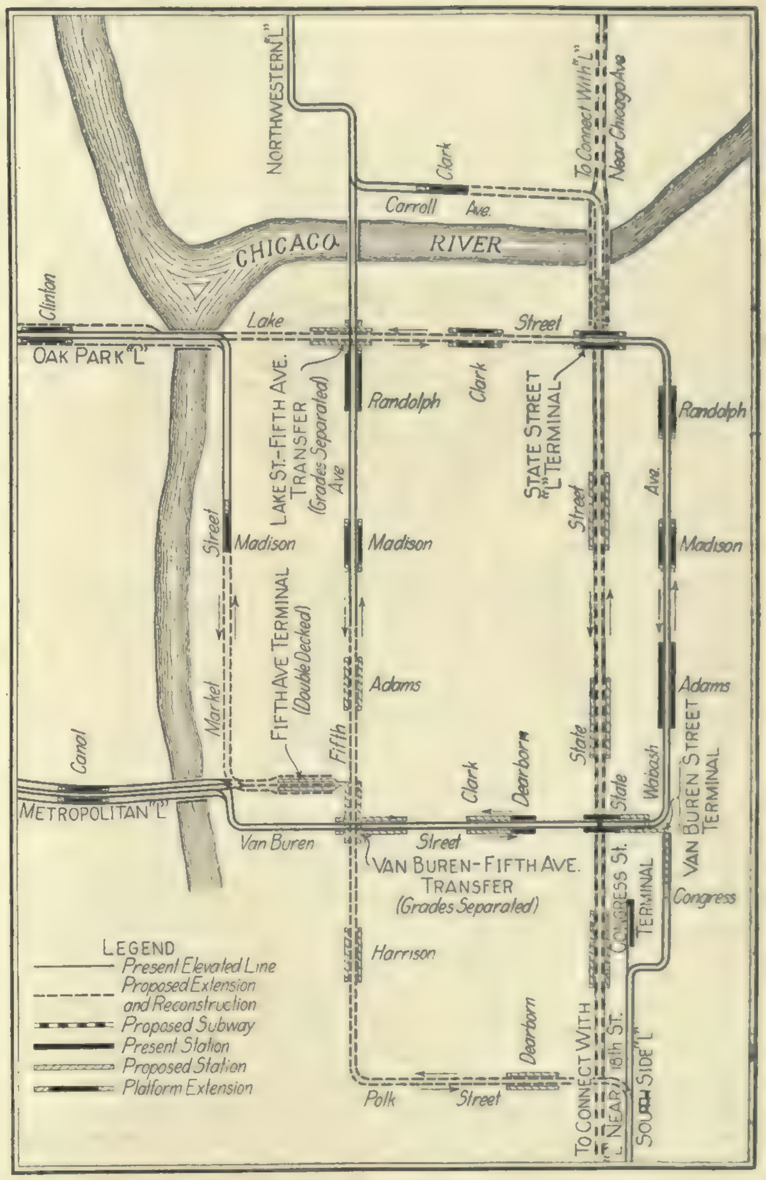
5. To provide express service, by the addition of third and fourth tracks, on all parts of the rapid-transit system.

6. To regulate properly street vehicular traffic.

Some of the facilities to be built must be subways, others should be elevated structures, while a few can be formed by a combination of both types. It is to be borne in mind that a subway costs about four times as much per mile as an elevated railroad and that it will furnish no more passenger carrying capacity, speed or other advan-



PRESENT AND PROPOSED RAPID-TRANSIT SYSTEM WILL TAKE NINE YEARS TO BUILD



PROPOSED SYSTEM FOR BUSINESS DISTRICT WOULD STRETCH LOOP ON ALL SIDES

central business district with a southwesterly tendency as it progresses west from the Loop district.

LOOP NO LONGER THE WHOLE BUSINESS DISTRICT

The designation of Chicago's former Central business district as the "Loop," which term originally applied strictly to the area within the Union Elevated Loop, is no longer at all descriptive and inclusive of the city's present central business area. This district, which was originally physically bounded on the north and west by the river, on the east by the lake and on the south by the steam railroad yards below Polk Street, has now spread beyond these limits, so that a marked growth is found southerly along Michigan Avenue, Wabash above if supplied with transportation facilities.

What is needed is briefly:

1. To provide main rapid-transit lines that will serve all parts of the city, distribute traffic, relieve congestion and carry people to and from all the business districts of the city, whether central or outlying.

2. To provide rapid-transit routes outside of the Loop district, enabling through passengers to travel direct, without being unnecessarily diverted into or through this district, and to give direct facilities to outlying centers.

3. To provide additional and better means of travel through the Central district with a view to broadening its area.

4. To relieve surface congestion wherever necessary and carry as many West Side cars tages than the former. By its extra cost it absorbs additional capital and so limits extension of other lines and curtails the sum total of the possible supply of service if built where an elevated railroad is permissible.

THE REMEDY

A summary of the recommendations was printed in the Engineering Record of Dec. 9, page 723.

The general plan which the commissioners recommend has in view a development along the following broad lines, which as a primary basis will require the construction of four north-and-south rapid-transit lines parallel with the greater dimension of the city. Two of these lines will pass through the present Loop district

and the other two will be located farther west on Halsted Street and Ashland Avenue. The east-and-west rapid-transit lines extending from the outer limits of the city to and through the greatly broadened Central business district will intersect the above-mentioned four lines, with transfer arrangements at points of intersection.

This rapid-transit system is to be extended, as may be necessitated by the city's growth from time to time, so as to serve the new and growing subcenters and residential districts. Elevated platforms are to be lengthened and at convenient points transfer is to be provided from the surface lines to the rapid-transit lines.

Divert Long-Haul Quickly to Rapid-Transit System

It is proposed to install a system of transfer from the surface cars to the elevated and subway lines so as to divert the long-haul travel from the surface to the rapid-transit lines, the surface lines being used as pick-up or feeder lines in the residential districts, transferring to the rapid-transit system the passengers who have long journeys to make. It has been found that this can be accomplished and rapid-transit service offered to greatly extended areas in the city by the establishment of certain transfer stations in outlying districts where radiating lines of surface cars can deliver passengers directly to elevated trains, in some cases across platforms at the same level.

In laying out the general plan for the subways in Chicago, it has been necessary to use two levels, one for the north and south and one for the east and west subways. In order not to destroy the Illinois tunnel, it has been necessary to keep the upper level closer to the surface of the street than in the opinion of the commissioners would otherwise be desirable. In order to avoid this necessity in future subway construction, the Illinois Tunnel Company should be required to build all its tunnels hereafter so that the clearance between the tunnel structure and the street surface should be not less than 38 ft.

Chicago's Subsurface

The subsurface material of the business district of Chicago consists in general of a top layer of non-homogeneous sandy loam and clay (largely débris and fill) of approximately 15 to 20 ft. in thickness, underlain by a homogeneous clay, varying in bearing power with the degree of moisture involved, but decreasing in moisture until it becomes very compact before reaching the rock overlay. This overlay, consisting of hardpan, sand pockets, and miscellaneous deposits, is at so great a depth beneath the surface as not to be a factor in the construction of underground railways.

The clay stratum at the proposed subway depth is not of so satisfactory a character for excavation along streets lined by heavy buildings as would be rock, dry sand, hardpan, or dry clay. With the exercise of care, however, subways as proposed can safely be constructed. The necessary precautions will add to the cost, which addition has been included in the estimates, and these same precautions will require the use of other construction methods than have been adopted in cities where the subsoil conditions are radically different from those found in Chicago.

In planning for subway construction, the commissioners have carefully considered the necessary readjustment of the sewers, the water, and gas mains, and other utilities affected. In the Loop district the high-level subways will be so close to the street surface that it will be necessary in places to provide chambers or galleries to take care of these utilities, particularly at some of the street intersections. As to whether public-utility galleries should generally be constructed in connection with the transportation subways, the commissioners express no opinion for the reason that the determination of the advisability or non-advisability of the general construction of public-utility galleries depends upon considerations that have no necessary connection with the transportation problems (except as noted) to which the work of the commission has been specifically confined by the ordinance.

The initial downtown terminal construction program provided for is designed to utilize to the best advantage all existing track capacities, both elevated and surface, and in the location of the subways necessary for adding to the terminal capacity of the elevated lines the controlling consideration has been the necessity for avoiding the use of the underground space in the main streets of the Loop district for such short connecting subways. The Loop district of Chicago is very much like the south end of Manhattan Island in New York, where it is already necessary to reserve every street for a through line, and in some cases for both elevated and subway. Chicago when embarking on a liberal plan for future rapid-transit lines should jealously guard against unnecessarily occupying any subsurface street space in the downtown district for the reason that it cannot possibly be foreseen to what extent or where such space may be needed for through service connecting the outlying parts of the city.

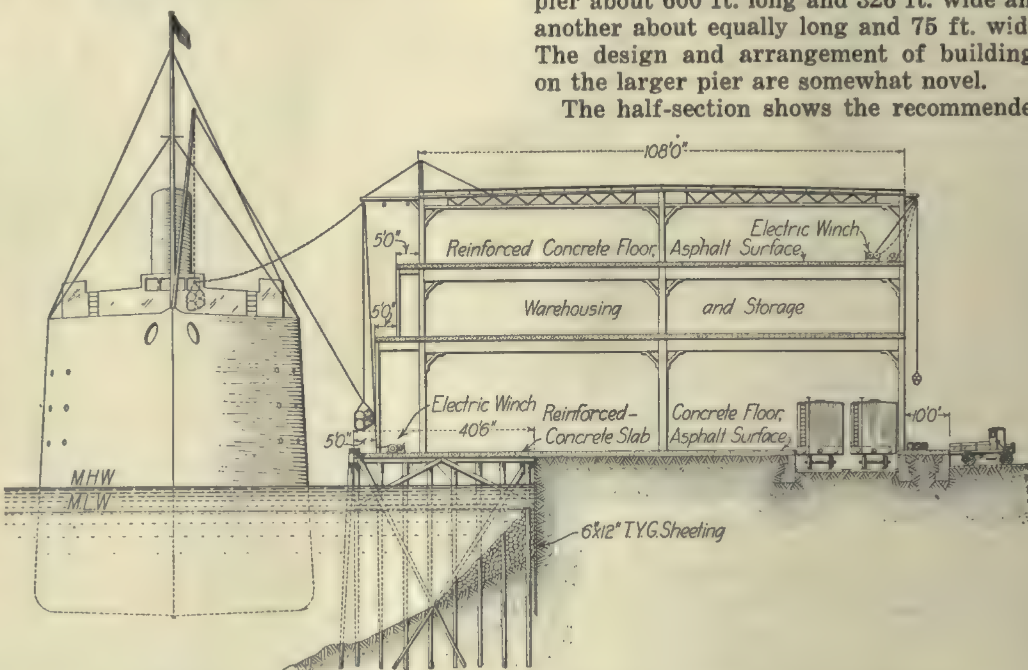
Building in San Francisco Since 1906

Since the fire of 1906 the city of San Francisco has issued a total of 66,278 permits for building construction, the value of which was $292,846,885. The permits include 211 Class A buildings, 221 of Class B and 3101 of Class C. The figures also include eighty-three exposition buildings.

Combination of Piershed and Warehouse Proposed

For Municipal Wharf at Camden, B. F. Cresson, Jr., Recommends Three-Story Sheds, Each Floor Stepped Back at Water Side

A COMBINATION of piershed and warehouse is a feature of the plans proposed by B. F. Cresson, Jr., chief engineer of the New Jersey State Board of Commerce and Navigation, as the first step to be taken by Camden, N. J., for the development of its waterfront. The development proposed, mentioned in a news note in the Engineering Record of Dec. 9, page 724, would be at the foot of Spruce Street. Mr. Cresson recommends the construction of two piers, together with suitable rail connections and a small switching yard. He proposes one pier about 600 ft. long and 326 ft. wide and another about equally long and 75 ft. wide. The design and arrangement of buildings on the larger pier are somewhat novel.



HALF-SECTION OF PROPOSED PIER, WITH COMBINATION PIERSHED AND WAREHOUSE

The half-section shows the recommended arrangement. Along each side of the pier would be a three-story building 118 ft. wide at the lower floor. The lower floor would have a headroom of 22 ft., and would be used for the ordinary purposes of transshipment. On the water side would be a 5-ft. platform. Just inside the driveway side of the building would be two railroad tracks, sunk to bring the floors of cars level with the floor of the building. Between the two buildings would be a space of 80 ft., divided into a 60-ft. roadway and two 10-ft. platforms. The two upper stories of the building would each be 12 ft. high in the clear. Each would be stepped in 5 ft. on the water side to allow a working platform. Hoists carried on overhanging arms and operated by electric winches, working with the ship's tackle, would permit easy transshipment of cargo between vessel and any floor of the shed, while other hoists on the inner side of the shed would raise and lower the cargo between the outside platform and either of the upper floors.

With such an installation, the report points out, trucks may drive upon the lower deck of the pier, where they may deliver cargo to or receive it from ships. Cargo coming from ships to railroad cars may be trucked directly across the floor of the pier and into the body of the car at the same level as the pier's floor, and a reverse course for cargo going from the railroad cars into sheds will be followed.

Cargo received from ships for storage

will be unloaded directly upon the platforms of the second or third floor by means of the ship's tackle and the cargo hoists. Cargo from the warehouses going into ships will be unloaded from the platforms along the edge of the pier into the ship in similar manner. Cargo from the warehouses to railroad cars will be lowered from the doors of the warehouses on the street side to the narrow platform to the rear of the shed and from these platforms into the body of the railroad car on the level of the platform. Cargo from the warehouses to trucks will be lowered in a similar manner to the platform and directly into the trucks.

It is proposed to make the wide pier solid fill, but in order to lessen the cost the outer 40 ft. is to be carried on timber piles, the fill to be held by timber sheeting as shown. The half-section is taken midway between bents. All columns would be supported by concrete pedestals carried on piles surmounted by timber platforms at mean low water. A 10½-in. concrete floor slab would be carried the full width of the lower floor.

Wells Protected from Flood Damage by Wedges

City of San Diego Installs Wooden Barriers as Safeguards Against Floating Débris and Scour

By A. C. FRANCIS
Operating Department, San Diego, Cal.

BECAUSE of flood damage done during the storms of January, 1916, San Diego, Cal., found it necessary to rebuild the entire field plant of the Mission Valley pumping station, a 5,000,000 gal. capacity auxiliary pumping station in the bed of the San Diego River. Of the twelve wells in operation before the flood only three were recovered. Accordingly nine new wells were drilled and an air-lift system of transmission of the flow from the wells to the plant installed, which takes the place of the individual pumps and motors located at each well prior to the destruction of the plant.

WEDGE-SHAPED BARRIER PROTECTS SAN DIEGO WELLS FROM FLOOD DÉBRIS

In order to protect the wells from being torn out during stormy weather by floating débris, the Operating Department, under the direction of City Manager F. M. Lockwood, has placed a wedge constructed of heavy timber and railroad iron in front of the wells, with the nose pointed upstream. Three 30-lb. rails were driven to a depth of about 24 ft. in the sands, and the wedge was constructed around these rails out of 8 x 12-in. planks 12 ft. long. The wedge extends 6 ft. below the surface of the sand and 6 ft. above, thus protecting the wells both from shifting sands and floating débris upon the surface of the stream.

The cost of the entire reconstruction was about $26,000. Nearly $5,700 was spent in attempting to relocate and recover the old field plant and in general reconstruction. The air-lift system cost $11,270; the new wells, $8,069; a survey of the property, $356, and the wedges to protect the wells, about $700.

Flood Control Will Make Waste Land Factory Sites

City Plan Commission of St. Louis Reports on $8,000,000 Industrial Development Project for River des Peres

EXTENSIVE tracts of idle land in St. Louis, Mo., will be made available for industrial and residential use if the flood-control and improvement project for the River des Peres, upon which the City Plan Commission has just reported, is put into effect. The work will cost about $8,000,000 and will involve the construction of a river channel and sewer, a railroad to complete the belt line around the city and a scenic driveway. It is planned to open up an area of 950 acres for industrial development and, by means of the proposed railroad, to divert through freight around the city rather than into the congested Mill Creek Valley, as now done. From the report of the City Plan Commission, for which Harland Bartholomew is engineer, the following details regarding the project have been taken:

More Industrial Sites Needed

St. Louis has experienced, like all other cities, a certain haphazard growth. This indiscriminate expansion has produced uneconomic conditions which to-day are being realized in an apparent or threatened decline in the rate of increase of the city's population and industry. It cannot be said that reaction has set in, yet it is a well-known fact that rapid growth of population and industry is taking place in neighboring cities across the Mississippi River and St. Louis County, all of which are within the metropolitan district.

Locations for these increasing metropolitan activities are selected outside instead of within the city, because St. Louis cannot at present offer such cheap, attractive and available residential and industrial sites. If St. Louis is to benefit from the increases for which it is primarily responsible, and grow as other large cities are growing, it must take immediate steps to place on the market the advantageous areas within its bounds and to make these areas so attractive to prospective industries and residents that they will not consider going elsewhere.

Storm Water and Sewage

The existence of the River des Peres in its present state is partly responsible for the uneconomic development of St. Louis. Because of floods it has rendered useless extensive tracts of land which should long ago have been converted to industrial use. Because of offensive odors it has rendered unfit for residence purposes much excellent adjacent territory. To dispose of the storm-water and sewage problems of the River des Peres is the first step in the development of the River des Peres Valley, and the development of the River des Peres Valley would immediately create additional and sorely needed room for the industrial and residential expansion of St. Louis.

Plans for a complete storm-water and sewage system have been prepared as follows:

Open Channel

From the Mississippi River to the several forks of the River des Peres in Maplewood there will be an open channel 160 to 180 ft. in width and 18 ft. deep, built of reinforced concrete. This channel will follow approximately the line of the foul-water sewer already there. The foul-water sewer is of sufficient size to dispose of the dry-weather flow. The channel will be of adequate width and depth to carry off the floods caused by excessive rainfall. From Macklind Avenue to the forks in Maplewood there will be a channel about 80 ft. wide and 16 ft. deep. Beneath this will be constructed a foul-water sewer to carry dry-weather flow, the sewage and storm water both now being carried off in the present open channel of the River des Peres. From Macklind Avenue to the Mississippi River the open channel will be of sufficient grade and easy curvature to permit direct flow and thus eliminate all stagnant water now caused by the extremely irregular course of the present stream. While the open channel will be dry and clean, except at times of heavy rainfall, it can, if necessary, be covered over at some subsequent date without unusual added expense. From Macklind Avenue to Union Avenue in Forest Park there would be a double section reinforced-concrete sewer, each section being from 27 to 30 ft. wide by about 22 ft. high. From Union Avenue to the city limits in Hodiamont there would be a single section reinforced-concrete sewer about 30 ft. wide by 23 ft. high. These sewers would carry off such extensive rains as the two in 1912 and the long rain in August, 1915.

The total estimated cost for the relief of sewage and storm-water troubles in the River des Peres Valley, including open channel from Mississippi River to Macklind Avenue, closed sewer from Macklind Avenue through Forest Park to the city limits, foul-water sewer from Maplewood to Macklind Avenue, reconstruction of bridges, purchase of right-of-way and necessary extensions and connections, is $5,815,450.

It is proposed to pay for the River des Peres sewer and channel entirely by bond issue. It would be the city's largest outlet sewer and therefore a public sewer which should be paid for by the city at large. Furthermore, in the River des Peres Valley only 11 per cent of the cost of all sewers has been paid by the city, or $89 out of every $791 per acre of cost.

A Municipal Railroad

As a part of this River des Peres plan a municipal railroad is proposed from the levee at the mouth of the River des Peres to the Frisco and Terminal Railroad intersection at Maplewood. The two chief benefits to be derived from such a system as described would be (1) the opening up of large areas, now idle, to good industrial use, and (2) an opportunity to direct through freight around the city rather than into the congested Mill Creek Valley, as is now done. The total cost for the construction of the railroad, including right-of-way, grading, culverts, bridge construction, paving, track work and all related items, is $526,615.

From the Frisco Railroad in Lindenwood east as far as Morganford Road there is a

strip of property between the city line and the proposed channel which varies in width from 150 to 800 ft., being about 200 to 300 ft. wide on the average. This land is mostly unused. With the proposed improvements of channel and railroad it would still be of little use for residence or industry, due to inaccessibility and its steep slope toward the river channel. Because of its natural attractiveness, its use for park purposes is suggested. The very limited width, however, would indicate that a drive, rather than a number of disconnected parks, could best be built.

The estimated cost of the driveway and adjacent park land, 280 acres in all, bridges, grading, paving and parking complete, is $1,277,668.

The total cost of the River des Peres plan is $8,019,118, divided as follows:

Open channel, closed sewer and all other related construction	$5,815,450
Double track industrial railroad complete	526,000
Driveway from Kingshighway southwest to McCausland Avenue and Manchester	1,277,668
Ivanhoe Avenue — McCausland viaduct (city's share)	400,000
Total	$8,019,118

It is proposed that the entire sum should be raised by a bond issue, the term of which must be 20 years, according to the present limitations of the state constitution. Approximately 72 per cent of the entire cost of the proposed plan is for the sewer and channel which the city must soon construct. When it is considered that for an additional 28 per cent ($2,203,668) untold benefit can be derived in the opening up of idle territory to industries and residence, with highly desirable railroad facilities, a complete circuit driveway and a good street plan, the necessity for simultaneous action on all projects seems obvious.

Special Details in Erection Reduce Secondary Stresses in Longest Simple Trusses

Phosphor-Bronze Bearing Blocks and Steel Castings Allow Rotation in Two Directions During Erection of 720-Foot Span of Metropolis Bridge

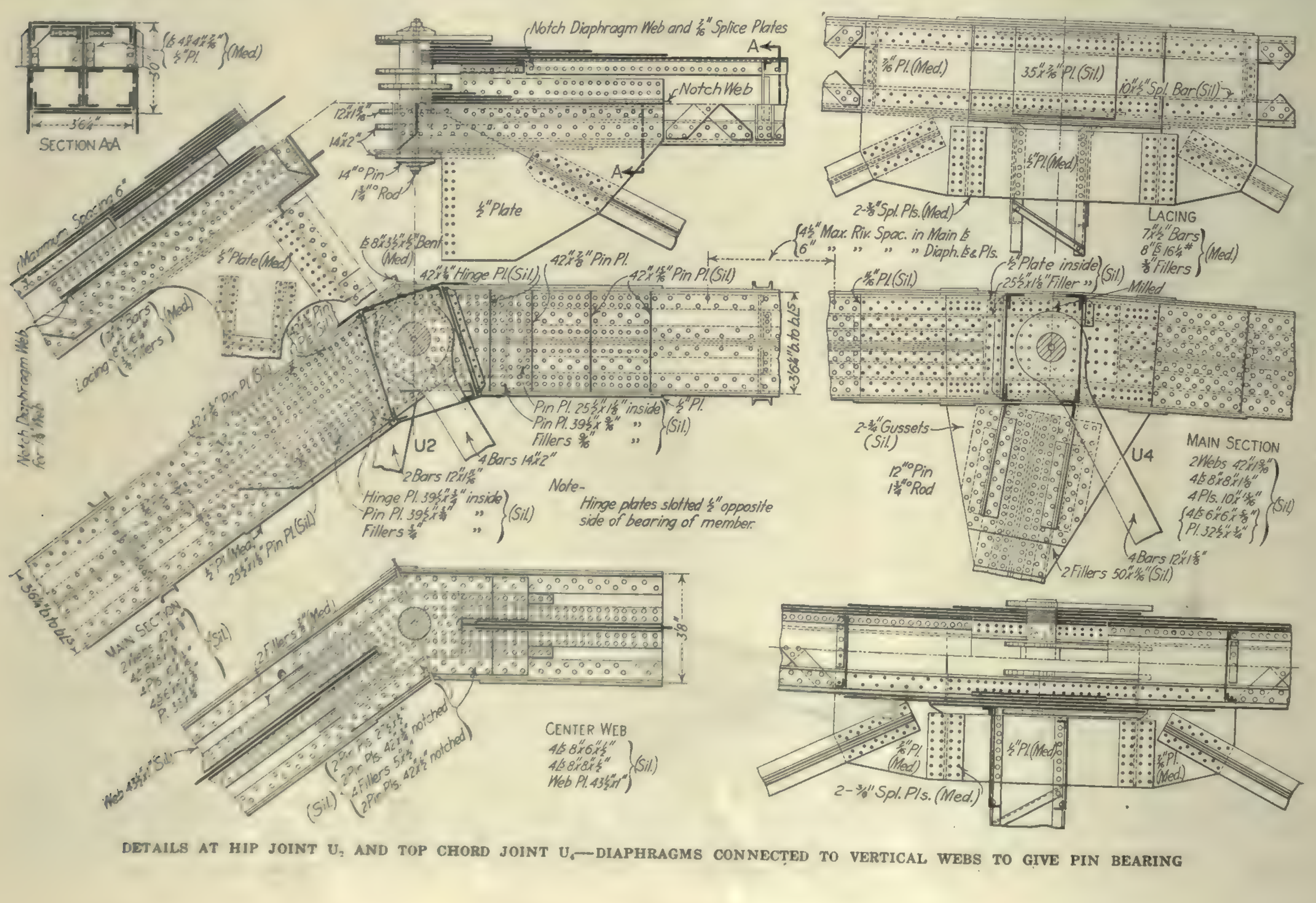
THE 720-ft. record-breaking span of the Metropolis Bridge, one of a series designed to carry the Paducah & Illinois Railroad, a separate company constituting the connecting link between Metropolis, Ill., and Paducah, Ky., for the Chicago, Burlington & Quincy Railroad and the Nashville, Chattanooga & St. Louis Railway, was swung on Dec. 11. The bridge, which was described in the Engineering Record of July 10, 1915, page 53, is more than a mile long and is designed for unusually heavy live loading—Cooper's E-90 engines followed by 7500 lb. per foot of track, with an impact factor which is independent of the loaded length.

The long span is the first through span on the Kentucky side. The trusses of this span are spaced 37 ft. apart on centers, and the design contemplates double-track operation, although only a single track is to be provided at this time. While many of the details and much of the design of this 720-ft. span of the Metropolis Bridge conform to the usual practice and are not unusual, except in size, the details of the hip joint and the method of introducing camber to eliminate secondary stresses in the truss members are of special interest. The rocker end support used in this longest simple span, which exceeds the present record-holding span of the St. Louis Municipal Bridge by 52 ft., is also of particular interest at this time.

The main chords, end posts, end lower chords and built-up diagonals in the center panels are of silicon steel, the eyebars and pins are of nickel steel and the bracing is of medium carbon steel. As indicated by the accompanying details of the hip joint U_2 and top-chord joint U_4, the main-chord members and some of the posts are built-up H-sections with longitudinal center diaphragms, laced top and bottom by flats and transverse channels. Eyebars 14 in. wide are used for the diagonals in the two end panels and 12 in. wide for the hanger verticals U_2L_2. The lower cord bars are 14 and 16 in. wide, and eyebars are used for the hangers at the subpanel points. The heaviest eyebars are 16 x 1 15-16 in. in the lower chords L_4L_6, with 14-in. pins. The lower chords L_0L_2 are of built-up sections consisting of four webs 39 x 1 in. and eight angles 8 x 6 x 7/8 in.

On an accompanying drawing are indicated the details of the pin plates and the lateral and portal connections at the hip joint U_2. In order to transfer the chord stresses from the center diaphragms to the 14-in. pin, these diaphragm web plates were notched around the center vertical webs bearing on the pin, with four 8 x 8 x ½-in. angles connecting the webs together. Notching of the diaphragm webs and splice plates to clear pin plates was also necessary. The gusset or tie plates on the bottom flanges near the end of the end posts and top chord U_2U_4 are notched, as shown, to clear the eyebar verticals U_3L_3 and diagonals U_3L_4.

The high secondary stresses due to bending of the main members of this subdivided

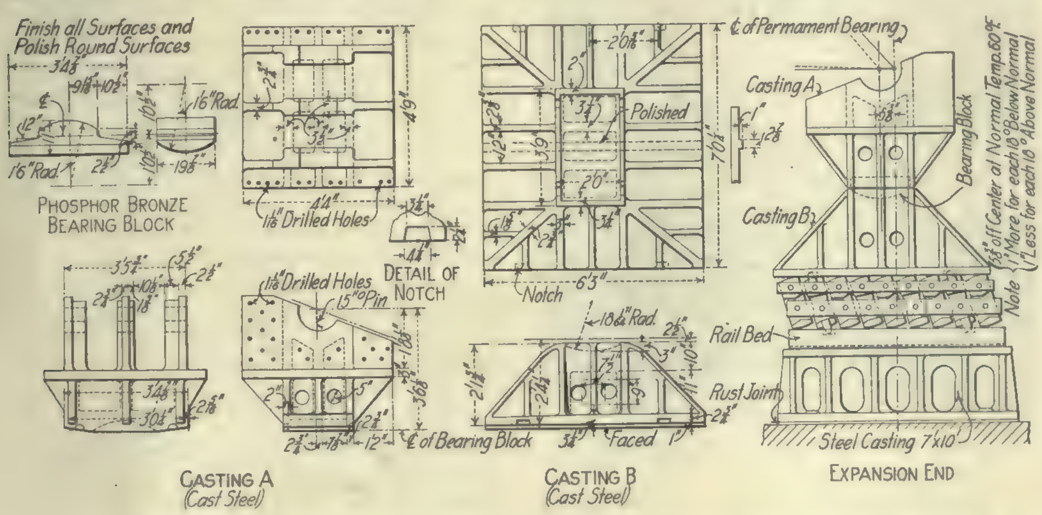


DETAILS AT HIP JOINT U_2 AND TOP CHORD JOINT U_4—DIAPHRAGMS CONNECTED TO VERTICAL WEBS TO GIVE PIN BEARING

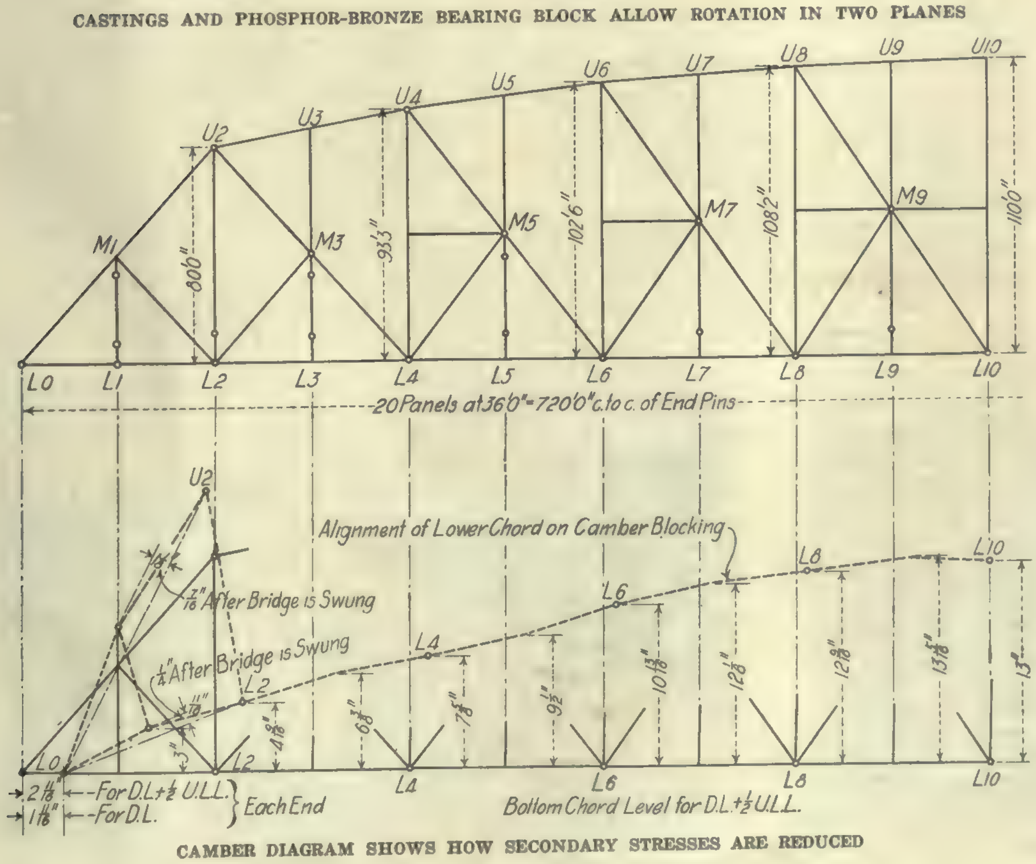
ERECTION OF 720-FT. SPAN BEGAN AUG. 26—PHOTOGRAPHS TAKEN NOV. 25 AND DEC. 11, AFTER BRIDGE WAS SWUNG

panel type of truss, especially in the end posts, are decreased by proper allowance made in locating the erection positions of the lower chord panel points on the falsework. The strains in the subtruss members, and the amount by which the end posts and diagonals must be bent out of line in order to assume a straight position under the prescribed camber loading of dead load plus one-half uniform live load, have been computed. The accompanying camber diagram shows the resulting positions necessary to insure a horizontal lower chord and straight diagonals under the camber loading mentioned. The shop length of all members was of course computed upon this basis.

It is seen that the end posts will be erected $1\frac{1}{8}$ in. out of alignment at M_1 and are given a reverse bend in the field after the splice above M_1 is made secure. The chord splices are to be made by bringing the sections to firm bearing and true alignment, held in position by jacks or otherwise, then drilling the holes for the splice and boring the pinhole.



CASTINGS AND PHOSPHOR-BRONZE BEARING BLOCK ALLOW ROTATION IN TWO PLANES



CAMBER DIAGRAM SHOWS HOW SECONDARY STRESSES ARE REDUCED

ERECTION ON ROCKER JOINT

In order to provide for the relatively large movements due to the camber and possible lateral displacements during erection, a special end detail has been designed. An accompanying drawing indicates the steel castings and phosphor-bronze bearing blocks which will be used to allow rotation of the end joints L_0 either in a longitudinal or a transverse plane. It is seen that instead of a double-pin rocker casting, a bearing block with perpendicular cylindrical bearing surfaces has been adopted.

Exactness in the placing of the steel on the falsework has been given careful consideration. It is seen that for a normal temperature of 60 deg. the end pin L_0 is to be set $5\frac{3}{8}$ in. off the center of the permanent bearing at the expansion end, varied proportionally at the rate of 1 in. for each 18-deg. change in temperature above or below normal.

This bridge was designed by the late C. H. Cartlidge, bridge engineer of the Chicago, Burlington & Quincy Railroad, with Ralph Modjeski, consulting engineer, of Chicago, supervising the design and details, which were worked up in the office of the railroad company. After Mr. Cartlidge's death Mr. Modjeski was placed in charge of the entire construction. The substructure is being built by the Union Bridge & Construction Company of Kansas City, and the superstructure is being fabricated and erected by the American Bridge Company.

Washington Will Spend \$5,000,000 on Roads During Next Two Years

More than \$5,000,000 will be spent on Washington roads during the next two years, is the estimate recently made by the highway commissioners of that state. The funds to be expended include \$2,000,000 of the public highway fund, to be raised by the one-mill levy; the \$3,000,000 permanent highway fund, raised by the mill-and-a-half levy; about \$430,000 federal-aid money, to be spent by the state, and \$91,739 which represents Washington's share of the proceeds from national forests, which are devoted annually to building of roads. The \$3,000,000 which it is estimated will be realized on the mill-and-a-half levy will be spent by the counties under the supervision of the state department. The annual appropriation from the forest-reserve money will be expended by the federal government on recommendation of the state highway department.

Reinforced-Gypsum T-Beams for Roof Decks Cast at Site and Hoisted to Place

Steel Purlins Eliminated in Sawtooth Roof by Using 10-Foot Spans—Units Molded in 15 Minutes for Rapid and Economical Construction

By WHARTON CLAY
Architectural Engineer, United States Gypsum Company, Chicago

EVIDENCE that the recently developed material for roof-deck construction, reinforced gypsum, tests of which were described by Mr. Marani in the Engineering Record of Dec. 16, page 745, is both practicable and economical is presented in the application to 10-ft. spans in a sawtooth roof of the building constructed for the Walker Manufacturing Company, at Racine, Wis. At this plant rapid and economical construction resulted from the use of "Structolite," a quick-setting gypsum, for T-beams cast in a molding yard near the building and removed from the molds in about 15 minutes ready for hoisting to the roof in about 4 hours. This is the first time that gypsum has been reinforced and used like concrete for a span as long as 10 ft. This type of construction eliminates the steel purlins, as the gypsum beams span from truss to truss.

Development of Gypsum Tile

The first application of reinforced gypsum was the development of factory-cast solid reinforced roof tile 30 in. long and 3 in. thick, weighing only 13 lb. per square foot, which are set on the roof between steel tees. To decrease the cost of the steel framing, tile from 4 to 6 ft. long were developed, which span from purlin to purlin to eliminate the tees. The light weight of these tile, also only 13 to 14 lb. per square foot, was maintained by increasing the effective depth, using a slab and joist construction.

In order further to decrease the structural steel cost, the development of a tile which spanned from truss to truss, eliminating the purlins, was the next logical step. However, the great length of such tile made factory-cast units impracticable because of the possibility of fracture in shipment. Therefore the longer units are cast at the building site. As the time of set of gypsum can be controlled in the manufacture by the use of retarder, any desired speed of fabrication can be attained and the number of molds reduced to a minimum, depending on the skill and number of the workmen employed.

The process of casting these structural gypsum units is well illustrated by the methods adopted at the Walker Manufacturing Company plant. This building covers an area 180 x 200 ft. and is of sawtooth-roof design, with columns spaced on 20-ft. centers in both directions. A jack truss midway between columns reduces the roof-tile span to 10 ft. between trusses. The dimensions and design of the T-beam reinforced-gypsum units were given in the article by Mr. Marani previously mentioned; they are a standard type similar to reinforced-concrete T-beams. After placing they are covered with a composition roofing.

HOISTING DECK UNITS—INTERIOR VIEW

The light weight of this roof deck, 17 lb. per square foot, made it possible to use minimum sections for the structural frame. The total weight of the steel per square foot of floor area is 5.5 lb., which is low for this type of construction.

Collapsible wooden molds were built just outside the building line at the freight siding and near industrial tracks which enter the building. It was found by experiment that only thirteen molds were required for the most economical operation. The first shipments of gypsum were manufactured with sufficient retarder to allow the workmen ample time to learn their respective duties. Successive shipments were retarded less and less until this small and inexpensive plant increased its output from 600 sq. ft. to 2800 sq. ft. per day. At this speed the gypsum was mixed, cast and removed from the forms in a completely set condition in only 15 minutes and was ready to be hoisted in place in 4 hours.

The maximum day's run was 3120 sq. ft. and the total time required from start to finish of job, manufacturing and laying in place 32,000 sq. ft. of roof, was only 16 working days, making an average of 2000 sq. ft. per day, including the time taken in breaking-in the gang.

Details of Operations in Casting Units

Each man had his specific job and followed the man before him in a regular path from mold to mold. No opportunity for improper proportions was possible in this work, as the gypsum was packed in bags of exactly the weight required, so that two bags made a tile.

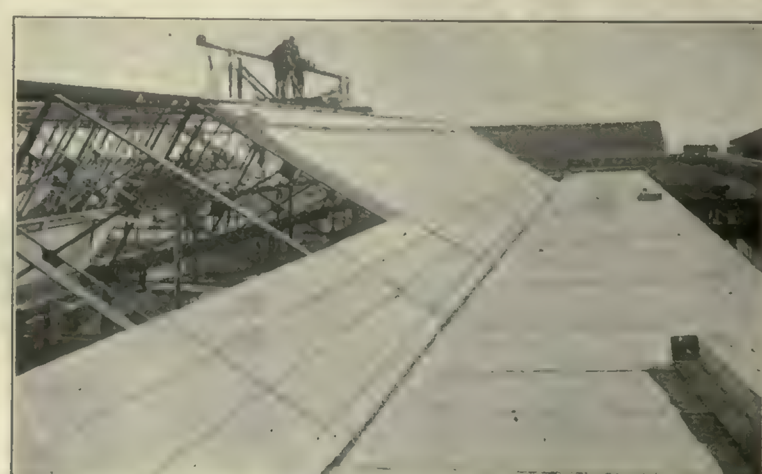
The routine followed in casting the T-beam units was as follows: One man oiled the mold with paraffin and placed the reinforcement on ¾ x ¾ x 2½-in. gypsum chairs set in the bottom at the quarter points; two men carried the sacks of gypsum from the car on an adjacent siding, leaving one sack untied at each end of a mold; one man carried water and filled the measuring buckets at each end of the mold; two molders and two helpers poured the gypsum into the measured water in the mixing buckets, agitating the mixture and pouring it into the mold at the ends. One man adjusted the reinforcement, placed the wire mat in the flange and struck off the top even with the mold.

Wrecking Forms

Three form wreckers followed about 10 to 15 minutes later taking down the collapsible sides of the forms, cleaning and reassembling them. The tile, now firmly set, was carried by two men to a transfer car at one side of the molding yard, pushed into the building and unloaded in position below its location.

The triangular end walls of the sawtooth section, 3 in. thick, were poured on the flat portion of the roof in adjacent bays as monoliths, and then raised into position as complete units.

As reinforced gypsum is designed to be of sufficient strength for its full load when wet, operations may continue during any



GYPSUM BEAMS ARE CARRIED TO ROOF ABOUT 4 HOURS AFTER LEAVING CAR—CASTING YARD ON LEFT

weather conditions when men will work. Tile last molded at night were hoisted the next morning, even though exposed to rain all night. Enough heat is generated in the setting of the gypsum to keep the material warm and prevent damage from freezing temperature.

Concrete of 24 hours' setting time on this job would have required much more labor and 154 molds instead of 13 to finish the roof in 16 working days. Although free sand and free gravel were available on the site for concrete aggregate, the saving in steel due to the lightness of structural gypsum and the saving in labor and in the cost of forms made the gypsum roof cheaper in place than a concrete roof.

The plant of the Walker Manufacturing Company was designed and built by the Arnold Company, Chicago, under the direct supervision of P. L. Battey, vice-president and chief engineer. The detail design of the roof tile was made by Calev Payne of the United States Gypsum Company. This company has been developing gypsum for structural purposes for several years, and made the special tests for the constructors and owners, as quoted in the article by Mr. Marani in last week's issue.

Topographic Maps Made of 1,237,520 Square Miles

This Is 40.9 Per Cent of the United States—1302 Stream-Gaging Stations in 39 States, Alaska and Hawaii

IN THE ANNUAL report of the Secretary of the Interior for the fiscal year ended June 30, 1916, made public Dec. 7, Franklin K. Lane discusses the results of surveys and investigations of water resources conducted by the Department of the Interior.

The report states that new areas amounting to 19,230 square miles were mapped topographically, making the total area of the United States surveyed to date 1,237,520 square miles, or 40.9 per cent of the country. Areas aggregating 3486 square miles were resurveyed, making the total area surveyed or resurveyed during the year 22,716 square miles. These surveys were made in twenty-nine states, seventeen of which co-operated in the work. The technical field force numbered 140, and in addition 36 technical field assistants were employed.

At the end of the year 1302 gaging stations for measuring the discharge of streams were being maintained in thirty-nine states, Alaska, and Hawaii. Investigations of underground waters have been made in sixteen states, in Alaska and in Cuba. Investigations of the present and possible use of both surface and underground waters have been made in connection with the classification of public lands, especially with reference to their use for power under government permit or for agriculture under the enlarged-homestead, desert land, or Carey acts. In the hydrographic work three states and Hawaii co-operated, as well as the Reclamation Service, Forest Service, Indian Office, Engineer Office, Navy Department, War Department, Department of Justice and the city of San Francisco, largely in the study of the flow of certain streams. About 64 per cent of the appropriation of $150,000 was spent on the public-land states, largely in stream gaging. The technical force engaged in the work on water resources numbered seventy.

Literature

For the Civil Engineer and Contractor

New Publications

LIST OF REFERENCES ON VALUATION OF STEAM RAILWAYS. Prepared by the Bureau of Railway Economics, Washington, D. C. Bulletin 190, American Railway Engineering Association. Paper, 6 x 9 in.; 154 pages. Chicago, American Railway Engineering Association.
This list of references is limited strictly to the economic aspects of the valuation of steam railways, all but the more striking literature relating to other public utilities being excluded.

HANDBOOK OF FORMULAS AND TABLES FOR ENGINEERS. Compiled by Clarence A. Peirce, assistant professor of power engineering, Cornell University. Mathematical sections by Walter B. Carver, assistant professor of mathematics, Cornell University. Second edition, revised and enlarged. Flexible leather, 4 x 6¾ in.; 188 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $1.50 net.
This second edition of this useful little handbook contains a few corrections of errors in the first edition and a small amount of new material —including formulas of hydraulics, tables of natural logarithms and hyperbolic functions. Requests for further additions were denied because of the restriction to convenient pocket size.

COMMUNITY ACTION THROUGH SURVEYS. By Shelby M. Harrison, director, department of surveys and exhibits, Russell Sage Foundation. Paper, 6 x 9 in.; 29 pages. New York, Russell Sage Foundation, 130 East Twenty-second Street. 10 cents.
This paper was presented in part at the Indianapolis meeting of the National Conference of Charities and Correction in May, 1916.

CITIZEN AGENCIES FOR RESEARCH IN GOVERNMENT, PART 1. Bulletin 77, Bureau of Municipal Research. Paper, 6 x 9 in.; 114 pages. New York, Bureau of Municipal Research, 261 Broadway. $1.

GEOLOGY AND GROUND WATERS OF NORTHEASTERN ARKANSAS. Water-Supply Paper 399, U. S. Geological Survey. Paper, 6 x 9 in.; 310 pages; illustrated. Washington, Government Printing Office.

BRIDGE MANUAL FOR COUNTY SUPERINTENDENTS OF HIGHWAYS, RESIDENT ENGINEERS AND INSPECTORS. Bulletin 10, Illinois State Highway Department. Prepared by Clifford Older, bridge engineer. Paper, 6 x 9 in.; 104 pages; illustrated. Springfield, Ill., State Highway Department.

THE FLOW OF WATER IN WOOD-STAVE PIPE. By Fred C. Scobey, irrigation engineer, with discussion by others. Bulletin 376, U. S. Office of Public Roads and Rural Engineering. Paper, 6 x 9 in.; 96 pages; illustrated. Washington, Government Printing Office.

TABULATED DATA RELATING TO FLOW OF WATER UNDER PRESSURE THROUGH CLEAN CLOSED PIPES. By George T. Prince, C. E. Flexible leather, 4½ x 6½ in.; 149 pages; illustrated. New York, D. Van Nostrand Company. $2 net.

THE ADMINISTRATION OF INDUSTRIAL ENTERPRISES. By Edward D. Jones. Cloth, 5 x 7½ in.; 442 pages, illustrated. New York and London, Longmans, Green & Company. $2 net.

DEPARTMENT OF WHARVES, DOCKS AND FERRIES, PHILADELPHIA: ANNUAL REPORT, 1915. Paper, 6 x 9 in.; 145 pages; illustrated. Philadelphia, George S. Webster, Director, Bourse Building.

SEWAGE DISPOSAL FOR SCHOOL BUILDINGS IN OHIO. By R. S. Durrel and D. E. Adams, assistant engineers, division of sanitary engineering, Ohio State Board of Health. Paper, 6 x 9 in.; 13 pages; illustrated.
Reprint from the Ohio Public Health Journal, August, 1916.

CANADIAN TRADE INDEX. Cloth, 7 x 10 in., 560 pages. Toronto, Canada, Canadian Manufacturers' Association. $5 net.

STANDARDIZATION OF PUBLIC EMPLOYMENTS, PART 2. Practical Side of Standardization in American Governments. Bulletin 76, Bureau of Municipal Research. Paper, 6 x 9 in.; 148 pages. New York, Bureau of Municipal Research, 261 Broadway.

TREATISE ON HYDRAULICS. By Mansfield Merriam. Tenth edition, revised with the assistance of Thaddeus Merriman. Cloth, 6 x 9 in.; 565 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $4 net.
In this latest addition of Merriman's well-known text book, over 40 pages have been rewritten and minor changes made in about 50 other pages. The new articles treat proportional weirs, Biel's formula for flow in pipes and channels, backwater due to bridge piers and hydraulic machinery. The articles on turbines have been revised to include modern turbines.

MECHANICAL EQUIPMENT OF BUILDINGS—Volume 1, Heating and Ventilation. By Louis Allen Harding, B. S., M. E., chief engineer and member of firm of John W. Cooper Company, Buffalo, and Arthur Cutts Willard, S. B., assistant professor of heating and ventilation, University of Illinois. Leather, 7 x 9 in.; 615 pages; illustrated. New York, John Wiley & Sons, Inc. $4 net.
This first volume of a new reference work for engineers and architects treats only heating and ventilation systems and details. Subsequent volumes are planned to cover power plants, elevators, lighting systems, refrigeration plants, sprinkler systems, vacuum cleaning and plumbing. The object of the authors is to present sufficient theoretical and commercial data for practical use in the drafting room, and at the same time show students the relation between theoretical principles and practical applications. Extensive use is made of manufacturers' data. The first volume contains 21 chapters, covering the heating and ventilating field from the elementary definitions of heat units and complete theoretical treatment of fundamentals up to the discussion of cost of equipment and the preparation of plans and specifications.

PROGRESS REPORTS OF EXPERIMENTS IN DUST PREVENTION AND ROAD PRESERVATION, 1915. Bulletin 407, U. S. Department of Agriculture, Office of Public Roads and Rural Engineering. Paper, 6 x 9 in.; 71 pages. Washington, Government Printing Office.

RULES, REGULATIONS, FORMS AND PRACTICE RELATIVE TO THE CONTROL, DISTRIBUTION AND USE OF THE WATER RESOURCES OF OREGON. Compiled under the direction of John H. Lewis, state engineer, by Percy A. Cupper, assistant state engineer. Paper, 6 x 9 in.; 70 pages; illustrated. Salem, Ore., Bulletin 6, Office of State Engineer.

WATER SUPPLY—CONSIDERED PRINCIPALLY FROM A SANITARY STANDPOINT. By William P. Mason, professor of chemistry, Rensselaer Polytechnic Institute. Fourth edition, rewritten. Cloth, 6 x 9 in., 528 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $3.75 net.

WEIGHTS OF STEEL. Computed by Thomas J. Elliott. Flexible leather, 6 x 9 in.; 662 pages. Cleveland, Ohio, The Penton Publishing Company. $20 net.
For the use of engineers, architects, contractors, builders and steel manufacturers in the exact computation of weights of rolled shapes for lengths varying from 1/16 in. up to 60 ft. It also includes the weights of round and square rods and deformed reinforcing bars of the usual lengths.

TRANSACTIONS OF THE INTERNATIONAL ENGINEERING CONGRESS. 1915; INDEX VOLUME. Paper, 6 x 9 in.; 273 pages. San Francisco, W. F. Durand, chairman of committee of management.
Section 1 gives historical and statistical information; section 2 short abstracts of the papers presented, and section 3 is a contents and author index.

MONTHLY BULLETIN, PENNSYLVANIA DEPARTMENT OF LABOR AND INDUSTRY, SEPTEMBER, 1916. Paper, 6 x 9 in.; 104 pages. Harrisburg, Pa., William Stanley Ray, state printer.
A compilation of all essential portions of Pennsylvania labor laws that should be known by all employers, employees, employment agents and proprietors of institutions and public halls throughout this commonwealth.

Books Reviewed

Municipal Engineering Practice

Author, A. Prescott Folwell, past president of the American Society of Municipal Improvements; editor of *Municipal Journal*. Cloth, 6¼ x 9¼ in.; 422 pages; illustrated. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $3.50 net.

REVIEWED BY JOHN H. GREGORY
Consulting Engineer and Sanitary Expert, New York City

In this interesting book the author has brought together matter on several branches of municipal engineering not readily obtainable elsewhere. No attempt is made to treat of sewerage, water supply and street paving, the reader being referred to standard text-books for such matters.

The first chapter is devoted to a discussion of certain fundamental data needed by the municipal engineer as a guide in solving many of the problems which fall to his lot to work out. The nine subsequent chapters treat respectively of the city plan; street-surface details; bridges and waterways; city surveying; street lights, signs and numbers; street cleaning and sprinkling; disposing of city wastes; markets, comfort stations and baths, and parks, cemeteries and shade trees.

The author has had an exceptional op-

portunity for acquiring a vast amount of information on the subjects of which the book treats, and from this material he has selected that which has real value. He has been unusually successful in presenting this material in such a manner as to make the book exceedingly readable. Although the book is non-technical, it contains a great amount of practical data and information which the technical man needs, and while some of the subjects are treated in a more or less general manner, others are gone into in much detail.

The average city engineer, especially in the smaller and medium-sized municipalities, is generally supposed by the layman to be an expert in all branches of municipal engineering, and it is especially to the large number of such engineers, as well as to all engineers who may, at times, be called on to do work of a nature similar to municipal engineering, that the book will appeal. To the young engineer just entering the field of municipal engineering the book should be invaluable. If carefully and conscientiously read he will have brought to his attention many suggestions and ideas which otherwise might be acquired only after many years of active practice. And if city officials, under whose general direction municipal engineering works are carried out, would take the time to read the book they would be well repaid for the time thus spent.

The book is well written, contains numerous carefully chosen illustrations, both drawings and halftones, and is well indexed.

Passenger Terminals and Trains

Author, John A. Droege, general superintendent, New York, New Haven & Hartford Railroad. Cloth, 6 x 9 in.; 410 pages; illustrated. New York, McGraw-Hill Book Company, Inc. $5 net.

Knowing the author to be a railroad operating official, undoubtedly fully cognizant of all that goes to make up a convenient and efficient passenger terminal, and recognizing in "Passenger Terminals and Trains" a pioneer in the field, and a book that is worth its price just for its illustrations of terminals all over the world, the reviewer hesitates to say that the book is disappointing. Perhaps this disappointment is because the author's earlier work, "Freight Terminals and Trains," was so satisfying. The new book, however, seems almost to have been addressed to the public rather than to the technical man. The author does not set forth his views concisely, but describes—in very interesting fashion, it is true—station after station, each one of which, it is found on reading, illustrates one or more features that seem desirable to the author. The track layout is subordinated to a surprising degree to the arrangement of facilities in the building. The architect will find his field wholly covered, but the track man will have to be contented with generalities.

The chapters that directly concern the engineer are mainly in the first part of the book. A chapter on general principles is followed by one on construction and maintenance details. While it may be a little difficult to find the author's views on a specific point, the latter chapter is replete with useful suggestions.

Chapter 3, "Interlocking and Approaches," is one of the disappointments of the book. Written in collaboration with a signal engineer of the New Haven, it features the signaling almost to the exclusion of the track details. Important as the signal system is, the best system in the world could not save a terminal with an ineffective arrangement of ladders, crossovers and approach tracks. The chapter gives little help on this point.

Through stations, head stations, waterfront terminals and the terminals of New York City are the subjects of the next four chapters. These rank with the best in the book, and give the reader 106 pages, abundantly illustrated with both photographs and plans. They, with a Chapter 3 on somewhat different lines, would give both the architect and the track man a comprehensive idea of how to combine in the solution of their problems the best that has been done elsewhere. The track man would still have to go to a subsequent chapter on car-cleaning plants to learn about coach yards, and here, again, he would fail to find useful recommendations of the yards and terminals committee of the American Railway Engineering Association relative to track centers, desirability of stub tracks, and the like.

Three more chapters in the book, on small stations, foreign passenger trains and terminals and electrification, are of direct interest to the engineer. The remaining chapters would appeal to him as a railroad man rather than as an engineer, as some of the titles indicate—"The Station Master," "The Ticket Office," "Train Indicators," "Accidents and Their Prevention," etc. Two of them, "Passenger-Terminal Operation" and "Passenger-Train Operation," suggest that perhaps here will be found mention of the studies of terminal operation made by the yards and terminals committee of the American Railway Engineering Association. There is no such mention. The chapters are written from the viewpoint of how the operating department can satisfy the public with the facilities available, not whether the facilities are of proper capacity or arrangement.

And now, having found considerable fault with the volume, the reviewer would urge all interested in passenger terminals to read it. While the book does not tell all that a terminal designer should know, it tells much and shows much by plan and picture. And it is likely to be some time before the subject is covered better.

Laboratory Manual of Bituminous Materials for Highway Use

Author, Prévost Hubbard, chemical engineer, chief of the Division of Road Material Tests and Research, Office of Public Roads and Rural Engineering, U. S. Department of Agriculture; lecturer in highway engineering chemistry, Columbia University. Cloth, 6¼ x 9¼ in.; 153 pages; illustrated; blank pages for notes. New York, John Wiley & Sons, Inc.; London, Chapman & Hall, Ltd. $1.50 net.

REVIEWED BY S. WHINERY
Consulting Engineer, New York City

In this little book the author has brought together and systematized the laboratory technique of classifying, analyzing and testing the various bitumens that are now so largely used in paving and highway work. Heretofore most of the literature on the subject has been scattered through books, the proceedings or committee reports of technical societies, and the engineering press, and was not always readily available to the student or engineer.

The reader is likely to be impressed with the idea that the main purpose of the author was the preparation of a suitable textbook for classes in the technical schools, but like all good text-books, it deserves, and is likely to have, a much wider field of usefulness.

The book is not confined strictly to the chemical and physical processes and results of the laboratory; it contains much valuable information on the mineralogy, classification, and physical properties of the bitumens, and their uses in highway building.

One feature of the book is especially worth noting. Following the description of each analysis or test is a concise discussion of its interpretation, value, or significance as related to highway work. After all, this is the important thing to be kept in mind, for the most complete and accurate laboratory work is of little practical value unless we know how to apply it intelligently so as to obtain the best results under varying conditions.

The book is divided into three parts. Part 1 is devoted to types and classification of bituminous materials, the collection and preparation of samples, and forms for recording results. It includes more than five pages of definitions of words and phrases used in connection with highway work, as adopted by or proposed to the technical societies.

Part 2, entitled "Methods of Testing," covers the laboratory work proper and the interpretation or value of the tests. Part 3, on "Characteristics of the More Important Bituminous Materials," is devoted to a brief but comprehensive description of the various bitumens used in highway work and their characteristics.

On the whole, the book covers its field very satisfactorily and is a valuable addition to our literature on highway construction.

American Sewerage Practice: Volume 3—Sewage Disposal

Authors, Leonard Metcalf and Harrison P. Eddy. Second edition, with appendix on activated sludge, and minor revisions. Cloth, 6½ x 9½ in.; 877 pages; illustrated. New York, McGraw-Hill Book Company, Inc.; London, Hill Publishing Company, Ltd. $6 net.

REVIEWED BY GEORGE W. FULLER
Consulting Engineer, New York City

Under date of Aug. 29, 1916, in reprinting this volume, the authors have taken advantage of the opportunity to add an appendix of about twenty-five pages descriptive of the activated-sludge process for the treatment of sewage and other waste liquids. This new matter is a comprehensive, conservative statement of this phase of the subject and will be read with interest by all those who are engaged in the consideration of sewage-disposal problems of magnitude.

Slight revisions where necessary have also been made, as is customary in books of this size and character.

Gage Stations in Oregon Stream

In order to compile more complete records of the flow of Oregon's streams on which to base studies of water-power and irrigation possibilities, gage stations have recently been established on nearly all the important streams in that state not heretofore gaged. Weekly reports of gage readings will be made to the government. The installations were made under the direction of Charles F. Batchelder of the U. S. Geological Survey and V. H. Reineking, consulting engineer, of Portland, who recently completed a 2500-mile trip by automobile, undertaken to establish the stations and employ resident recorders.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Sand Boxes to Lower Arch Centers

SIR: Referring to the article by Frank P. McKibben in your issue of Oct. 28, page 530, Professor McKibben mentions the cast-steel double-screw wedges that were used at the Rocky River arch, Cleveland, and states that the cost is said to have been somewhat in excess of that of sand boxes. If you will refer to the article on "Steel Centering Used in the Construction of the Rocky River Bridge," written by the writer and published in the *Transactions* of the American Society of Civil Engineers, Vol. 74, page 9, you will find the estimated cost of sand boxes, screw wedges, screw jacks and hydraulic jacks for this work.

The screw wedges cost $350 more than the sand boxes and saved more than this amount to the contractor, due to the fact that they were designed to lift the dead load of the centering as well as to lower the centering when the load of the arches was on. These double-acting screw wedges were very successful and enabled the centers to be removed and jacked up into their new position in a remarkably short time, and it is the writer's opinion that they proved themselves to be far superior to sand boxes for this purpose. These wedges were purchased by the McClintic-Marshall Construction Company after they were used at the Rocky River bridge, and it is our understanding that some of them were used at Panama in the erection of the lock gates for the canal.

WILBUR J. WATSON,
Chief Engineer, Wilbur J. Watson & Company.
Cleveland.

[The following estimated costs of the different types of lowering devices are given in the article to which Mr. Watson refers: Sand boxes, $1,300; screw wedges, $1,650; screw jacks, $2,000, and hydraulic jacks, $2,400.—EDITOR.]

Why Not Grout Cracks of Old Brick Pavements?

SIR: Much has been written recently about monolithic brick pavements and improved methods of grouting, but I have failed to see anything about cleaning out the cracks of old pavements and refilling them with grout. Many miles of brick pavements are in very fair shape so far as the general contour and surface are concerned, but the edges of the joints have spalled off and the filler has been replaced by dirt. Why cannot these cracks be cleaned out and the pavement grouted to make it smooth and sanitary, to say nothing of materially prolonging its life?

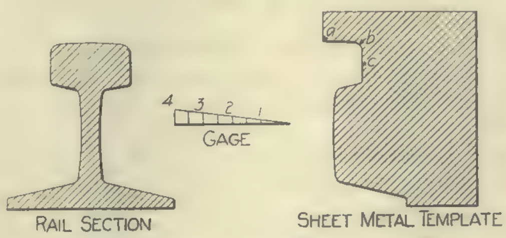
A simple way of removing the dirt is essential; the grouting process is sufficiently standardized not to need any discussion. It is suggested that a comparatively small boiler could be mounted on a truck to furnish steam through a hose and nozzle under high pressure for the purpose of loosening up the dirt in cleaning the joint clear to the bottom. It would probably be advantageous to flush the street of any surface material to start with so as to moisten the dirt to the bottom of the joints. Water from the street hydrants might be used to do the work, if it was found not to disturb the sand cushion with which practically all former pavements of brick were laid. There would be hardly enough moisture from the condensed steam to do any damage.

INTER NOS.

[Undoubtedly some one has tried out the grouting of old brick pavements as suggested, although it is doubtful if any one has used steam to clean out the joints. A discussion of this addition to the maintenance engineer's remedies is solicited.—EDITOR.]

Gage to Measure Rail Wear

SIR: The article in the Engineering Record of Nov. 4, page 555, describing a gage for measuring wear on rails, brings to the writer's mind a device used by him in 1906 as tapeman with the Chicago & North Western Railway, at Omaha. The apparatus consisted of a template of sheet metal, made to fit the standard section of rail to be measured, and a triangular gage



TEMPLATE FOR STANDARD RAIL SECTION

of the same material graduated as shown in the drawing.

The work was done by two men, one keeping the notes and the other manipulating the tools. The template was held against the base and web of the rail, the gage inserted at the points *a*, *b*, *c*, or at others if desired, and the amount of wear recorded as read on the gage.

The foregoing statements are from memory, but are believed to be essentially correct.

C. H. EIFFERT.
Dayton, Ohio.

How Shall He Melt Lead from Joints of Water Line?

SIR: What, in your judgment, is the best way to melt lead from joints of an abandoned 24-in. cast-iron water line? I may become interested in taking up 16,000 ft.

I was thinking of uncovering the pipe with a dragline, spading by hand below the spring line, melting out the lead two-thirds of the way around from the top side down, using a gasoline blow torch or a carbide outfit, pulling the pipe and hoisting it to the bank with the dragline.

If you are able to give me any ideas along lines that will help I will appreciate it. The job is large enough to afford spending a few dollars in equipment.

Houston, Tex. HARRY WATTS.

[Perhaps some of the readers of the Engineering Record can suggest a good method of doing the work.—EDITOR.]

New Methods Devised for Building Ships of Concrete

SIR: In a recent issue of the Engineering Record I noticed an article regarding Norwegian concrete barges and a short comment by a naval engineer, who stated that although numerous barges of this kind had been built in this country and the Panama Canal Zone, their use had not been an unqualified success and that the possible advantages in cost would be more than counteracted by increased cost of propulsion due to the heavier weight of the vessel.

There is, without question, a great future for reinforced concrete in ship construction. The first attempts have necessarily been crude and have therefore not always been entirely successful. However, we must not forget that all great inventions, especially in ship construction, have been the results of scientific development of ideas which often were introduced by laymen in a very crude form, and were later, with the assistance of experienced marine engineers, transformed into the great successes of the present day. Compare the steamship of to-day with the first vessels of this kind. Consider the difficulties which had to be overcome in introducing iron and steel in ship construction and you will probably agree that the concrete ship of the future will undergo the same development change of opinion, and of course will also be a great success after the combined experiences of the marine and the concrete engineer have come to its assistance.

I have made the building of concrete ships one of my life's problems, and have carefully studied the scientific principles which must be adopted in order to insure success. Not only for the construction of smaller vessels, as barges and scows, is concrete an entirely suitable material, but also for large ocean-going ships will its use be perfectly safe and extremely advantageous.

The principal faults of all previous attempts at concrete-ship construction have been that concrete builders tried to use everyday methods and means in design and mixing and applying the materials. Most of these vessels were built of ordinary concrete mixed and placed in the common way. The special requirements of ultimate service were not sufficiently taken into consideration. The designs were made without consultation with marine engineers, and the strains which the empty and the loaded ship had to resist under all the different and changing conditions were only more or less intelligently guessed at.

In spite of all this, however, satisfactory results have been obtained in most cases, and therefore the subject is worthy of careful consideration and encouragement, especially at this time when the production of freight ships is one of the greatest problems of all nations.

So far two methods have been used for the construction of concrete barges:

The first method consisted in building an inside and outside form for the ship's hull, and between these forms (which were separated to allow for intended wall thickness) the necessary reinforcement was placed. Then a concrete, composed of Portland cement, sand and crushed stone or gravel, was poured in a semi-liquid condition to fill the forms and to incase the steel reinforcement. After the concrete had sufficiently hardened, the forms were removed and the barge was finished by pouring bulkheads,

division walls, decks, etc., in a similar manner.

This method resulted in extremely clumsy and heavy vessels, which can only be used for sand and construction barges. The ship itself is unelastic, and in collision with wharfs and other vessels dangerous cracks develop which are difficult to repair and which will often result in loss of the entire ship.

The second method consists in using a light steel skeleton, placing over the outside of it an expanded metal or wire fabric and finishing the hull by plastering over this sheathing a rich mortar coating in the same manner as light curtain and partition walls are formed in fireproof-building construction. This method is a great improvement over the first one, but can only be used for smaller boats, launches, etc., and of course is practically out of the question for freight barges.

I have invented and developed a series of entirely new methods of construction which not only solve the problem in a scientifically correct manner, but allow the building of large and small concrete vessels of remarkable elasticity and of comparatively light weight. In addition to this, the cost of construction is greatly reduced because no forms are required. All concrete is handled, applied and finished by machinery especially designed by me for this purpose. The risk of poor workmanship is almost completely eliminated.

Owing to the present international patent situation, I am not able to publish complete details of construction. In order, however, to give some advance information to your readers who are interested in the subject I will here explain the general outlines of the methods employed in my systems:

The ship's hull consists of a strong framework of steel, which is so designed that the combined strength and advantages of steel and concrete are fully recognized. This truss frame is erected and riveted in the ordinary manner. In the completed ship the steel frame is entirely incased in concrete and thereby protected against rusting. By this incasing the steel members are also stiffened and the buckling stresses are greatly reduced. For this reason the steel members of the frame are of simple design and relatively light weight.

After the steel frame is completed it is covered with my multiple-unit wall construction of varying thickness. The walls are formed of a high-grade concrete applied by compressed air, and each section is independently reinforced by networks of light steel bars and wire mesh. All ship walls, bulkheads, decks and partitions are formed in a similar manner without the presence of any construction or connection joints, so that the completed ship is one seamless, monolithic structure.

The concrete is composed of Portland cement and crushed quartz or other suitable stone material. All pieces not passing a ½-in. screen are rejected. These materials, with the necessary waterproofing medium and the water for proper hydration, are mixed and ground together, and before being placed are properly conditioned to reduce the danger of cracking because of excessive expansion and contraction.

The material so prepared is applied in even and uniform layers by means of a powerful stream of compressed air with a special machine named the "Tector," especially designed by me for this purpose. For the material combination thus described the name "Torcrete" has been adopted. It is really a waterproof concrete of highest possible quality.

After the last coat of Torcrete has sufficiently hardened, the outer surfaces are rubbed down to an even, smooth finish with rotary compressed-air-driven grinders, and the entire ship may be painted as usual.

These, of course, are only the general outlines of future cement, or rather Torcrete, ship construction. These methods can also be advantageously employed for reconstruction and repair of old steel ships and for placing of bulkheads, tanks and decks in old hulls.

The principal advantages of the Torcrete ship are its low cost and the rapidity with which such vessels can be built. However, even at a considerably higher price, its use would be of greatest value for cargoes which require even temperatures and which are destructive to steel. For tank barges, ore and coal boats, refrigerator ships and similar vessels, the advantages of a non-rusting ship will be quickly recognized. Improvements will be made as quickly as the development suggests, and of course the combined experiences and efforts of marine, concrete and structural engineers must be utilized to the fullest extent.

CARL WEBER,
President, Cement-Gun Construction Company.
Chicago.

Longest Span Slab Used in Chicago Hospital

SIR: It is to be regretted that J. Norman Jensen did not give more data in regard to the 36-ft. 15-in. tile hospital floor described and illustrated in the Engineering Record of Aug. 19, page 233, and show where it does or does not meet the requirements of the Chicago building code. In this code we note that 1:2:4 concrete is limited to 700 lb. extreme fiber stress, also that the clear space for concrete below steel must equal the diameter of bar, which, in this case, would place the center of steel 1½ in. from the bottom and 16½ in. from the top.

Making use of the portion of the web of beam below the flange as being more favorable than the use of the flange alone, we find the neutral axis to be 6.08 in. below the top and the effective depth to be 14.47 in. The weight of this floor, including 6 lb. for the plastered ceiling below, and steel is about 128 lb. per square foot, which with 50 lb. for the live load gives a total load of 178 lb. per square foot. As no reinforcement is shown in the top at the ends, this beam must be considered as discontinuous, and $wl^2/8$ must apply. The resulting moment at the center is 489,900 in.-lb.

The extreme fiber of the concrete is stressed to 806 lb. per square inch. This is 15 per cent above the allowable code value of 700 lb. per square inch.

A great many architects and some engineers seem to think partitions have no weight, and these are neglected in their calculations. In the article referred to the statement is made that with this design the partitions can at any time be shifted to whatever position any new arrangement of rooms may dictate. Now, assuming an 8-ft. corridor and a 12-ft. ceiling and light partitions of, say, 3-in. "Pyrobar" weighing 16 lb. per square foot, we obtain a moment in the beam of 46,700 in.-lb., and for the partition between the rooms a moment of 225,800 in.-lb. if taken by one beam, or 112,900 in.-lb. if divided between two beams, or 75,260 in.-lb. if distributed over three beams. Taking the latter supposition, we have 489,900 + 46,700 + 75,260 = 611,860 in.-lb., producing a stress in the extreme fiber of the concrete of 1000 lb. per square inch, which would require 2.35 sq. in. of steel reinforcement in the bottom, against 2 sq. in. shown. If a reinforced-concrete floor or other structure after being "skinned" will pass the building departments simply upon test, why not make the test method apply to steel construction as well?

CHARLES F. SERVISS,
The Walter P. Rice Engineering Company.
Cleveland.

[The foregoing letter was submitted to Mr. Jensen, and his reply follows.—EDITOR.]

SIR: In reply to the communication of C. F. Serviss, I beg to advise that the design in question met with the approval of the engineers of the Building Department of Chicago, and the test was also satisfactory to this department. As Mr. Serviss did not clearly show how he obtained the results he did, it was impossible to check his figures.

In regard to the sweeping denunciation of architects, I wish to state that this design was prepared by a firm of architects whose fame in certain lines of building construction is national. It seems almost a waste of energy to discuss and attempt to prove the weakness of a piece of construction which was carrying, without any evidence of failure, a load five times the live load for which it was designed.

J. NORMAN JENSEN,
Chicago. Architectural Engineer.

To Compute Properties of Unsymmetrical Sections

SIR: The article in your issue of Dec. 2, page 682, entitled "To Compute Properties of Unsymmetrical Sections," is another illustration of the saying, "There is nothing new under the sun," as the identical method illustrated was shown in the first edition of "Osborn's Tables," published in 1886, thirty years ago.

FRANK C. OSBORN,
Consulting Engineer.
Cleveland.

SIR: I noticed in your issue of Dec. 2 an article on page 682 giving a method of computing moment of inertia of box sections. This identical method is one which I have used for a number of years and which I presented in my book on plate-girder design, which was published in 1913 by the McGraw-Hill Book Company, Inc.

LEWIS E. MOORE,
Bridge and Signal Engineer, Massachusetts Public Service Corporation.
Boston.

[It was realized, when published, that this was an old method; however, for the benefit of the many students and engineers found to be using the longer methods, it was decided to present it.—EDITOR.]

Colorado Town Cannot Prohibit Pavement Use by Ordinance

Fort Collins, Col., tried to prohibit by ordinance the use of its new paved district by wagons hauling beet pulp, but it has had to repeal the ordinance to comply with injunction orders of the district court.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Full-Width Iron-Shod Screed Gives Crown to Concrete Road

By J. M. OATES, Jr.
Superintendent, Pittman Construction Company, Atlanta, Ga.

IN ORDER to give the required curved crown to an 18-ft. concrete road, a full-width screed shod with No. 12 gage iron has been found to be rapid and satisfactory. This screed, illustrated in one of the photographs, is built up of two $\frac{7}{8}$-in. boards 8 in. wide at the ends and 20 ft. long, trimmed on the lower edges to the desired curved outline for the road surface to a crown of 2 in. in 18 ft., making them 6 in. wide at the center. The boards are fastened with screws to 2 x 4-in. blocks spaced about 2 ft. 3 in. apart, and shod on the bottom with No. 12 gage iron 8 in. wide, turned up 1 in. on each side and screwed to the boards on side and bottom and to the separating blocks, using countersunk screws on the bottom.

Two handles at each end are made of bent $\frac{3}{4}$-in. round iron and a $\frac{3}{4}$-in. pipe 6 in. long, fastened through end blocks by $\frac{1}{2}$-in. bolts 7 in. long. To give weight to the screed, the trough between the boards may be filled with stone or earth. In operation, the screed is handled by one man at each end and supported by the 2 x 4-in. timber form boards on the sides, being pushed back and forth to bring the concrete down to the exact level. A long-handled roller is then run over the surface, which is finished by dragging with a $\frac{3}{4}$-in. hose.

CONCRETE ROAD MATERIALS DELIVERED ON PLANKING PRESERVE SUBGRADE

The concrete aggregates were delivered on a plank roadway placed on the completed subgrade for a distance of 1000 ft. This distance was just sufficient to store enough material for two days' run of the mixer. For this roadway 2 x 8-in. pine boards 16 ft. long were used.

Another special feature of this concrete road work is the use of a simple expansion joint detail. These joints are located every 25 ft. by placing a $\frac{7}{8}$-in. board supported by six $\frac{7}{8}$-in. round iron pins 16 in. long hooked over the top and driven 8 in. into the subgrade. Tar paper is laid against this board, with the top edge 2 in. below the top of the board, to which it is held by $1\frac{1}{2}$ x $\frac{1}{8}$-in. iron staples 9 in. long. Thus when the concrete is placed no evidence of the joint appears at the surface, but the contraction occurring in winter weather causes cracking at the plane of weakness above the tar-paper joint.

FULL-WIDTH SCREED LEVELS AND CROWNS CONCRETE ROAD—ROLLER FOLLOWS

The road here described is called the Mason and Turner Ferry road, located a few miles outside of Atlanta, Ga. It is 2.25 miles long and connects with the Hightower road, which is 1.7 miles long and of similar construction. Both roads are being built, under the supervision of the writer, by the Pittman Construction Company, of Atlanta.

Temporary Studs Aid in Spacing Steel for Circular Reservoir

By D. H. MATHIAS
Circular Concrete Company, Minneapolis, Minn.

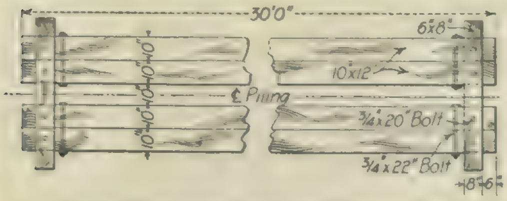
VERTICAL 2 x 4s in which 20d. spikes were driven at proper intervals were used recently to support in exact position the horizontal steel reinforcing for a small circular concrete reservoir, constructed by the writer's firm, until this steel could be wired securely to the vertical reinforcing rods. The proper placing of the horizontal steel in reinforced-concrete tanks and bins of the circular type is of the first importance if the strength of the steel is to be developed, but is a matter of considerable difficulty from a practical point of view, especially with thin walls, as those who have built such structures are well aware. Though the practical difficulties might be solved by designing the steel with closely spaced vertical rods of large size, such a design, in most cases, would require considerably more steel than is really necessary.

The concrete reservoir referred to, which was completed this year, is 32 ft. in diameter and 15 ft. deep. Wood forms were used. The outside forms and vertical steel rods were set first. Next, sixteen of the 2 x 4s mentioned, with the 20d. spikes, driven just through them at proper intervals in the flat side, were stood up around the outside of the circle to which the horizontal reinforcing was set, with the heads of the nails projecting inward. These uprights were then fastened securely to the outside form so that when the steel was placed on the spikes and against the 2 x 4s it was at the proper distance from the outer surface of the wall. After the horizontal steel had been properly fastened to the vertical rods, forming a stiff structure which had been erected in correct position before it was required to carry its own weight, the spikes were pulled from the inside of the reservoir and the 2 x 4s removed.

Rigid Guide Frame Holds Wood Sheet Piles

By C. LOUIS ZULL
Inspector, U. S. Engineer Office, Florence, Ind.

AN EXTRA-HEAVY and rigid frame, shown in the sketch, has saved time and given satisfactory results in driving with swinging leads the 10 x 12-in. wood sheeting required under the lock and guide walls at government dam 39 on the Ohio River. More than 3500 of these piles, from



STIFF RUNWAYS PREVENT TWISTING

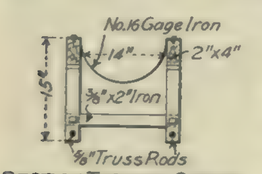
20 to 25 ft. long, are required for this part of the dam. Each pile is made by spiking to the 10-in. sides of a 10 x 12-in. timber a 3 x 4-in. tongue on one side and two 3 x 3-in. pieces to form a groove on the other.

The runway, the construction of which is shown in the sketch, was built with the center space exactly 10 in. wide, so that the stiffness of the construction would be developed to hold the piles from twisting out of line. In setting it, the cross-piece at one end rested in an 8-in. notch cut out between the last two piles driven. The other end was set to line, and braced securely on each side to prevent shifting. Twenty-two piles could be driven before the runway need be moved, so that, once set, it was good for 12 to 16 hours' driving. Moving required only about 20 minutes, the runway being handled with the pile line.

Dam 39 is being built by U. S. Government forces in charge of L. H. Prell, assistant engineer. Charles E. Hammell, junior engineer, is in charge of the inspection.

Emergency Chute Made Cheaply of 2 x 4s and Sheet Iron

CONFRONTED with the necessity for a substitute length of chute in the construction of a $250,000 building at Tacoma, and with 10 to 15 days required to order and receive a new length of steel chute, Mr. Pearson, superintendent for the contractors, built the wood-and-sheet-iron chute shown in the photograph for $35, and put it to work without delaying the job. As indicated in the sketch, the chute is made of No. 16 gage sheet iron bent to a semicircle and nailed at the sides to 2 x 4-in. pieces. The chute is 24 ft. long, and the center 14 ft. of this length is trussed with 5/8-in. rods secured to the 2 x 4s with brackets of 2-in. strap iron. The bottom section of sheet iron projects about 3 ft. beyond the end of the 2 x 4s, and a hopper 30 in. long and 10 in. high is built on the upper end. It is stated that the home-made chute cost about half the price, delivered to the job, of a manufactured chute of the same length.



SECTION THROUGH CENTER

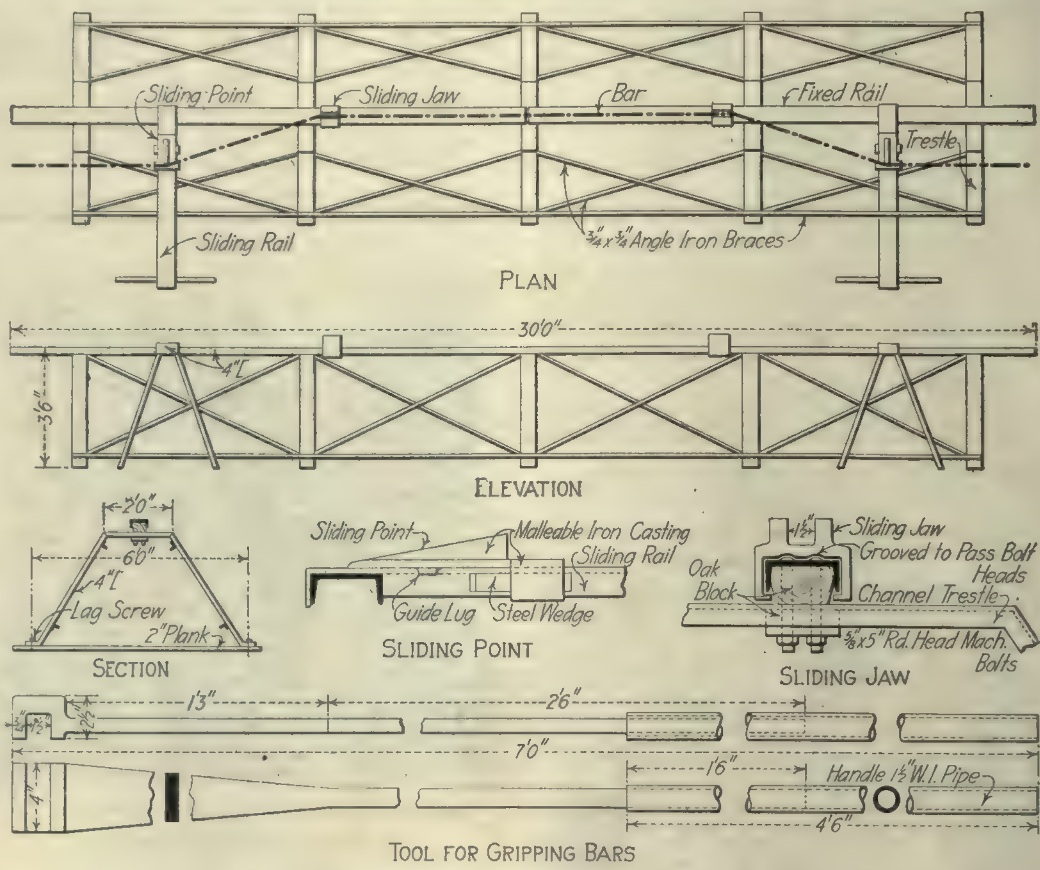
The building in question, known as the Jones Block, is being erected by the Realty Construction Company of Tacoma.

WOOD AND SHEET-IRON CHUTE, BUILT ON THE JOB, SAVED TEN DAYS' DELAY

Bend Both Ends of Bar at Once on Rigid, Durable Bench

By GEORGE W. DAVIDSON
Providence, R. I.

A RIGID, durable steel bench which can be quickly set to make any sort of bends in reinforcing bars up to $1\frac{1}{2}$ in. square, and on which both ends of a bar may be bent at the same time, was recently built by the writer while steel foreman on a reinforced-concrete contract, and has given satisfactory service on two consecutive jobs of this sort.



FOUR MEN CAN REACH LARGE OUTPUT DOUBLE-BENDING EACH END OF BAR AT SAME TIME

The main part of the machine is a 30-ft. fixed rail made of two 15-ft. lengths of 4-in. channel mounted on five angle-iron trestles. At right angles to this rail, and built, as shown in the details, so that they can be moved along it, are two sliding rails supported at their outer ends by angle legs. These also are made of channels. Between the two sliding rails on the fixed rails are mounted two movable jaws. On each of the movable rails is mounted a sliding point, which is used to gage the first bend and against which the second bend is made. A scale is marked on each of the three rails, so that the jaws, movable rails and points can be quickly set without the use of a rule to make a double bend ranging in offset from 3 in. to 4 ft. The bending tools shown in this sketch are used to afford sufficient leverage to make a sharp bend quickly. Plate washers are used in the jaws when bars of less than the maximum size are bent.

In using the machine a bar is laid in the two movable jaws. One man with a bending tool standing outside the bend grips the rod and bends it over past the movable point and a second man with another tool catches the rod beyond the movable point and bends it back against it. A large output can be obtained with the machine by using four men, bending both ends of the bar at once, and having extra laborers to supply and take away the bars.

The machine is rigid, durable and large enough for bending any steel ordinarily required. On the other hand, it is readily knocked down for shipment, and two men can erect it in an hour. Five men can move it around the job. With this machine two men can bend $1\frac{1}{4}$-in. square bars steadily without fatigue.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Illinois Central Presents Electrification Plan

For Suburban Service in Chicago Within Next Five Years—Ordinance Submitted to Railway Terminal Commission

Electrification of the suburban service in Chicago by the Illinois Central Railroad within five years after the beginning of construction on its new terminal is a feature of the ordinance presented by the road Dec. 14 to the Railway Terminal Commission. The document contains the concessions asked of the city in the construction of the new terminal and extension of the railroad system upon shoreline property acquired from the South Park Commission in lieu of the company's surrender of its riparian rights.

The company asks permission to build a four-track subway in Grant Park between its present right-of-way and Michigan Avenue. This subway may be subject to joint use of any future traction subway system. The plans for the new passenger terminal include track facilities for the accommodation of all roads now entering the La Salle and the Dearborn stations.

Other Provisions of Ordinance

The ordinance also provides for the establishment by South Park commissioners of five bathing beaches between Twelfth and Fifty-first streets, and for the construction of the Eighteenth Street connection, bringing practically all of the railroads into communication with harbor district No. 3, between Sixteenth and Thirty-fifth streets. Indiana Avenue is to be widened to 100 ft. and extended diagonally across the block lying east of Michigan Avenue between Thirteenth and Twelfth streets, railroad property upon which the present station stands is to be dedicated as part of Grant Park, and the company is to be allowed to fill in five slips near Randolph Street and use ground for railroad purposes. The ordinance also says that disputes regarding terms of ordinance are to be settled by arbitration, and prior grants canceled and rights defined are to be granted in perpetuity.

Railroad's Point of View

In a statement emphasizing the railroad's point of view and benefits to the public, C. H. Markham, president, said that the proposed scheme of operation would eliminate 70 to 80 per cent of the switching and smoke from the downtown lakefront. "Location of the road on the lakefront always has been a liability and not an asset, as is generally believed, and the only way the company can be recompensed for surrender of its riparian rights along the lakefront, and in addition thereto surrender of the site for the Field Museum, the widening of Indiana Avenue and extension of Twelfth Street and Grant Park, will be in the securing of rights to use the new property acquired under contract with the South Park commissioners for purposes which will permit of arranging with other railroad companies to use its passenger terminal."

Open South Tube of East River Tunnel

The final blast in the south tube of the tunnel from Old Slip, in Manhattan, to Clark Street, Brooklyn, New York City, was fired last Tuesday morning. This tube is for the eastbound trains of the dual rapid-transit system, and, like its twin, the north tube, which was opened Nov. 28, will connect the Seventh Avenue subway with the first subway in Brooklyn.

Highway Officials Convene in St. Louis

Twenty-five States Represented—Think Expansion Joints in Concrete Roads Unnecessary —Maintenance Serious Question

The third annual meeting of the American Association of State Highway Officials was held Dec. 5, 6 and 7 at St. Louis, with representatives from twenty-five states in attendance. The federal-aid road bill, road-surfacing materials and their cost, maintenance of roads, highway legislation and bridge patents and recent decisions were among the subjects discussed. The interpretation by the Secretary of Agriculture of the federal-aid road bill, which had been drafted by the association, was given considerable prominence. While the officials were not in full accord with the interpretations of the secretary and with the rules and regulations that he promulgated for the operation of the bill, it was the consensus of opinion that this was co-operative work and that the state highway departments were ready to try the secretary's interpretation of the bill and his rules and regulations and do everything possible to make the act a success in furthering the construction of roads.

New Field for Use of Bitumen

In the discussion relating to surfacing materials information was given that indicated the opening up of a new field for the use of bitumen in road surfacing. This was in connection with the construction of sand-clay, topsoil and gravel roads, such as are being built so extensively throughout the South. Many officials stated that they did not consider it necessary to use expansion joints in concrete roads, but that the concrete after it was set would crack, and then these contraction cracks could be used as expansion joints.

One of the principal points brought out in discussing brick pavements was that while formerly it was considered necessary to lay the brick on a sand cushion, now the brick is laid in green cement, with better results. Photographs were exhibited of a working model of a paving machine used in laying pavements in the shops of the William Bayley Company, Springfield, Ohio. The device prepares the foundation for the brick, places the grout, shapes it, and lays either brick, asphalt blocks, wood blocks, or other form of block pavement.

It was shown that the question of maintenance of public roads is one of the most serious now confronting state highway departments. All agree that provision must be made for the maintenance of roads as fast as they are built.

When the subject of bridge patents and recent decisions was introduced, it was learned that many state highway departments have experienced considerable inconvenience and expense in regard to certain patents that have been awarded in connection with bridge designs. It was thought that some of these claims ought not to be patented. Among them were patents on straight or curved wing walls below the roadway level, protection apron projecting downward into bed of stream, horizontal projection depressed below pavement, spandrel or girder cantilevered on abutment, and claims in regard to re-alignment of coping formations.

The officers elected at this meeting for the ensuing year were: George P. Coleman, Richmond, Va., president; A. B. Fletcher, Sacramento, Cal., vice-president; Joseph Hyde Pratt, Chapel Hill, N. C., secretary; F. F. Rogers, Lansing, Mich., treasurer; W. D. Uhler, Harrisburg, Pa., chairman executive committee.

12,000 Snow-Fighters Prevent New York Traffic Tieup

Commissioner Fetherston Mobilizes Emergency Force at Quick Notice and Uses 102 Motor Snow Plows

New York City's snow-fighting system, which John T. Fetherston, street cleaning commissioner, has been perfecting for several years, met a severe test last week when it was called upon for the first time this season to clear away a 12-in. fall of snow occurring between 6 a. m. and 9 p. m. Friday, Dec. 15. A few hours after the first flakes had settled upon the city streets 12,000 emergency workers and regular street-cleaning department employees had been mobilized, and their efforts, reinforced by 102 motor-driven plows and the use of the municipal sewerage system as a means of snow disposal, succeeded in preventing any serious tieup of traffic, in spite of the unusual severity of the storm. The response to the call for emergency snow-fighters exceeded all expectations of street-cleaning department officials, for with the present condition of the labor market great difficulty had been anticipated in recruiting the force up to a strength sufficient to cope with a real storm. A strike of garment workers in New York, however, is believed to be responsible in part for the large turnout.

Emergency Men Called

The Weather Bureau notified the Department of Street Cleaning that a heavy snowfall could be expected on Dec. 15. At 9:25 a. m. the automobile snow plows of the snow-fighting force were ordered to start work. At 10 a. m. the snow-fighting force (emergency laborers and regular D. S. C. sweepers) began work in the various districts, and by 1 p. m. 12,000 men were at work clearing crosswalks and nearside car stops and sewering and piling snow, each gang in its appointed place with the necessary equipment of shovels, picks, pan scrapers, red flags, hose, etc. This first shift of laborers worked until 11 p. m. Friday, when a second shift was started, composed of 6000 emergency laborers and half the regular sweeping force, the latter acting as squad leaders. These 7500 men worked from 11 p. m. Friday until 8 a. m. Saturday.

One hundred and two 5-ton motor trucks, with snow plows attached, started work on Friday, and continued all day until 8 a. m. Saturday. On Saturday morning 1300 contractors' trucks and 1500 laborers started carting snow, and continued work all day Saturday.

Pay $36,000 in Silver

After the last snow-fighting shift, ending at 8 a. m. Saturday, 5320 emergency laborers and 1500 sweepers continued snow work, sewering and piling until 5 p. m. Saturday, when payment to 12,000 snow-fighters, who worked Friday and up to 8 a. m. Saturday, was started and finished by 8 p. m. This is said to establish a new record for prompt payment of emergency laborers by municipalities, where the usual red tape of making out, certifying and auditing payrolls must be complied with. The men were paid at 106 different points in Manhattan, The Bronx and Brooklyn, and as the banks closed at 12 o'clock Saturday it was necessary to secure money promptly. More than $36,000 was paid in silver, as no bills were procurable.

Work continued Saturday night in the downtown section of Manhattan only, where 200 contractors' trucks and 400 laborers worked.

On Sunday morning every possible force was put to work on the snow job, including all

regular employees of the street cleaning department and as many emergency laborers as could be secured. The total force on Sunday amounted to 10,000 laborers and sweepers and 3610 vehicles.

The total depth of snowfall given by the Weather Bureau amounted to 12 in. The snowfall started about 6 a. m. on Friday, Dec. 15, and continued falling heavily until about 9 p. m., then intermittently until 2 a. m. Saturday.

By Saturday morning, according to the department records, all main arteries had been plowed and the snow piled so that traffic moved freely. Most of the side streets had been either plowed or piled. By 6 p. m. Sunday most of the snow was removed from the main arteries and important crosstown streets. The total area scheduled for snow work is over 30,000,000 sq. yd., equivalent to a roadway 60 ft. wide reaching from New York to Chicago (950 miles).

The surprising fact developed in the snow-fighting force was that 9000 men reported for work without special notice on the part of the Police Department, and very few of these men had registered in advance of the snow job. Just where the men came from is not at all certain, but there is a garment workers' strike on in New York, and possibly a great many of the garment workers applied for snow jobs. The City College, Columbia University and New York University were requested to send students. Some of the students volunteered to shovel snow, but the number who actually did work is not known at this time.

Snow-fighters are paid 30 cents an hour. After the storm is over, when emergency labor is employed, the men are paid 25 cents an hour. Each shift runs for 9 hours, and 4 hours are allowed for the first shift to get under way. Thus, men on the first shift may work 13 hours, if they report at the station at the time the call is sent out.

Highway Conference January 29 to February 3 at Pittsburgh

The Pennsylvania State Highway Department will again co-operate with the University of Pittsburgh in offering a conference on highway construction and maintenance in Thaw Hall, University of Pittsburgh, from Jan. 29 to Feb. 3 inclusive. While the course is intended to be a continuation of the subjects discussed at last year's short course in highway engineering, the conferences will be so arranged that those not present last year may take up the work with those who attended. The leaders in the discussion of the various subjects will be selected from the state highway department officials, school of engineering faculty and others.

A new building for housing the laboratory for testing highway materials, now in process of erection, will be completed in time for use during the conference. Those desiring tests of materials should send their samples to Professor L. C. McCandliss not later than Jan. 15. No charge will be made for tests to those attending the conference. A registration fee of $5 is charged.

American Waterworks Association Convenes in Richmond Next May

The thirty-seventh annual convention of the American Waterworks Association will be held at the Jefferson Hotel, Richmond, Va., May 7 to 11, according to an announcement just issued by President Leonard Metcalf. Several important committees will report at this meeting, among them those on electrolysis, water consumption and private fire protection. Some important changes in the constitution also will be considered. The executive board urges members to send at once to the secretary suggestions for papers or topics for discussion. It is planned to devote at least three full sessions to "Superintendents' Day" if the superintendents will provide the material to fill the time. The nominating committee has selected the following candidates for offices in the association during the ensuing year: President, Theodore A. Leisen, general superintendent, Board of Water Commissioners, Detroit, Mich.; vice-president, Charles R. Henderson, Davenport, Iowa; treasurer, John C. Trautwine, Jr., civil engineer, Philadelphia; trustees, Beekman C. Little, superintendent of waterworks, Rochester, N. Y., and Henry B. Morgan, manager, waterworks company, Peoria, Ill. Additional nominations, indorsed by twenty-five members, may be made up to Feb. 7, 1917.

Illinois Commission Adopts New Rule for Examining Highway Engineers

Because the old ruling made it necessary for applicants to go to the expense of coming to Illinois to be examined, which resulted in few applications from engineers outside of the state, the Civil Service Commission of Illinois has adopted a new plan for examining applicants for positions as junior highway engineers. Under the new arrangement, unassembled examinations will be made and the applicants will mail their papers to Springfield.

The first examination under the new ruling will be held Feb. 3. It is open to all citizens of the United States. The salary is $75 to $120 a month.

Seattle Engineering Societies Consolidate

The consolidation of the six engineering societies of Seattle was recently announced by John L. Hall, temporary president of the Associated Engineering Societies of that city. The joint council of the organization met Dec. 9 and effected a permanent organization. The object of the consolidation is to promote the welfare of engineers and engineering and of the public as affected by engineering matters. The various organizations will not lose their individuality, but the members of each society will be members of the Associated Engineering Society. Represented in the newly organized society are the Pacific Northwest Society of Engineering, Washington Association of Engineers, Seattle Association of Members of the American Society of Civil Engineers, Puget Sound section of the American Institute of Mining Engineers, Seattle section of the American Institute of Electrical Engineers and the Puget Sound section of the American Chemical Society.

Meetings will be held at stated intervals, public problems discussed and technical papers read, looking toward the betterment and advancement of the engineering profession. Quarters will be engaged for a library of technical literature and for a meeting place.

Announce Nominees for Railway Engineering Association

John G. Sullivan, chief engineer of the Western Lines of the Canadian Pacific Railway, has been announced as nominee for president of the American Railway Engineering Association for the coming year. Earl Stimson, engineer maintenance of way of the Baltimore & Ohio Railroad, is nominated for vice-president. George H. Bremner and E. H. Fritch are renominated for treasurer and secretary respectively.

Three directors are to be chosen from the following nine nominees: J. A. Atwood, Pittsburgh & Lake Erie; Hadley Baldwin, Cleveland, Cincinnati, Chicago & St. Louis; W. H. Courtenay, Louisville & Nashville; L. A. Downs, Illinois Central; S. B. Fisher, Missouri, Kansas & Texas; H. E. Hale, Presidents' Conference Committee; John D. Isaacs, Southern Pacific; E. H. Lee, Chicago & Western Indiana, and E. B. Temple, Pennsylvania.

Five members of the nominating committee are to be selected from these ten candidates: J. R. W. Ambrose, Toronto Terminals; George H. Burgess, Delaware & Hudson; W. M. Dawley, Erie; V. K. Hendricks, St. Louis & San Francisco; W. T. Dorrance, New York, New Haven & Hartford; B. H. Mann, Missouri Pacific; J. A. Peabody, Chicago & North Western; S. T. Wagner, Philadelphia & Reading; C. A. Wilson, consulting engineer, and H. S Wilgus, Pittsburgh, Shawmut & Northern.

Engineers Will Take Most Prominent Place After the War

The important position in the life of the United States which will be occupied by the engineers of the future was the subject of the address by Newton D. Baker, Secretary of War, at the Washington Society of Engineers' annual banquet in Washington, Tuesday evening, Dec. 5. The part engineers are going to play in the making of the new civilization probably is more important than that of any other profession, said Mr. Baker. In the industrial and commercial undertakings in the next eight or twelve years, engineers are going to be a vastly important factor, Mr. Baker believes.

"We of America must meet the Europe which, after the war, will be working with might and main for common good," he continued. "The engineer is going to take his place alongside of the politician in making possible the vast extension of activity in our country. I find in my observations in the War Department that war is becoming more dependent on engineering than on the contributions of any other science. This government is fortunate in that it has always had a great corps of engineers of all kinds who now can be mobilized in preparation for a new era."

Long Sault Development Loses in Supreme Court

The United States Supreme Court recently held that the decision of the Court of Appeals in the Long Sault Development Company's case presented no question for decision under the Federal Constitution, and for want of jurisdiction dismissed the writ of error. This action was brought by the Long Sault Development Company, to which the Legislature of New York in 1907 granted rights to the use of the bed of the St. Lawrence River, subject to approval by Congress, against John J. Kennedy and later against Homer D. Call, as treasurer of the state.

The Court of Appeals held that the legislature had no power to grant to the development company the right to the land under a navigable stream to which the people of the state had a right of ownership for any possible public use.

Community Activated-Sludge Plant for Chicago Stockyards

Engineers of the stockyards interests and the Sanitary District of Chicago, after making a joint study of the proper disposal system, agree that the activated-sludge method will handle the sewage in a manner which will produce an effluent suitable to discharge into the main channel of the district. They also conclude that a community plant to take care of all the wastes from all the packing industries is better than the disposal by each company of its own wastes. The second question put to the engineers was as to the works, expenditures, appliances for collection and disposal, location, cost of installation, repair maintenance, operation and revenue that might be expected. A preliminary report states that, having concluded that activated sludge will do the work, effort is now being directed toward answering the second set of questions. Langdon Pearse represents the Sanitary District of Chicago and W. D. Richardson the packers.

Two Highway Engineering Sessions Next Week in New York City

It has been decided to hold two joint meetings Dec. 28, to discuss highway engineering, in the assembly hall of the Automobile Club of America, New York City. These sessions are being promoted by Engineering Section D of the American Association for the Advancement of Science, which organization convenes Dec. 26 to 30. The first session, at 2 p. m., will be devoted to a consideration of road subjects to be included in the civil engineering curricula of universities and colleges. At the second session, beginning at 8 p. m., research papers in various fields of highway engineering will be presented, including several pertaining to the use of motor trucks and their relation to highway construction.

Popularizing the Water Department

Giving free samples of its product in every variety is a part of the policy of the water department of Hope, Ark., as evidenced by the picture. The well shown was installed by the municipal department, which controls the cen-

FAUCETS ARRANGED TO GIVE RESIDENTS CHOICE OF WATER FROM THREE DIFFERENT LEVELS

tral station and the waterworks. The faucet on the left gives fresh water from a 500-ft. level, that in the center from a 1480-ft. depth and the one on the right supplies mineral water from 2685 ft. below the surface. The arrangement is said to be extremely popular with the townspeople.

Engineers to Lay Out Motor-Truck Routes in Cleveland

Residents of certain districts in Cleveland have complained so much about the annoyance and damage to light pavements that the city council has ordered the commissioner of engineering, in making plans for the expenditure of $3,000,000 for a repaving program recently voted, to consider the question of laying out routes to which drivers of motor trucks will be required to confine themselves. A request was also made for a report on the advisability of legislation which will restrict commercial motor trucks to certain routes, except in cases where they are required to deliver material upon residence streets.

Engineering Society Activities

Engineers' Society of Western Pennsylvania held its annual banquet recently at the William Penn Hotel, Pittsburgh. Among the speakers were Major-General George W. Goethals, who told about the construction of the canal and its relation to the extension of America's commercial interests, and William L. Saunders of New York, ex-president of the American Institute of Mining Engineers, who spoke on "The Engineer in Civic Life." More than 1100 were present at the largest banquet in the society's history.

Engineering Association of the South has plans under way for disbanding. The various sections will probably continue as local societies. The Nashville section has already begun organizing its members into the Nashville Engineering Society.

Idaho Society of Engineers will hold the seventh annual convention Jan. 18, 19 and 20 in Boise in conjunction with the conference of the operation and maintenance engineers of the U. S. Reclamation Service, to be held Jan. 16, 17 and 18. The program is not yet available.

Illinois Association of Members of the American Society of Civil Engineers at the Dec. 11 meeting elected the following officers: President, C. F. Loweth; vice-presidents, A. N. Talbot and A. S. Baldwin; secretary-treasurer, E. N. Layfield, secretary Western Society of Engineers. The executive committee was asked to take under advisement the proposition of increasing the activities of the association along technical and social lines, both of which heretofore have been left entirely to the Western Society of Engineers.

Providence Engineering Society has added 300 new members. Frederick H. Newell, professor of civil engineering at the University of Illinois, will address the society Dec. 27. The subject of his paper will be "Home Making in the Arid West." He will show slides of work the Reclamation Service has been and is now doing.

San Diego Branch of the American Society of Civil Engineers at the annual meeting held in that city on Dec. 1 elected the following officers: President, W. J. Gough; vice-president, W. S. Post; secretary-treasurer, J. R. Comly. Following the election an illustrated lecture on the "Development and Construction of Water Systems" was given by H. N. Savage, consulting engineer for the Sweetwater Water Company.

What Engineers and Contractors Are Doing

H. W. LEWIS, who had charge of concrete jetty construction on the Shark River at Belmar, N. J., has resigned to enter the employ of Westinghouse Church Kerr & Company. Mr. Lewis will go to Matanzas, Cuba, to build a masonry dock and sea wall.

J. H. BYRD, formerly with Smith, Rea & Leavitt, architects, of Kansas City, has been made secretary-treasurer of the Collapsible Joint Form Company, of that city. The firm has just been incorporated and has headquarters in the Finance Building.

HARRY H. SCHOEN, who has been in the employ of the Interstate Commerce Commission, Division of Valuation, for the last 2½ years, has resigned. He is now employed by the engineering department of the Minnesota & Ontario Power Company, of International Falls, Minn. Mr. Schoen is a graduate of Rensselaer Polytechnic Institute, class of 1911. Before his employment by the Interstate Commerce commission he was with the Boston & Maine Railroad for 3 years.

JOHN EDWARDS, JR., was recently appointed assistant supervisor of the Connellsville division of the Baltimore & Ohio Railroad, with office at Meyersdale, Pa. He first entered the employ of the Baltimore & Ohio in 1912. The next year he joined the U. S. Forest Service and in 1914 went to Washington to work in the district engineer's office. Mr. Edwards was appointed junior civil engineer for the Interstate Commerce Commission in 1915, which position he has left to return to the Baltimore & Ohio.

S. L. TOLMAN has left the employ of Post & McCord of New York City to go to the Caefer Construction Company at Holyoke. Mass.

C. B. FREEMAN, for the last seven years chief engineer for the William P. Carmichael and the Carmichael-Cryder companies, of St. Louis, will on Jan. 1 become chief engineer of the Walter S. Newhall Company, of Cleveland His headquarters will be in Detroit.

HENRY L. COLLIER, who opened consulting engineering offices in Atlanta, Ga., last year, will on Jan. 1 become chief of construction of that city. Mr. Collier has for many years been active in Atlanta engineering undertakings. He was recently consulting engineer for the Yellow Pine Manufacturers' Association.

S. J. MAAS, assistant office engineer in charge of the computing section of the valuation committee of the Missouri, Kansas & Texas Railway, with headquarters at Parsons, Kan., has resigned to become resident engineer of the Galveston, Houston & Henderson Railroad, with office at Galveston. Mr. Maas succeeds Mr. F. W. Bailey.

F. W. BAILEY, superintendent of bridges and buildings for the Missouri, Kansas & Texas Railway from 1905 to 1911, has resigned to go to the San Antonio & Aransas Pass Railroad as engineer maintenance of way, with headquarters at San Antonio.

F. E. WILMOT, who has been in the service of the Philippine government since 1911, is in the United States on a vacation. He is at present located at Los Angeles and expects to remain in this country until next March.

E. L. CRUGAR, formerly assistant engineer for the Illinois Central Railroad at Chicago, has been made district engineer at New Orleans. He succeeds C. E. Weaver, who was recently appointed engineer maintenance of way for the Central of Georgia Railway.

C. R. HARDING, formerly chief draftsman for the consulting engineer of the Southern Pacific system, is now assistant to the consulting engineer of the New York Central Railroad.

J. H. SCHUCH has been made chief engineer of the Butte, Anaconda & Pacific Railway to succeed Charles A. Lemmon.

ROSCOE L. SMITH has resigned as principal assistant engineer of the St. Paul water department, effective Dec. 15. He is a graduate of Lafayette College of Engineering, class of 1908, and has spent the last 4½ years in the position from which he has just resigned. Mr. Smith has announced no plans for the future.

FRANK M. WILSON of Trenton has been appointed borough engineer of Hopewell, N. J.

MORSE W. REW has resigned as assistant engineer of the Cincinnati Rapid Transit Commission to take a position as assistant to E. K. Morse, transit commissioner of Pittsburgh. Mr. Rew's successor has not yet been announced.

ROSCOE SAWISTOWSKY was recently elected city engineer of Davenport, Iowa.

VICTOR COTNER, who recently formed a partnership with D. T. Cotner and opened consulting engineering offices at Lovell, Wyo., has charge of three drainage projects and also directs the engineering work of that city. The drainage work includes one project at Cowley, another at Lovell and two proposed undertakings at Worland and at Lovell. Vic-

tor Cotner has been engaged on engineering work in the West since 1912.

J. A. GRENIER has resigned as assistant chief engineer of the Bollinger-Andrews Construction Company to become chief engineer of the Andrews Construction Company, Pittsburgh.

GEORGE S. RICE, chief engineer of the U. S. Bureau of Mines, Washington, has been engaged by the province of British Columbia to make an investigation of the Coal Creek coal areas of the Crows Nest Pass Coal Company. He will attempt to ascertain the causes of accidents which have caused many deaths.

FREDERIC V. PITNEY, hydraulic engineer, of Dover, N. J., has been engaged by the local board of water commissioners to arrange for an additional water supply for the city.

J. E. JOHNSON, who has been connected with the engineering department of Illinois since 1912, has resigned to become county superintendent of highways at Princeton, Ill. He will succeed F. R. Bryant, whose resignation becomes effective in February. Mr. Johnson was graduated from Swarthmore College in 1910. His first work was in the construction department of the Pennsylvania Railroad. The following year-and-a-half were spent with the Bell Telephone Company. Mr. Johnson went to Illinois in 1912 and has been employed as inspector of bridges and concrete roads for the state ever since. He superintended the construction of the Marquette Hill and Shippingsport roads near La Salle and also had charge of laying out and building the permanent roads at Starved Rock State Park. He had charge of construction of the monolithic state-aid road at Seneca.

Obituary Notes

THOMAS ELWOOD CALVERT, chief engineer of the Chicago, Burlington & Quincy Railroad, died Dec. 19 at his home near Lincoln, Neb., at the age of 67. Mr. Calvert's engineering experience had been entirely with the railroad which he served forty-five years. He was born near Philadelphia in 1849 and was graduated from Yale University in 1870. The following year he entered the service of the engineering department of the Chicago, Burlington & Quincy. His promotion to the superintendency of the lines west of the Missouri River came in 1875. In 1905 he was made chief engineer.

WILLIAM C. NIXON, president of the St. Louis & San Francisco Railroad, died Dec. 15 in St. Louis in his fifty-ninth year. Mr. Nixon worked his way up from the position of a day laborer. He was born in Earlville, Ill., and began work in 1878 as a bridge carpenter on the Burlington & Missouri Railroad in Nebraska.

Civil Service Examinations

New York—Examinations will be held Jan. 27 for junior assistant in engineering departments, salary $901 to $1,200.

United States—Examinations will be held Jan. 17 and 18 for surveyor, salary $100 to $150 a month and subsistence, and mechanical draftsman, salary $1,000. Forms 1312 and 304 respectively should be filled in by applicants. Examination will be held Jan. 23 for senior structural engineer, salary $3,000 to $4,000 a year. Fill in form 2039. Another examination to be held Jan. 23 is for architectural draftsman, salary $130 a month. Ask for form 2118.

Examinations Previously Announced

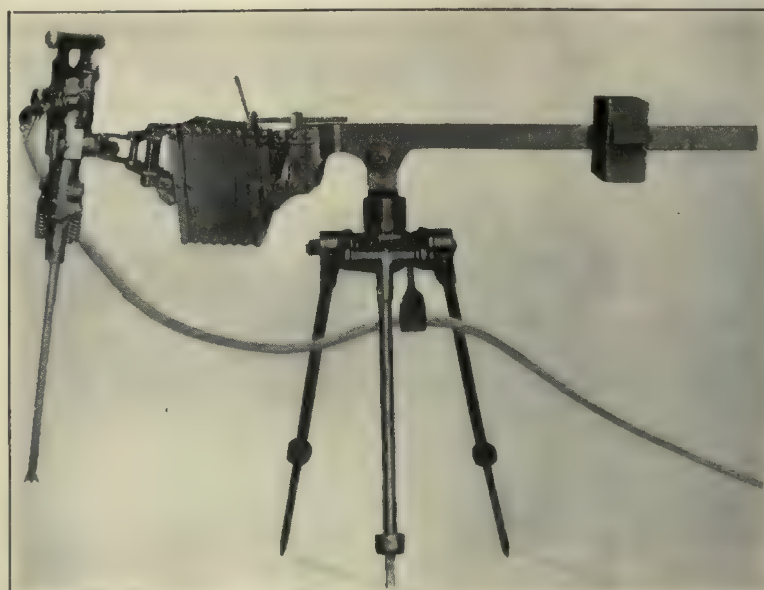
Date	See Eng. Record
Jan. 8. Transitman, United States	Dec. 16
Jan. 8. Examiner of surveys	Dec. 16
Jan. 8. Geologic aid	Dec. 16
Jan. 9. Draftsman, United States	Dec. 16

Should Burn Dynamite Boxes

Owing to the possibility of nitroglycerin leakage of dynamite, due to improper storage, there is danger in making any use of an empty dynamite box, according to E. I. du Pont de Nemours & Company, and all explosive dealers should be instructed to destroy such boxes after demonstrations. The boxes should be burned without being knocked to pieces or split, as wood that has absorbed nitroglycerin is explosive.

Counterbalanced Toolholder Has Flexible Extension Arm

By employing the easy-jack principle to the extension arm of a counterbalanced toolholder, greatly increased range of operation of portable tools to 16 ft. has been obtained. The holder illustrated has been tried out for some



EASY JACK EXTENSION GIVES TOOLHOLDER 16-FOOT RANGE AND IS SAID TO RELIEVE WORKMAN OF WEIGHT AND SHOCK OF TOOL

time on various pieces of construction for which George W. Jackson has been contractor. From experience gained in this work the maker, the Jackson, Schmitz & Shanks Engineering Company, Chicago, makes the following comments: "Where portable tools have to be held to the work by one or more men, it is beyond their strength to get 100 per cent efficiency. With the toolholder the workman is relieved of the weight and shock of the tool and can direct his energy to guiding it. The type shown, mounted on a tripod or on a truck, will take tools weighing from 20 to 150 lb." Some suggested uses are pneumatic riveting, chipping, busting, blacksmithing, holding jack hammers, drills, tamping tools, electric grinders and drills and coal cutters, tools for cutting pavement, breaking concrete and frozen ground, tamping ground and driving sheeting.

Auto Trailers Band Together

The Trailer Manufacturers' Association of America, formed by automobile trailer manufacturers at a recent meeting at Detroit, plans to conduct a publicity campaign to stimulate the use of trailers. George B. Russel of the Russel Motor Axle Company of Detroit, told of the good results of the campaign of the Internal Gear Drive Association. The trailer men decided to leave the details of an advertising campaign to the executive committee, made up of the following: A. C. Geiger, president Troy Wagon Works, Troy, Ohio, president; Miss Kate Gleason, secretary, Rochester (N. Y.) Trailer Company, vice-president; A. P. Warner, Warner Manufacturing Company, Beloit, Wis., vice-president; J. C. Endebrock, Sechler & Company, Cincinnati, secretary-treasurer; S. A. Griggs, Detroit Trailer Company; A. A. Keesler, president Watson Wagon Company, Canastota, N. Y., and James E. Britton, Rogers Brothers Company, Albion, Pa.

Galvanized Wire Mesh with Felt Used as Light Reinforcing

Galvanized wire mesh combined with tarred felt is a new product of the Clinton (Mass.) Wire Cloth Company. "Welded sheathing" is used as a support for plastering and as a light reinforcement for concrete floors and roofs. It is essentially a light grade of Clinton electrically welded wire fabric provided with a tarred felt backing, manufactured by arranging longitudinal and transverse wires on opposite sides of a sheet of tarred felt and electrically welding them together through very small holes previously punched in the felt at each point where a longitudinal wire crosses a transverse wire. In this way the tarred felt becomes an integral part of the wire mesh, and is securely locked and held between the two groups of wires. At the same time the felt has no physical connection to any of the wires. The longitudinal, or so-called carrying, wires are all arranged on the side of the felt to which the plaster or cement mortar is applied. Thus they are entirely unobstructed and become thoroughly embedded in the body of the plaster as the felt bulges slightly away from the wires under pressure of the plasterer's trowel.

Trade Publications

The following companies have recently issued trade literature:

Osgood Company, Marion, Ohio. Circulars 14 and 18 describing excavating machinery. Illustrations show uses.

A. Leschen & Sons Rope Company, St. Louis. Catalog 35, 3½ x 6 in., 94 pages, illustrated. Tables and data on wire rope and aerial wire rope tramways.

Blaw Steel Construction Company, Pittsburgh. Catalog 16, 6 x 9 in., 128 pages and cover, illustrated. Pictures show adaptability of Blawforms for all kinds of concrete work. Well presented and contains information on and pictures of many big jobs in the United States. Divided into chapters, each devoted to one kind of work.

Bucyrus Company, South Milwaukee. General catalog 15, 6 x 9 in., 40 pages, illustrated. Excavating, levee-building, pile-driving and unloading machinery.

Templeton Kenley & Company, Chicago. Catalog describing jack for straightening and pulling poles.

Lowell Wrench Company, Worcester, Mass. Catalog of reversible ratchet wrenches.

Avery Company, Peoria, Ill. Catalog, 8 x 11 in., 80 pages, illustrated. Tractors and steam engines.

Ideal Concrete Machinery Company, Cincinnati. Catalog 27, devoted to concrete mixers.

Engineering Record

A Weekly Journal Devoted to Civil Engineering and Contracting

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A Change in Dress Only

THIS issue of the Engineering Record is the last to appear in the large-page size. Hereafter the dimensions will be 9 x 12 in. It is not without a feeling of regret that the publishers and their friends will witness the passing of the old format. There is something akin to the personal about the comings of a journal that for 40 years has brought the news of the engineering world, that has lived through and with great developments in technical design and construction, that by its optimism has been no small factor in encouraging improvements, that has steadfastly stood for high professional ideals. It will be somewhat of a shock to see this visitor in a new dress. Yet the dress is an incident only. The same point of view, the same principles will control its editorial policy. The same enthusiasm will pervade its staff, the same high ideals dominate it as a whole. And then, in addition, there will be advantages—greater ease in handling and filing. We commend the journal to you in its new size, and beg of you to remember that it is the same Engineering Record, even though it may look, for a time, unfamiliar.

The Part-Time Road Boss

THAT it is just as difficult to serve two masters in the highway field as in any other line of work is the argument advanced by the American Highway Association in a recent bulletin. The reference is to the local road boss who devotes part of his time to the highways and the remainder to farming or some other occupation. While this official occupies a relatively minor position, he is, nevertheless, an important factor in the upkeep of a state's highway system. It is unfair to him and to the roads over which he has charge to expect him to be a jack-of-all-trades. Let him be either a road builder or a farmer—not both. It is asking too much of human nature to expect that the job on the roads will not be neglected when crops need harvesting or there are customers waiting at the cross-roads store. It is not in road-building alone that the part-time official has proved unsatisfactory. The history of public-health work in this country is replete with examples of reduced efficiency due to part-time employment of health officers. No railroad company would think of paying for part of the time of a man to act as section boss and leaving him to use the remainder of his time in his trade. For the same reason a competent man should be put in charge of a large enough system of roads to keep him busy all the time, and he should be retained in office as long as his work is done efficiently and economically. The building and maintenance of roads is not a job which can be well done during a man's spare moments. It demands practical experience and judgment, and these qualities can be acquired only after persistent and continuous service. It is false economy to save the meager salary of a full-time road boss and later pay many times this amount for repairs which, under intelligent administration, would never be necessary.

Water in Concrete

"WE face a revolution in our knowledge of the factors that go to make concrete." Such was the statement made recently by a distinguished investigator after detailing his studies on the influence of different quantities of water on the strength of the concrete mixture. Because the importance of the water content was not appreciated many past investigations are now of little value. They laboriously studied the effect of changes in proportions and in the gradation of sand, while at the same time the varying water content was vitiating results. In this issue Nathan C. Johnson discusses the subject of water in concrete, not from the theoretical, but rather from the practical, standpoint. His article, of the greatest value in the warning it gives, will serve also as an introduction to the data soon to be published on the detailed investigations which justify the opening sentence of this editorial note. One feature of Mr. Johnson's article is sure to arouse considerable discussion—his recommendation that the lighter portions of the mix be wasted. Yet the recommendation, taking practice as we find it to-day, is sound. Moreover, the Engineering Record ventures the prediction that such a provision will before long become standard, or there will be such a radical change in our making of concrete that extensive and dangerous laitance bands will be impossible.

The Heartwood Clause

TWO MONTHS AGO this journal called attention to a certain false sense of security engendered by the lack of a heart specification in the Southern Pine Association's select structural grade of yellow-pine timber. The defect has been remedied, for the following heartwood clause has now been written into the specification: "Unless otherwise specified, select structural material shall show 85 per cent of heart, girth measurement, measured anywhere in the length of the piece. Any greater or less requirement as to heart shall be expressed in terms of per cent of girth measurement. Sap stain is not a defect in this grade." In the previous editorial an unintentional injustice was done the American Society for Testing Materials when it was stated that "the specifications of this organization (the A. S. T. M.) ignore the important difference between longleaf and the two other principal Southern pines." It should have been stated that the specifications of the society do contain heartwood requirements, but that its specifications cover bridge and trestle timbers only. On the other hand, the select structural grade of the Southern Pine Association has been widely sold for all important structural uses. It is hoped, for the benefit of engineers in every line of practice and for the architects, that the society will see fit to adopt a general specification for the highest grade structural timber. Such a specification would be sure to contain a heartwood grade. The action of the Southern Pine Association in adopting the heartwood clause marks a fitting culmination of a development in timber specifications that has been going on for some years.

A Race of Young Engineers

SANTA CLAUS has turned civil engineer. Time was when he belonged in the mechanical-engineering camp. Toy trains—spring propelled—and small stationary steam engines were the finest prizes in his bulky pack. Later, to keep up with the times, he electrified his railroads and added small motors to his stock. Now he seems to place greatest store by ingenious sets of building blocks and of light metal truss frames that lend themselves to the construction of marvelous bridges and windmills and buildings. Metal and wood have been favorite materials, but, as in the field of actual work, concrete now demands consideration. This year there were sets of metal molds for making small concrete, or rather mortar, blocks, accompanied by a stock of mixed sand and cement. All in all, we consider it quite a victory to have made Santa Claus neutral, instead of having him partial to mechanical and electrical engineering. Possibly the race of young engineers will divide more equally hereafter between those whose ambition it is to build bridges and those who want to pull throttles and become wireless operators. Heretofore the two latter callings have had a majority of prospective applicants.

Late-Season Contracts Costly

UNDULY high prices are usually the penalty for failure to prepare contract work in time for letting early in the season. This is particularly true in highway work. Iowa's experience in this regard was detailed in a recent bulletin of the Iowa Highway Commission. As many of the lettings were held late in the season, there was little competition, for most of the large contracting firms had as much work as they could complete by the end of the season. Many of the lettings were for small jobs,

probably a few items that had been overlooked in planning the season's work. Then, too, in order to economize on time, some of the lettings were advertised only a few days before bids were to be submitted and only local contractors received notice of them. On the other hand, boards of supervisors and county engineers who had prepared their plans during the winter and were ready to advertise their whole season's work at one time were able to get their work done at attractive figures. Some of the counties are paying dearly for their neglect of advance planning. Coming at a season when construction is terminated by cold weather, the Iowa advice is exceedingly timely. Engineers can save money by arranging now for work to be begun next spring.

Taxing Education

ATTENTION was called in this journal last week to the clause in the pending Post Office Appropriation Bill which would place a heavy tax on information by raising the postage rates on periodicals and putting them on a zone basis. Last Saturday's newspapers carried the information that while certain members of Congress are proposing to tax the distribution of information the same as we do groceries and discriminate against citizens, by reason of their residence, in their endeavor to obtain educational literature, the Postmaster General has written a letter indorsing a bill for purchase and ownership by the government of the telephone system of the District of Columbia. The author of the purchase measure proposes to buy the system with the "surplus" revenue ($7,000,000) expected next year. We do not believe that the intelligent people of this country will sanction the placing of barriers to the spread of education, particularly when some of the added revenue derived from the procedure is to be used for government-ownership experiments. If you are one of those who do not believe in charging the man in Texas more than the man in New Jersey for magazines he needs in order to keep up with his profession or business, say so to your representative in Congress—both in the House and in the Senate—and do it now.

Annual-Report Time

IT is now annual-report time. If you are a department head, what kind of a report are you going to issue, and when? Are you planning to fill page after page with inconsequential detail and dry statistics, or will you tell the story of the work done in 1916 and what you are planning for next year? Why not make a serious effort to interest the taxpayer? He will listen to what you have to say if you will only talk to him in terms that he can understand. Get out a copy of last year's report—that is, if one has appeared in print by this time—and examine it critically. Consider ways of improving it—of making it readable. Eliminate the paragraph telling how the picket fence around the pumping station was painted. Write a report that will reflect the energy and thought that you and your men have put into your work during the last twelve months. And then when you have finished it do not let it lie around for a year or more before distributing it. If there must be a delay in printing, prepare a condensed version and send it to the newspapers. Get public sentiment behind you. You will find that it will pay handsome dividends when you are trying to get approval for a bond issue to cover the cost of some public improvement.

A Sane View of New York's West Side Improvement

CONTRASTING with the numerous one-sided and hysterical criticisms that have broken into print since the proposed plans for the West Side improvement in New York City were made public last spring is the sane and reasonable discussion of the subject by R. A. C. Smith, Commissioner of Docks and Ferries. Addressing the principal trade organizations of the city, Mr. Smith holds that the commercial needs of the whole city far transcend in importance the issues that are being kept to the front—notably the aesthetic treatment of Riverside Park. As Mr. Smith sees it, the proper development of the city demands prompt relief from existing conditions.

And what are the possibilities for relief? On the one hand we have half a dozen railroads terminating on the New Jersey side of the North River. Each of these roads has its piers up and down the Manhattan side, and each brings over and takes back a flotilla of car floats daily, disgorging vast quantities of food and other local supplies to be hauled away through the streets in the morning, and absorbing equal quantities of other commodities trucked in through the streets in the afternoon. None of these roads reaches more than a few points on the waterfront, and none shows any inclination to join the others in an untried and tremendously expensive belt-line scheme.

On the other hand, one road, the New York Central, runs almost the whole length of Manhattan, reaching terminals and industries all the way, and, granted that its management is ready to make the most of its superior advantages, the line is almost indispensable to New York's daily needs in the way of food. But its facilities are sadly outgrown and it is ready and anxious to spend immediately a considerable sum of money to bring these facilities up to and beyond present needs. At the same time various nuisances incident to present conditions and methods of operation would be eliminated.

Mr. Smith divides into three groups, as follows, the numerous schemes that have been proposed to settle Manhattan's general problem: (1) Those which propose some form of through rail service along the marginal way, to be used by all of the railroads, including the New York Central; (2) those contemplating discontinuance of the through rail service of the New York Central to points south of Thirtieth Street and suggesting the development of joint inshore terminals or some form of store-door delivery, and (3) those giving a separate and independent treatment of the New York Central trackage. As to the first, Mr. Smith thinks, as does this journal, that a bird in the hand is worth two that may possibly be in the bush, and that it is folly to hold back one road ready to make improvements for six not at all ready. As to the second, he thinks the New York Central is legally established so that it could not be ousted, if desirable—and he does not think it desirable. The third class of solution is a compromise. The immediate benefits offered by the New York Central would be accepted, but the way would by no means be barred to whatever development the Jersey roads might join in at some later date.

Accepting as fair and reasonable the general idea of the New York Central scheme, and discounting the charges that the road is seeking a permanent monopoly of all Manhattan, and is in addition trying to bunco the city in the exchange of land, Mr. Smith is able to look past the minor inconveniences and losses inevitable during the construction period and see great social and aesthetic opportunities for the future. Regarding Riverside Park, which has become the center of the argument, he realizes that it is not feasible to press a button and have the tracks slip under the park without disturbing the ground surface; and that to create a larger and finer park the city will have to step in and spend some money after the New York Central has made this possible by removing the barrier of its tracks. To him the all-important thing is that the New York Central will remove that barrier.

As to the feared permanent disfigurement of the park by a barren, unnatural ridge, Mr. Smith does not share the fears. By the simple expedient of examining the model in Grand Central Station he has found that there will be little evidence of any ridge if the typical park plant life will grow on the 3 ft. of soil over the tunnel roof, while he calls an eminent landscape architect to witness that the vegetation on this 3-ft. made depth will have somewhat the advantage of that at present thriving on the rock-bound slopes. If further irregularity is desired at certain points for landscape effects, it can be had if the city will pay the extra cost of the roof.

It seems to this journal that Mr. Smith has presented a sane analysis of the situation. Without any inclination to deliver the city body and soul to the New York Central Railroad, he recognizes the dependence of the city for its daily needs on the West Side line. He also realizes that the line has been outgrown, and is glad to foster the company's readiness to bring it up to present needs at its own expense. The case is urgent—yet it has already dragged for years and could drag forever if everybody must be satisfied absolutely. Neither the radicals who wish to make the railroad pay everything and receive nothing, nor the idealists who imagine the proposed plans will hamper their Utopian schemes for the twenty-first century, nor the estimable ladies who think the shrubs of Riverside Park must be saved at any cost should be allowed to block this far-reaching improvement.

The Government's Scientific and Engineering Work

On its executive side, our federal government, like Topsy, "just growed." As new needs developed, new departments were created, and when the nation's activities became still more varied, the scope of these departments was enlarged by creating within them new bureaus and offices. These were tucked away in whatever department appeared convenient, with little regard for administrative principles. Consequently, we find a most heterogeneous array of functions under the control of various Cabinet officers. In no respect, however, is the allocation of functions so curious as in the distribution of the scientific and engineering work of the government. We find it scattered, without reason—other than the accidental ones that were determining when the particular activity was initiated—through six of the departments. When the progress of our great corporations toward greater efficiency is remembered—a progress marked by consolidations of organizations alike in character—the persistence of our government in continuing its unscientific executive organization is a reflection on our civic management.

The segregation of all the scientific and engineering work of the government in one department, a Department of Public Works, has long been advocated. Some of the reasons—those hinging on the advantages of close association between men engaged in the same general pursuit and the elimination of duplication in organization and function—are obvious. But there is a further reason in the case of the government. If a scientific and engineering department were established, scientific and engineering ideals dominating its work would be likely eventually to impress the Congress, with an end result of substituting for present pork-barrel procedure sound engineering and business principles.

For years, the pork barrel has been a synonym for river and harbor and public building legislation. Two years ago the Reclamation Service was put—as to its appropriations—into the same class. Further decadence in the same direction is almost certain to occur unless a new ideal dominates the executive end of our government. No influence that we can fancy would be more certain to bring to a cabinet correct ideals regarding the conduct of government work than the creation of a cabinet position —a secretaryship of Public Works—whose incumbent would be in constant touch with the heads of engineering bureaus and would be imbued with the necessity of divorcing the work of his department from political exigency and pressure. The scientific and engineering ideals are repugnant to waste, inefficiency and graft. As now organized the engineering and scientific work of the government is but an incident in the work of each department and one cannot expect from cabinet officers the same appreciation of the principles that must govern the same strenuous resistance to political pressure that would be natural in a Secretary of Public Works.

The extent of the scientific and engineering activities of the government is little realized by those not familiar with federal appropriation. The following table shows the appropriation for the fiscal years of 1915-16 and 1916-17:

	Appropriation for fiscal year ending June 30 1916	1917
TREASURY		
Public Health Service........	$3,145,609	$3,059,606
Supervising Architect's Office.	220,800	225,000
Public Buildings Bill.........	19,473,730	17,720,914
WAR		
River and Harbor Work......	33,982,000	45,839,510
Office of Public Buildings and Grounds (Washington)	402,080	686,165
Mississippi River Commission	5,371,000	9,132,000
NAVY		
Naval Observatory	44,240	44,540
INTERIOR		
General Land Office..........	673,805	705,356
Geological Survey	1,355,520	1,515,520
Reclamation Service	13,930,000	9,938,000
Bureau of Mines..............	753,800	992,810
AGRICULTURE		
Office of Public Roads and Rural Engineering..........	586,490	612,505
Federal Road Aid.............	....	5,000,000
COMMERCE		
Bureau of Standards.........	728,780	1,217,880
Coast and Geodetic Survey...	1,365,620	1,976,968
Steamboat Inspection Service	539,140	641,940
Total	$82,572,614	$99,258,704

Exclusive of the Patent Office, the income of which exceeds its expenses, the appropriation for scientific and engineering work in the year ending June 30, 1917, is roughly $100,000,000. To get an estimate of what this means in government affairs, comparison needs to be made with the appropriations of other departments. Excluding river and harbor work, the appropriations for the Mississippi River Commission and for the Office of Public Buildings and Grounds in Washington, the War Department appropriation for the fiscal year ending June 30, 1916, was only $123,000,000. For the 1916-17 fiscal year, excluding the same three classifications, the appropriation is $188,000,000. The Navy appropriations, excluding the naval observatory allotment in each case, are for 1916 and 1917 respectively $152,000,000 and $220,000,000. These are the leading departments so far as appropriations go. Agriculture, excluding the allotments to the Office of Public Roads, received $27,000,000 during the last fiscal year and has $29,000,000 to spend during the present year.

It is apparent, therefore, that a Department of Public Works made up of the appropriate bureaus and officers already in existence would make a large and important department of the government. The logical method of procedure, as this journal has several times pointed out, is to make the new department the logical successor of the Interior Department. Certain bureaus not of an engineering or scientific character would have to be eliminated, while those listed above, not already in the Interior Department, would have to be transferred to it.

Knowing how matters of this sort are looked upon in Congress, the suggestion is likely to be received there with little enthusiasm. Unfortunately, political exigency controls on Capital Hill. A Department of Public Works would certainly work away from this governmental standard.

Nothing worth while, however, is accomplished without considerable effort. To the engineer and the scientist the proposal is clean cut. It speaks his language. It is in the direction of co-operation, of efficiency, of centralization of similar functions under one head. It must eventually prevail, but it will not come until the slogan "America Efficient" receives as hearty support from the men who make our laws at Washington as it does from scientists and engineers and all thinking elements in our population.

The subject deserves the attention of engineering bodies throughout the country. If the plan is ultimately to prevail, it will probably be only after they have taken an active interest in the subject and exercised their influence toward its accomplishment.

Bridge Manual for Highway Officials

Some idea of the extent and importance of proper highway-bridge construction, renewal and maintenance may be gained from a statement in the introduction to the "Bridge Manual" recently issued by the Illinois State Highway Department, prepared by Clifford Older, bridge engineer. Between $40,000,000 and $50,000,000 will be required in the next fifteen years for the repair and renewal of the older and more or less temporary bridges in Illinois. According to the bridge survey of 1914-1915, 75 per cent of the total of nearly 200,000 drainage structures of all types and sizes on the public roads outside of the corporate limits of cities and villages in Illinois are of such a temporary character that the average life is only 12 to 15 years. Mr. Older says in the introduction, "It is estimated that if, during the next 15 years, modern bridges are built in all cases where renewal is necessary, our bridge expenditure may be reduced by not less than $2,000,000 per annum." When these values are multiplied to include all the states of the country, some conception of the millions of dollars involved will be obtained. Hence follows the importance of spreading such information as will raise the standard of highway bridge design and construction to a high plane of utility and economy.

This is just the kind of information which the Illinois State Highway Department is furnishing in this bulletin. It is a noteworthy attempt to secure co-operation between highway officials and the highway department of the state. After quoting the provisions of the revised road law, there is presented a valuable discussion of effective methods of inspection, of records and reports, of proper forms of contracts, of allowable stresses, of specifications, and, in detail, of the proportioning of concrete.

It is hoped that these efforts of the Illinois Highway Department will not only improve conditions in that state, but will be taken as an example by other commonwealths. While it is admitted that no set of rules and specifications will cover all conditions, there is no doubt that the attempt to standardize practice and to disseminate clear-cut information on the factors of bridge design and construction will do much to bring about desired improvement in this phase of highway development.

Water the Chief Factor in the Making of Good Concrete

Researches on Cement and on Aggregate Now Supplemented by New Knowledge —Suggestion Made That Lighter Portions of Mix Be Wasted to Eliminate Laitance

By NATHAN C. JOHNSON
Consulting Concrete Engineer, New York City

THE improvement of concrete is an objective earnestly to be striven for. Defective concretes are within lens shot of every camera; and if their number is not to increase as the uses and applications of concrete are extended, effective rules must be established which will remove the present uncertainty as to ultimate result.

No studies are more informative, or more productive of constructive knowledge, than systematic investigations of defects. On such studies has been built the whole science of preventive and remedial medicine, with its incalculable benefits to humanity. Perfect structures, whether of flesh or of concrete, will care for themselves, but the ailing structure needs care and attention so that the ills may be remedied and their recurrence prevented.

In both sciences much has already been achieved through such study, yet even more remains to be accomplished. In ailing humanity, each nerve, each muscle, each minute, component part is recognized as affecting the harmony of the whole. In ailing concretes each part is equally important to mass strength and endurance, yet seldom is proper recognition given to this fact. Cement has been closely studied. Sand and stone have had most careful scrutiny. But although cement and sand and stone are not concrete without water, the functions of this essential substance are so little regarded as to have been, up to a twelvemonth ago, almost wholly neglected. But it is not idle or thoughtless to venture the prediction that within twice that span of time, water in concrete will be subject to closer regulation than any other substance, through sheer impossibility of longer withholding recognition of its preponderant importance.

It is with the hope that interest and discussion in this important subject will be aroused that this article is written. It contains a recommendation regarding the wastage of the lighter parts of the mix that may arouse considerable antagonism, but which is fully justified by the facts here presented.

Day's Work Planes

When structures of concrete subjected to water action in any degree are examined after two or three years of service, the surfaces are found to be discolored, usually along horizontal planes. "Efflorescence" is the explanatory anodyne of apologists; but if the same structure is examined after a longer period, the conditions first noticed are found to be aggravated. Surface stains and unsightliness have gone deeper. Undeniably they are become local disintegrations, with oftentimes heavy surface incrustations below them; and it is thrust upon one's notice that these surface deposits originate and these disintegrations are most pronounced at strata lines where surface staining was first noticed.

"Day's work planes," says the advocate of any old concrete for any and every purpose. "They are natural to concrete." With the majority of concrete work as a basis of judgment, such a dictum is apparently justified, but if it is justified by fact, concrete may not safely be employed *when subjected to water action in any degree*, for the first surface stains, the later incrustations and the deeper disintegrations bear witness to percolation and removal of material by water along these planes. And if the substance of such planes is examined, it will be found to consist of fine, semi-solid material, chalky when dry, clay-like and slippery when wet, lying in layers of greater or less thickness and bearing little or no resemblance to concrete.

"Laitance," says the apologist. "We've had it analyzed. It comes from the cement. It's part of the concrete." Unfortunately it is; and a cancer is also part of the tissues which it destroys. Yet we ignore the one and spend millions in the effort to eradicate the other.

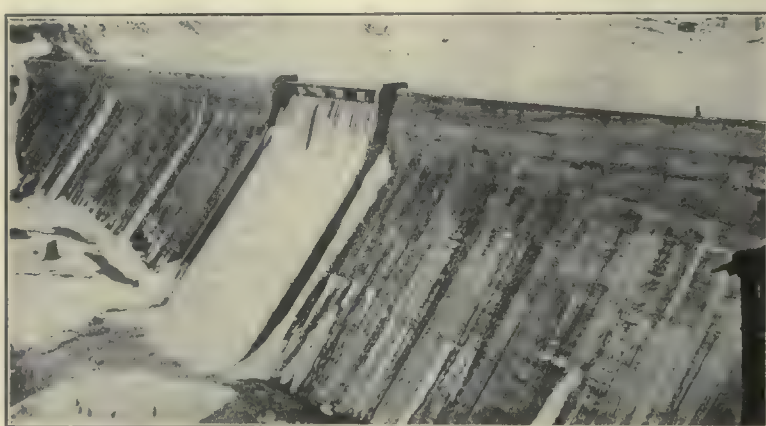


FIG. 1—DAY'S WORK PLANES SHOWING ON FACE OF AUSTIN, PA., DAM

The Austin Dam Failure

In 1911, the whole country was shocked at the failure of a concrete dam as Austin, Pa. Towns were swept away by the released waters, one hundred lives were lost, millions of dollars of material damage resulted.

Engineering examination subsequent to the disaster emphasized particularly the responsibility of a shale rock foundation, permitting slip of the entire dam. Two engineers laid emphasis upon certain defects noticeable in the concrete, but it is probable that the opinion accepted by the engineering fraternity at large was that the responsibility lay with a poor foundation.

Without disparaging in any sense these factors, it is of interest to an analytical study of defective concretes to notice the surface appearance of this dam before failure, and to endeavor to correlate this appearance with such rupture as occurred under stress of impounded water.

In Fig. 1 it is seen that this dam exhibits what might be termed a characteristic concrete surface, showing the marks of form boards in well-defined horizontal lines, with here and there darker lines, indicating the height of a lift of forms, with along and below these lines white extrusions of greater or less extent.

It is of special interest to note that one examining expert in his report to the coroner says, "One section at the west end slid on one of these horizontal construction joints" (day's work planes), and he adds that these "construction joints" are formed of "cement cream." A second engineer also notes that there was a laitance section 10 by 20 ft. in surface area near the west end that showed horizontal failure; and he states that "much of this material would have made excellent marking chalk." There was further a large section of the dam which sheared diagonally; and there was much speculation as to why massive concrete should have sheared in this peculiar way, along a plane greater than that defining a least area.

Remembering, then, that "day's work planes" are formed from laitance, or "cement cream"; and remembering the characteristics of this substance, light, semi-solid, chalky when dry, slippery when wet, nonadherent to concrete above and below it; remembering, too, the unquestioned existence of at least one large area of laitance at the west end of the structure, can foundation rock, poor though it unquestionably was, be held solely responsible for this failure? And may engineers accept day's-work planes as "inevitable," "harmless" and "natural to concrete"? No condemnation of concrete ever was greater; and, if true, condemnation is also made of any engineer who recommends concrete, except in enormous mass, for any water-exposed service, whether such exposure be to high heads of water, or to ground moisture brought through by negative pressure from surface evaporation.

Similar Characteristics

Nor is this an isolated instance. In Fig. 2 is shown the surface of a concrete wall not unlike the Austin Dam in general section. It is noticeably stratified, or banded; and at the center there are dips, or waves, as though a stream had plunged with force into a plastic substance, flowing off on either side from the point of delivery. But little imagination is needed to picture repeated batches pouring from a spout at this point, each batch forcing itself into the semi-fluid mass below. But examination reveals that each wave is outlined in a seam of laitance; that the broad, dark belt extending for some distance on either side is also laitance; and

at the extreme right is seen the same sort of white leachings so characteristic of the Austin Dam. Evidently the concretes placed in this wall must have been quite wet, to flow sufficiently to form waves and belts and stratifications.

At another point in this same wall the surface skin was removed to expose successive belts and inclinations of strata; it was found that in deep layers lay almost uncemented stone, with above each layer of stone a layer of laitance, with percolation made evident by surface incrustations starting above the relatively dense laitance, at its junction with the uncemented stone.

An inspection of the full length of this wall showed plainly the slopes and waves of successively poured batches. Unquestionably, this concrete is of uncertain and variable strength; and if one of the pouring slopes found in this wall had been in the Austin or in any other dam, with a separating laitance seam at its upper boundary, softened and made slippery by percolating water, might not diagonal failure "at a section greater than the least section" have been expected?

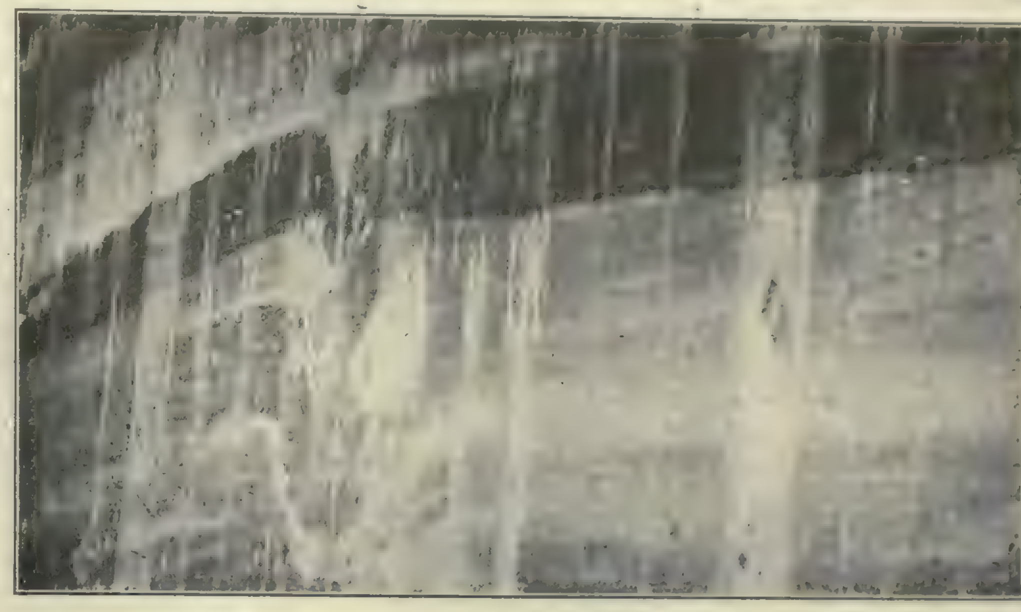


FIG. 2—THE CONCRETE IN THIS WALL WAS POURED WITH EXCESS OF WATER AND SHOWS THICK BANDS OF LAITANCE

EXCESS WATER RESPONSIBLE

Nor can the conclusion be escaped that excess water, added to save labor of mixing and labor of compacting in forms, is responsible for such planes of weakness in concrete, whether these planes are diagonal or horizontal or whether they occur in an Austin Dam or a countryside culvert. Of what use is elaborate design if execution is grossly at fault? Daily and hourly, at the very moment these lines are written, concrete of which the accurately descriptive adjective is "drowned" is being placed in forms under specifications which directly provide for its ultimate failure.

Yet, laitance is not the only defect resulting from excess water, nor is excess water the cause of all defects. But excess water, either as a prime cause or by aggravating initial deficiencies until they come to have an exaggerated importance in the final result, is of such importance as to be deserving of special attention and study.

FUNCTION OF WATER

Concrete is a composite, 80 per cent or more of which is sand and stone. The remaining 10 per cent is the product resulting from chemical combination between cement and water. But in spite of its percentage minority, this cementing substance has preponderant importance. Sand and stone by themselves are but feebly coherent at best, as in Fig. 3, wherein is shown a commercial demonstration of that fact. On the other hand, sand, stone and hydrated Portland cement may be "artificial stone" in the truest sense of that term, if attending conditions are right. Water, therefore, both in physical and chemical action, is the key substance of concrete.

Water in concrete functions in four ways:

First, Water forms, with cement, the binding material uniting sand and stone. This function consists in (a) dissolving the pulverized cement, with (b) formation of acids from anhydrides; and (c) bringing these new acids and the dissolved bases of cement into sufficiently intimate contact so that they may chemically react.

Second, Water operates to flux these cementing substances into multitudes of minute irregularities on the surfaces of sand grains and stone (or gravel) particles, rendering possible extensive adhesion through crystallization and adsorption as water is absorbed or evaporated.

Third, Water acts as a lubricant between harsh and irregular particles, rendering easy placement in molds and forms.

Fourth, Water itself occupies space in the mass.

CHEMICAL FUNCTION

The function of water first cited is basic and essential. If there is insufficient water, obviously the reaction of the cement would not be complete; and if there is too much water, it is equally obvious, since for its strength cement depends to a certain degree upon the formation of interlacing crystals, that adequate crystallization cannot take place, since crystallization takes place only from saturated or super-saturated solution. Furthermore, cementing action is dependent to an extent upon the formation of colloids, or non-crystalline, amorphous, glue-like substances. These substances also depend for their strength upon the amount of water combined with them. Undue dilution of these colloids cannot take place without impairment of strength, just as glue (a true colloid) may be a valuable adhesive when of proper consistency, while the same glue, if too dilute (or if too concentrated) may be useless.

What quantity of water is required to properly react with a given quantity of cement is not precisely known. Furthermore, if for no reason other than variance in composition of different brands, hard and fast rules would be impossible. Much can be learned, however, as to the influence of water from observation of its effects when mixed with cement in maximum and minimum quantities.

FIG. 3—THE RESULT OF NEGLECT OF PRECAUTIONS IN MAKING CONCRETE

WHAT A SPECIMEN SHOWS

If cement alone is mixed with excess water and allowed to set, a number of very interesting things become evident with passage of time. In Fig. 4 is a sectioned block of cement, cast somewhat over a year ago in a beaker. (See Fig. 2, "The Testimony of Moving Pictures in the Study of Concrete," Engineering Record, Dec. 4, 1915, page 685.) Since that time and until recently split open, this block of cement has remained exposed to room temperature and atmosphere with corresponding evaporation and drying.

It will be at once noticed that this block is stratified, lighter portions being at the top and heavier portions at the bottom. Inasmuch as cement particles vary in size, the heavier ones naturally gravitate to the bottom, particularly when there is excess fluid to act as lubricant, thus repeating in miniature the segregation in concrete. And at the top is a heavy deposit of fine white material, which investigation reveals to be largely hydrated lime, and which resembles the substance of which day's-work planes are composed.

OTHER THINGS SHOWN

But there are additional features in this section which compel attention.

First, there is a deep crack extending from outside to the junction of laitance and solid portion at the center, where unhydrated cement particles begin to show. The appearance and position of this crack indicate a warping of the top surface as the piece dried out, with separation from other portions. If this block were subjected to water pressure, leakage and solution, *with removal of any soluble portions of the block*, would take place along this junction plane. The same action takes place along laitance seams in concrete; and inasmuch as cement is *always soluble, even with lapse of years*, both in its unhydrated and hydrated states, the source of initial surface stains and, later, of heavy incrustations is evident.

Second, it is interesting to note that in spite of the length of time this cement has been mixed with water, a very considerable portion of it still remains quite uncombined with water. Obviously, excess mixing water is not an assurance of hydration, so that no merit may be claimed in this respect.

What Excess Water Does

When cement is mixed to normal consistency these defects are not all in evidence. The conclusion, therefore, becomes inescapable that excess water must be responsible for segregation, laitance and cracking. In wet concrete and mortar these actions are repeated to an exaggerated extent by reason of the large excess of water commonly employed; and segregation is further aggravated by the relative massiveness of stone particles as compared with the sand and cement particles.

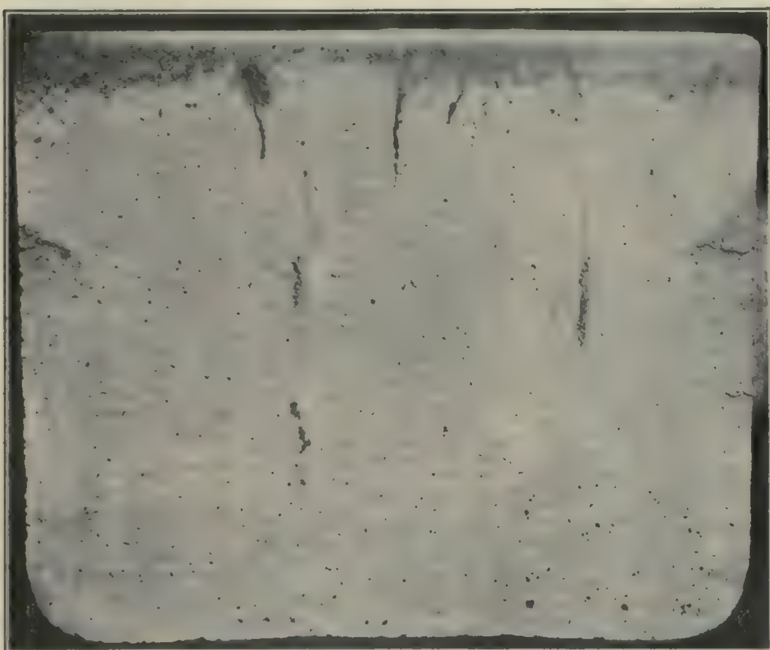


FIG. 4—UNHYDRATED CEMENT AND GRADATION OF PARTICLES FROM TOP TO BOTTOM ARE FOUND IN THIS YEAR-OLD BLOCK OF NEAT CEMENT

And so like the checking, warping and peeling of commercial surface coats is the behavior of the upper layers of this block, that the thought occurs with the force of a blow *that in excess water may lie the solution of the baffling stucco problem, of the dusting floor problem and of the problem of bonding new concrete to old.* With respect to this last, how puerile appears the dainty surface picking of massive deposits of concrete usually required, when the usual depth of laitance is taken into consideration!

Fluxing and Lubricating Functions

The second function of water—that of fluxing the cementing substance over the surface of sand, cement and stone or gravel particles—is closely related to the foregoing. Cement adheres to these substances by myriad contacts (see Fig. 5). If the solution is too dilute, or if these minute roughnesses are already full of water, the adhering substance can form but a meager attachment at a relatively small number of points, with proportionate weakness.

Nor is this an imaginary condition. In detailed examinations of concrete, it is found that probably not over one-third of the surface of stone particles and possibly the same relative proportion of the surface of sand particles, is in contact with cement, the balance of the surface having been protected at the time of setting by an envelope of water not carrying dissolved cementing substances, or an essentially similar envelope of cementing substances in so dilute a solution that they were unable to adequately crystallize. And like relations between dilution and strength affect the amorphous constituents. The quantity of these is directly dependent upon the concentration of cementing solutions. Quantity of water and strength of concrete are therefore closely related.

The foregoing actions are also closely connected with the third function of water—that of acting as a lubricant between particles. Water is a mobile substance and has high surface tension, so that in confined space, as between sand particles in considerable mass, it may act most effectively in this regard. The advantage to be gained, however, *is not commensurate with the quantity of water.* When the water content is increased beyond a certain point, segregation of coarser from finer materials invariably takes place, so that what is gained by fluidity in one portion is lost by harshness in the other portions with always very great detriment to the quality of the concrete.

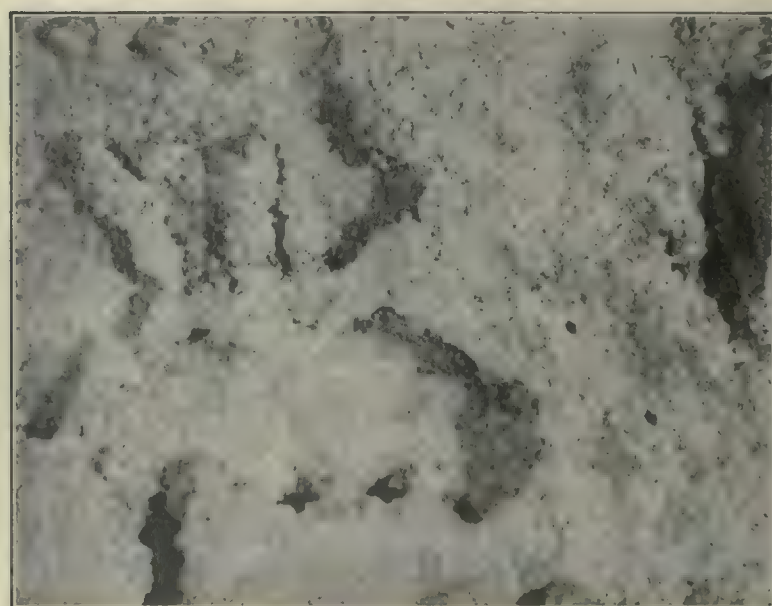


FIG. 6—EVEN A FIRST-GRADE COMMERCIAL CONCRETE SHOWS WATER VOIDS (4 DIAMETERS)

Water a Space Filler

All of the foregoing is intimately concerned with the fourth function of water—that of occupying space. There is no substance more incompressible than water when it is confined. Recognition is given to this fact in hydraulic presses. Forms for concrete are essentially confined spaces, care being generally exercised to see that they are made and kept tight. It follows, therefore, that each drop of water in concrete, whether combined or uncombined with cement, occupies a definite, unchangeable amount of space in the mass at the time the form is filled. It further follows, since it is impossible to conceive of this space-occupying water as otherwise than distributed throughout the mass, that dispersion of sand particles and stone particles, with proportionate lowering of mass density must occur. And since the foregoing is true, it is evident that if any part of this water is uncombined, all evaporation or drainage subsequent to setting will leave in the rigid mass hollows of a size equivalent to the spaces occupied by the water; and since this water was evenly distributed, such evaporation or drainage must result in an essentially porous mass. Attention is called to the water voids in a first-grade commercial concrete shown in Fig. 6.

We are so accustomed to thinking of concrete as a solid that it is somewhat difficult to realize that it is actually porous, 17 to 40 per cent being air and water voids. It is true that these voids may not constitute continuous passageways, but when this simple statement of void percentages is translated into dollars and cents and it is pointed out that for every $100,000 worth of concrete, from $17,000 to $40,000 is paid for *holes*, which not only have no value of themselves, but constitute a serious menace to the integrity and usefulness of any structure, the matter is brought more closely home. Nor is this an exaggerated statement. On the contrary, initial loss is but a small fraction of the ultimate loss. "Penny wise and pound foolish" would be a fitting epitaph for many a lamented construction.

Yet to-day, in the majority of concrete structures, these or like defects exist; and the most deplorable part is that at the present time there is little general inclination to better these conditions. But if concrete is to retain its prestige, a standard procedure for concrete work based on real knowledge must be evolved by those skilled in the art, adopted by engineering and architectural bodies vested with authority and recognized and insisted upon universally.

A Suggested Remedy

The unsightliness of day's work planes and their potential danger may, it is true, be recognized to such an extent as to cause provisions in specifications "that if the engineer deems it advisable he may require picking or roughing of the top portion of the work last poured, before pouring the next concrete in order that they may thoroughly bond." How often does the engineer deem it advisable? Such provisions might as well be omitted so far as their adequacy is concerned.

It is virtually impossible to effect adequate removal of laitance after the mass is set. This is especially true in reinforced work, where there is a network of steel. In

many such cases adequate removal of laitance would have to be done by knitting-needles. The only solution of the problem seems to be either prevention of formation of laitance, through improved methods of making concrete, *or else, after a form is filled, the removal of top boards to a point sufficiently low to allow the accumulated fine materials and fluids to flow off until coarse aggregate shows in the deposited mass, the drained materials being wasted.*

This remedy is radical. It will doubtless be subject to ridicule by the unthinking, but if the menace of day's work planes is to be avoided there seems at present no way other than this. Certainly the cost is insignificant as compared to the integrity of a structure and no more than the cost of an equal insurance against loss. When procedures are better perfected, different conditions will obtain, but in the present undeveloped state of the art, some adequate assurance is an imperative necessity.

But even granting adequate appreciation of these matters, procedures are exceedingly inconsistent. The menace of day's work planes and of laitance may be recognized

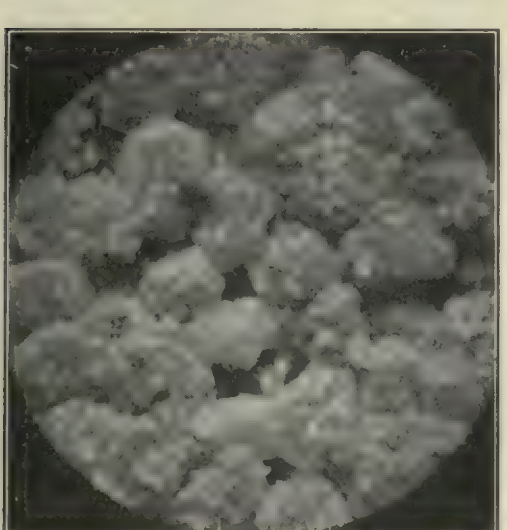


FIG. 5—CEMENT PARTICLES FLUXED OVER SURFACE OF SAND GRAIN

by provisions in building codes that "all concrete columns should be poured continuously to the top of the form." Yet it is quite common to permit the pouring of over-wet concretes in such columns, filling them to the top, without considering of what material the column head must be constituted.

Consider wet concrete flowing into a 20-ft. column form 2 ft. square. The first rush of material will be almost liquid. The heavier materials will follow in regular order. Necessarily, the heavier stones will go to the bottom, passing through a mass of liquid that will wash off the greater portion of any cement with which the stone might have been covered in the mixing process. Other materials will build themselves up as nearly as possible in the ratios of their sizes and gravities throughout the entire column length, with always a mass of uncemented sand and stone at the bottom, where the greatest stress is to be endured; and at the extreme top a layer of laitance of exaggerated depth due to the high ratio of length to sectional area. (See Fig. 7.)

If this laitance become water-soaked, slippage or settlement to a greater or less degree is to be expected. Doubtless the behavior of columns in concrete buildings will be cited in refutation of these statements, but it should be borne in mind that such columns are dried out soon after they are put in place; and that the stresses which they are called upon to bear are initially low. If these columns were subject to saturation or to high stress proportionate to their bulk, the result would be far different, as is evident in many a structure in distress.

SUGGESTED SPECIFICATIONS

Advocating concretes drier than present custom sanctions should not be construed as holding any brief for very dry concretes, laboriously tamped in place. One is almost as bad as the other. Yet drier concretes should be used, and to bring about their use it is necessary to so crystallize the growing sentiment against the use of excess water as to make sure the observance of necessary precautions; and to incorporate in specifications such clauses as will as nearly as possible insure the result desired.

Along these lines, the following specifications are suggested:

1. Concrete shall consist of sand, stone (or gravel), cement *and water* in such quantities as shall be designated by the engineer.

FIG. 7—SPIKES DRIVEN INTO LAITANCE AT TOP OF COLUMN

2. The proportions and quantities of all materials, *including water*, shall be as directed by the engineer and shall be subject at all times to such change as his tests or judgment may dictate as advisable.

3. *All* materials shall be accurately measured in measures of approved type and known capacity.

   Cement shall be measured by the standard sack or, if in bulk, by weight, 94.5 lb. being taken as an equivalent of one sack. Loose measurement of cement is prohibited.

   Sand and stone shall be measured in struck measures of a capacity and type approved by the engineer. Measurement in wheelbarrows of a type which do not admit of a struck measurement will not be permitted.

   Water shall be measured at each mixer in containers adapted to ready adjustment and to accurate delivery of variable quantities. Supplementing the delivery of such measuring containers by additions of water, because of slowness of discharge or for any other reason, will not be permitted.

4. *Concrete of a plastic consistency is required in all parts of the work, unless special permission be given by the engineer for the use of drier and stiffer mixtures. Sloppy and over-wet concretes are strictly prohibited. The quantity of water, therefore, will be subject to regulation at all times by the engineer according to the requirements of the aggregates in use at that time. The rejection and removal of over-wet concretes either before or after placing in forms may at the engineer's discretion be required of the contractor without compensation.*

5. *After any form or lift of forms has been filled, spaded and allowed an interval of settling not greater than one-half (½) hour, and while the concrete yet remains in semi-fluid condition, the top portion of the forms shall be removed throughout the entire length of the section to such depth as may be required by the engineer and the materials shall be allowed to flow out of the forms and be wasted. This wasting shall be carried to such a depth as will expose coarse aggregate in the mass. Concrete shall not again be deposited on the remaining concrete until the next lift of forms is ready to be filled.*

DISCUSSION NEEDED

It is not too much to hope that discussion will be had on this important subject at the coming annual meetings of the American Society of Civil Engineers and the American Concrete Institute. Discussion will surely stimulate thought and thought will stimulate research, so that before long it may well be that America will have solved this world-wide problem of how, day in and day out, to produce the highest type of concrete.

How Chicago Is to Finance Traction Program

Extension of Existing Profit-Division Plan Recommended — Amortization Funds Will Eventually Make City Owner

FINAL conclusions and recommendations of the Chicago Traction and Subway Commission are given in the completed main report turned over Dec. 20 to the city council transportation committee. The report hitherto made public and reviewed in the Engineering Record last week, page 770, was supplemented by the "Financial Plan," which is summarized by the following recommendations of the commission:

1. That a single corporation be organized to take over the surface and elevated lines.

2. That legislation be sought:

(a) To permit the formation of such a corporation.

(b) To permit the grant of a terminable franchise in return for which the existing companies shall surrender all their definite franchises.

(c) To empower the city to purchase the property of the new corporation.

(d) To empower the city to procure the consents of abutting property owners.

3. That the construction of a combined system of subways and elevated railroads be begun at once and co-ordinated with the present and future elevated railroads, so developed as to furnish the highest grade of rapid-transit service.

4. That the city be given full control over the extensions to the systems and additions to equipment and the furnishing of service limited only in that the net return to the corporation will not be reduced below 6 per cent.

5. That a financial plan be developed so as:

(a) To extend the partnership management now existing between the city and the surface lines to include the elevated lines so that the city shall have a share in the divisible net receipts of all the lines.

(b) To allow to the corporation, so far as affected by any act or orders of the city, a net return on the combined valuation of the existing properties of 6 per cent.

(c) To invest in the construction of subways or other revenue-producing additions the present traction fund and increase thereto on the same terms as new capital furnished by the corporation. That is to say, the corporation shall receive only the actual interest that it has to pay on the new capital furnished and the city shall receive on its revenue-producing investment the same rate of return.

(d) To provide for two amortization funds whereby the outstanding valuation or purchase price shall be progressively reduced, these amortization funds to be increased by all remainders of the traction fund over requirements for new construction.

(e) To confine the return to the corporation between the limits of 6 and 8 per cent on its then investment in road and equipment by requiring that after its total return exceeds 7 per cent a portion of such excess over 7 per cent and all of the excess over 8 per cent shall be paid into the special amortization fund.

(f) To provide for such use of the traction fund and amortization funds as to establish a practicable and feasible method of acquisition by the city of the entire local traction system.

Complete Recapture by 1960

A reasonable forecast of the results obtainable under this financial plan, concludes the commission, indicates that by 1937, or at the end of twenty years, there will have been amortized actually or in effect nearly $120,000,000, or 30 per cent of the then total capital investment in the combined properties. The continuation of this forecast indicates that by about 1947, or in about thirty years, not only will all of the additional capital to be furnished by the corporation, as contemplated in the report, be paid off, but the operation of the amortization fund and the city's traction fund will probably begin to reduce the original 1916 valuation of the combined properties. And, further, unless the divisible net receipts, and consequently the additions to the city's traction fund, are greatly reduced by unjustifiable expenditure, that possibly by the year 1960 the whole of the corporation's then investment will have been retired. Chicago will then become the actual owner in fee of a combined system of subway, surface and elevated railroads, which in accordance with the orders of the board of regulation and control and the provisions of the ordinance will have been maintained at full efficiency and will have cost at least $490,000,000, and which the city can then operate directly or lease to an operating corporation, as public opinion at that time shall determine.

The members of the commission are William Barclay Parsons, Bion J. Arnold and Robert Ridgway.

A supplement to the report will be given out later. It will contain about 150 pages of printed matter and fifty or more maps and plans.

Higher Unit Stresses for Pipe and Computation of Water-Hammer Pressure Advocated

Design of Heavy Steel Pressure Pipe Lines Can Be Made More Economical by Proposed Method Outlined in Detail

By BARTON M. JONES
Assistant Engineer, Miami Conservancy District, Dayton, Ohio

An interesting article by Frank H. Carter on "Selecting Economical Type of Riveted Joint for Steel Pipes and Standpipes" appeared in the Engineering Record of Oct. 14, page 467. In this article Mr. Carter shows that where a large quantity of metal is involved, as in large steel pipes and other structures built to resist internal pressure, a saving in cost can be effected by the use of the most efficient types of riveted joints. This is undoubtedly true, particularly where single or double riveted lap or butt-strap joints are commonly used, as in plate less than about ⅝ in. thick. For heavier plates it is customary to use the more elaborate joints. Aside from cost, mechanical uncertainties and the loss of power from increased resistance to flow should be watched to prevent the use of complicated joints from being carried too far.

Along a related line, the writer would like to outline a means for obtaining further economy in the use of the steel, particularly by the application of proper unit stresses. In another part of his article Mr. Carter calls attention to the use of unit stresses as low as 6000 to 7500 lb. per square inch of gross section, approximately equivalent to 8000 to 10,000 lb. per square inch in the net section. While these cases are somewhat lower than usual, they confirm the present-day tendency among engineers to adopt very low unit stresses because of experiences with pipe-line troubles. These unit stresses appear to be unnecessarily low and do not represent liberal designing, but a waste of money in not placing the steel where it will do the most good. Failure to understand and provide for the effect of water hammer is the principal cause of this situation.

Effect of Water Hammer

Mr. Carter uses the assumption that the effect of water hammer decreases from a maximum at the lower end of the pipe line to practically zero at the upper end. It is known from both observation and theory that a pressure wave from water hammer travels the full length of the pipe, or to a point of relief such as a standpipe or reservoir, and that its intensity is influenced only by the dimensions of the pipe at the various points along the line. Referring to his example of a pipe line of 54 in. diameter, 2800 ft. long, and varying in thickness from 5/16 in. to 9/16 in., a pressure at the lower end of the pipe of 100 lb. per square inch due to water hammer would result in about 85 lb. per square inch at the upper end, instead of zero as shown by him.

In common practice the thickness of the various lengths composing a pipe line is figured according to one of the three usual assumptions as to the pressure to which each length of pipe will be subjected. A low unit stress is adopted for the net section to provide the desired factor of safety, and in addition a uniform thickness is often added to allow for surface deterioration.

The three most common assumptions of pressure are as follows: (1) The maximum static pressure to which the pipe can be subjected; (2) the maximum static pressure plus an arbitrary amount to provide for water hammer, such as 100 lb. per square inch considered uniform over the entire line; (3) the maximum static pressure plus a moderate amount to provide for water hammer which is figured for each particular part of the pipe according to its diameter and thickness and the assumed rate of gate closing.

For proper balancing of parts the pipe should, if possible, be so proportioned that no one part will be stressed to the breaking point unless all other parts have likewise reached the same unit stresses. There is no uncertainty about the distribution of the extraordinary pressures which would cause these stresses. Aside from the static pressure which is definitely known, the only other bursting pressure is caused by water hammer, and the relative intensities of the latter at different points along the line can be readily calculated. That is, if a shock from water hammer produces a certain pressure at one point in the pipe line, the corresponding pressure at any other point can be determined. A pressure wave which results from the accumulation of several successive water-hammer shocks has the same effect as if it had been caused by a single larger shock, and can be so treated.

High Unit Stress Proposed

In order to distribute the steel in pressure lines of high head so as to obtain the greatest effective strength, it is suggested that the thickness of the shell be designed by using the elastic limit (or a value even more near the breaking stress) of the steel for the unit stress and obtaining the desired factor of safety by making provision for a severe water-hammer pressure in addition to the static pressure. If desired, a small uniform thickness may then be added as usual to allow for corrosion. This method is justified because the uncertainties due to imperfections in material and workmanship can be largely eliminated by a test made after the pipe has been laid, the remaining uncertainties being principally in the pressure to which the pipe will be subjected.

Under ordinary operating conditions or during a moderate water hammer, the unit stresses in a pipe designed as suggested would not be uniform, but would be greater at the lower end than at the upper end of the pipe. The pressure wave from a dangerous water hammer, on the other hand, would cause stresses which in maximum value would be nearly uniform throughout the full length of the pipe.

Purpose of Method

To make the purpose of this suggested method of design evident, it may be stated that many high-head penstocks could be proportioned by its use to resist a sudden closing of the entire flow without stressing the steel beyond the elastic limit at any

point, and the cost of the pipe so designed would be much less than one capable of withstanding equally severe shocks, designed in the usual manner with low unit stresses. The upper portion of a pipe line of ordinary design is made relatively too thin and could fail as the result of a pressure wave, while the stresses in the lower portion of the pipe remain comparatively low.

With a given water-hammer allowance, the diameter and thickness of a piece of pipe fix its lowest position along the profile. Pipe is built of plate the thicknesses of which do not usually change by less than 1/16 in. The diameters are chosen of even figures and often with a difference sufficient to allow nesting of the pipe for shipment. Having selected the pipe dimensions that could be considered for use, a table can be prepared to give for each diameter and each thickness of pipe its position on the profile in terms of the static head at that point. In computing this, the maximum head that the pipe will resist is first determined, using, as suggested, the elastic limit of the material. From this head is subtracted the pressure head that would be equivalent to the water hammer in case a given flow were suddenly stopped. The water-hammer pressure can be computed when the reduction in flow is known, together with both the diameter and the thickness of the pipe. The following is an equation arranged in a simple form for making the calculation:

$$h = \frac{2tse}{0.433d} - \frac{268{,}800Q}{d^2\sqrt{\dfrac{d}{t} + 102}}$$

in which h is the allowable static head in feet for a pipe of certain dimensions, indicating its position on the profile; t, the thickness of pipe wall in inches; d, the inside diameter of pipe in inches; s, the ultimate unit stress allowable in pipe wall in pounds per square inch; e, the efficiency of a longitudinal joint, and Q, the sudden reduction of water flow in second feet. For gradual gate closure, Q should be taken as the reduction in flow during the interval of time T which is required for the pressure wave to travel upstream through the pipe to the point of relief and return. Q must be found for each point along the line, as it depends upon T for that particular point. The time T in seconds is.

$$T = \frac{l'\sqrt{\dfrac{d'}{t'} + 102} + l''\sqrt{\dfrac{d''}{t''} + 102} + \dots}{23{,}600}$$

where l' is length in feet of part of pipe the diameter of which is d' and the thickness of which is t', etc.

The equations given allow for the elasticity of both steel and water, the coefficients used being 30,000,000 and 294,000 lb. per square inch respectively. It will be noted that the length of the water column does not affect the calculations except as to what would be termed "sudden closing." The velocity of the pressure wave through a particular part of the pipe is sometimes of interest. This velocity v in feet per second is

$$v = \frac{\sqrt{\dfrac{d}{t} + 102}}{23{,}600}$$

Regarding the economical diameter for the pipe, it is not particularly difficult to determine this, even when the thickness of the pipe is based on the water-hammer consideration as described in the foregoing. For the final design, the writer has found it convenient to combine the three operations of determining the economical diameter, the thickness, and the location of the pipe of various dimensions along the profile. For this purpose formulas are not entirely satisfactory, as they frequently call for impossible odd diameters and thicknesses of pipe.

In the table giving the position of each class of pipe along the profile may be shown also the total annual expense per unit length of pipe—that is, the loss in revenue due to friction losses plus the annual charges on the investment. Inspection will then show the most advantageous dimensions of pipe for certain static heads or points on the profile. In other words, it will enable the selection of a pipe which will fulfill the pressure requirements and which will at the same time represent the least annual expense.

This method of designing a pipe line involves only dimensions and weights based upon actual pipe designs instead of theoretical sizes. The results for all practicable combinations of diameter and thickness can be readily presented in a table for comparison and selection. It may entail slightly more labor than direct formulas, but the additional labor involved is well warranted by the results obtainable and the importance which usually attaches to the design of structures of this class.

Soft-Ground Tunnel Under Lake Union at Seattle Presents Many Difficulties

Poling-Board Compressed-Air Method, with Top Heading Lined Before Taking Out Bench, Solves Them, Though Section of Arch Settles and Four Blowouts Occur

REPLACING a temporary trestle which carried the water mains supplying Seattle across Lake Union, a concrete-lined tunnel has been completed in soft ground under the lake by the top-heading method, using poling boards and compressed air. The ground was so soft that the lining of the top heading, which had to be placed before the bench was taken out, settled at one point and had to be replaced. Four blowouts occurred through the lake bottom, all of which were successfully stopped with weighted timber or canvas blankets. Effective grouting was done with hand force pumps.

TUNNEL TO CARRY WATER MAINS AND CONDUITS

The water supply for Seattle comes from the Cedar Lake watershed, which is to the south and east of the city, so that mains must cross the chain of inlets and lakes which connect Lake Washington with Puget Sound in order to reach the northern part of the city. Heretofore water mains have been carried across Lake Union on a temporary wooden trestle, pending the time when it would be necessary to provide other means of crossing. With the completion of the Lake Washington Canal, Lake Union becomes navigable to vessels of considerable draft, and the water mains had to be kept clear of the channel.

The city, accordingly, awarded a contract in July, 1914, for the construction of a tunnel beneath Lake Union which would provide for water mains and telephone and electric wires. The work was to have been completed early in 1915, but owing to difficulties and delays the tunnel was not finished until October, 1916. The installation of water mains in the new tunnel for the present will consist of one 42-in. and one 16-in. main under a head of 470 ft. and one 24-in. main under a 375-ft. head. The 42-in. main, which has already been placed in service, connects reservoirs on opposite sides of the canal. The other two lines will supply the low and intermediate pressure districts of the city.

EXCAVATING SHAFTS AND TUNNEL

The tunnel is circular in section, about 900 ft. long, and crosses the channel at right angles, with its center 54 ft. below the water surface. At either end the tunnel terminates in a vertical shaft, the north 15 ft. and the south 16 ft. in diameter. Both the shafts and the tunnel are lined with concrete 22 in. thick. The north shaft was sunk in the open through a sand-and-gravel formation that offered no serious difficulties.

The south shaft, on the other hand, was for practically the entire depth in fine sand. After the first 25 ft. in the open, the use of caisson methods was required. Both the north and the south shafts were sunk as drop shafts by weighting with sandbags. The cutting edges of the shafts were made of angles and steel plates.

The tunnel was advanced from both ends, using the poling-board method. Because of the very soft material traversed, the entire work had to be done under air pressure, the maximum pressure being about 27 lb. per square inch. The compressor plant at each shaft consisted of two units, one with a capacity of 800 cu. ft. and the other with 700 cu. ft. of free air per minute. The motors were connected so that either of two separate sources of power could be drawn upon in emergencies.

FOUR BREAKS DURING THE TUNNELING

During the tunneling there were four separate breaks, or "blows," in which the sudden inflow of water caused a temporary shutdown and threatened the safety of the work. These breaks were repaired by mattresses placed from above on the lake bottom. Two of these mattresses consisted of 30-ft. squares of canvas upon which material was sluiced from the adjacent bank. In the second blow two distinct openings had to be closed, over one of which a timber mattress was placed. In the last case a larger area had to be covered and a 40 x 60-ft. timber mattress was built, floated into place and weighted down with 4 or 5 ft. of earth sluiced into place.

None of the breaks occurred so suddenly that there was danger to the workmen, and although the tunnel was flooded on two occasions there was no difficulty in unwatering it after the mattresses were placed. At other times, however, the full capacity of the pumps was taxed. In unwatering the tunnels air was turned on through the regu-

lar lines till sufficient pressure was reached to balance the hydrostatic head. This pressure did not, however, force the water out through the face, and the heading was drained by opening pipes passing through the tunnel lock and allowing the water to flow to pumps in the shaft. The capacity at each end totaled approximately 600 gal. per minute. The motors driving the pumps were connected so as to draw upon either of two separate sources from which energy could be supplied, to insure continuity of service in emergencies.

Arch Concrete Lining Placed First

In the tunnel the concrete was placed first in the arch, as indicated in the accompanying drawing, and later poured into the forms of the invert from the same level from which the arch was concreted. Concrete was delivered into the tunnel in cars of ¾-cu. yd. capacity, being lowered on hoists in the shafts and entering through the air locks at either end of the tunnel. After the first 30-ft. section from the south shaft was placed it was found that its timbers, forms and concrete had settled into the soft bottom, on which they were temporarily blocked, for a depth of about 6 in., thus leaving the arch about this much below grade at this point. The work was continued beyond this point, advancing at proper grade and leaving the section out of alignment to be dealt with later.

After the headings had met and the concreting was otherwise completed, the arch of the 30-ft. section which had settled was entirely removed and the timbering exposed. This was done of course with the air pressure on the tunnel. It was then found that at the point of maximum settlement a 16-in. thickness of concrete could be put in without interfering with the timbering. Reinforcing sufficient to give this thickness a strength exceeding that of the unreinforced 22-in. section was therefore put in and the correct grade for the arch at this point was secured. The amount of correction necessary had been reduced by increasing the specified grade of the tunnel from the center toward the south shaft. This change in grade put the specified elevation of the arch at the south shaft about 4 in. lower than was originally intended.

The entire tunnel drains toward the south shaft, where all seepage will collect in a permanent sump built in the concrete. This will be equipped with an eductor, or jet, pump operated by water from the mains which are to be carried through the tunnel.

Wedge Flange Against Leaks for Grout Connections

As was anticipated, when the concrete lining was finished and the air pressure was taken off there were numerous leaks through which water found entrance to the tunnel. Because the tunnel will be used only for pipes and wires, and because the pump installation referred to would be required in any event, it was not considered worth while to go to the expense of securing a practically watertight tunnel and it was decided to seal only those leaks which allowed a considerable inflow of water.

The contractor was required to stop 77 leaks indicated by the inspector and which developed a considerable flow, and in addition to these the city considered it worth while to stop about 295 more which were too small to be included among those assigned to the contractor. The grout used by the contractor in stopping the larger leaks was paid for by the city, and the compensation allowed therefor figured out at about $36 per cubic yard.

A 1¼-in. air drill was used to open up each leak before grouting, and it was found that those which afforded the largest flow were the most easily repaired. After drilling out a leak an 8-in. flange with a gasket was placed around the hole and was wedged tightly into place by means of a strut running diametrically to the opposite side of the tunnel. Attached to this flange was a 2-in. valve which could be closed to prevent the water flowing into the tunnel. The grouting pipe was then connected on the outside of this valve, and as the pressure was turned on the valve was opened so that the grout could be forced into the passage opened up by the drill.

Force Pumps for Grouting

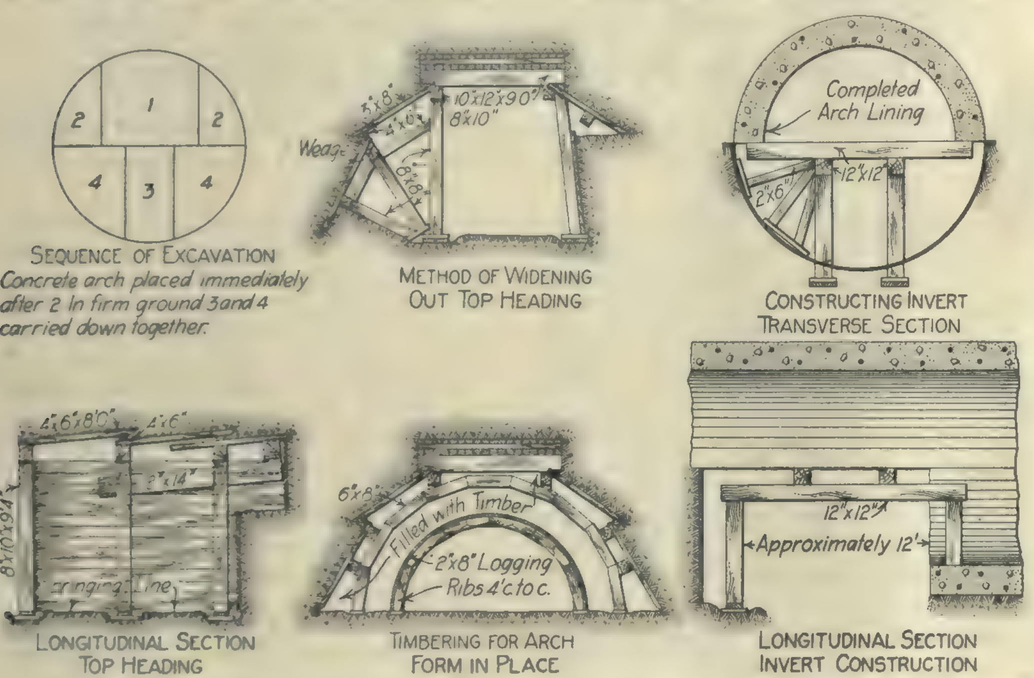
For grouting the contractor used a Grant force pump, which was able to develop a pressure of about 125 lb. per square inch. With this equipment some of the leaks were stopped with a very small amount of grout and others required almost half a cubic yard. For the 77 holes grouted with this machine a total of 1810 sacks of cement were used.

For the smaller holes which the city closed a home-made hand pump was used for forcing in the grout. This consisted of a double-action force pump with 1-in. suction and ½-in. discharge, having a 6-in. packing gland which was long enough to take about 2 in. of hydraulic packing. This packing gland and check valve were the only parts of this pump which had to be made up on order, all the remaining parts being assembled from stock material. With this device operated by two men with long hand levers it was possible to get pressures as high as 300 lb. per square inch. The ½-in. discharge was connected to a 1-in. air pressure hose, which in turn was connected with bushings to the valve on the flange fastened over the leak. With this small hand machine 295 holes were stopped with a total of 325 sacks of cement.

Bracing Struts Left Twelve Hours

After grouting the holes the bracing struts were left in place for twelve hours and then removed. In practically every case the repair by this method was effective, and it was considered that the scheme of grouting was notably efficient and inexpensive for a tunnel in such soft material as that encountered on this job. The use of the gasket and flange method leaves the repaired spot with a smooth finished surface that requires no further attention. In some cases where very large leaks were repaired the effective area of the flange, which was 8 in. in diameter, was increased by the use of a large wooden washer and gasket of equal size cut to fit the size and shape of the particular leak under treatment.

The construction of the tunnel was under the general supervision of A. H. Dimock, city engineer of Seattle. T. H. Carver, assistant city engineer, was in immediate charge of the work, and E. D. Alexander was resident engineer for the city. The original contract was awarded to Meecham & Babcock for $183,000 and the tunnel was driven and lined under subcontract by Joseph Hanreddy of Chicago, for whom Robert Spencer was resident superintendent.



VERY SOFT GROUND MET WITH TOP-HEADING METHOD, USING COMPRESSED AIR

What Drainage Reclamation Needs

Drainage problems were discussed recently before 500 business men of the Chicago Association of Commerce by Prof. F. H. Newell. Considering only the simple elements, the following conclusions were reached: Great areas of fertile lands lie unutilized along our rivers. Similar lands have been reclaimed and cultivated, with benefit to the state as well as to individuals, by improved health and increased agricultural production. While the easy work has been done, there is still more to be accomplished, and to even greater advantage to all. The legal obstacles should be made known and removed. The financial difficulties resulting from uneven distribution of cost and benefits must be adjusted, which can only be accomplished by arousing intelligent public opinion. The business man who is in a position to look into the future must lead in the education of the public to bring about the needed reforms in legal and financial details. The results of such action will be a more widely extended and more profitable agriculture, the basis upon which rests commercial success.

Brick Pavement on Two-Inch Mortar Base Laid for $1.45½ Per Square Yard

On Lightly Traveled Streets of Dwight, Illinois, Substantial Saving Was Made by Reducing Thickness of Foundation Course

By P. E. GREEN
Of Marr, Green & Company, Civil and Sanitary Engineers, Chicago

LAID upon a 2-in. mortar base, instead of upon 4 or 5 in. of concrete, the common practice for this type of surfacing, 20,000 sq. yd. of monolithic brick pavement in the town of Dwight, Ill., were constructed at a cost, exclusive of grading, of only $1.45½ per square yard, a substantial reduction from the usual price for this kind of work. Of course it is not presumed that a heavy traffic of 6, 8 or 10-ton motor trucks could use a pavement with so thin a base constantly without destroying it, but in small cities and on the residence streets of large cities it is believed that this type of construction can be successfully employed.

In the last few months there has been some development of a brick pavement in which the concrete base has been reduced to as small a thickness as 1 in., being then simply a bed to give the brick a smooth surface. This construction is based on the theory that, provided the subgrade is sound and dry and kept so, it is of ample strength to withstand the weight of any ordinary traffic.

To Keep Subgrade Dry

The problem of constructing a monolithic brick pavement on city streets is quite different from that of country roads. The necessity of proper gutters, variations in grades, numerous right-angled and acute intersections and adequate drainage complicates matters enormously. At Dwight the topography is practically level. The surface drainage therefore must be taken care of largely by means of variations in the height of the curb. In this particular case very great care has been taken to see that the final drainage is adequate. A complete system of storm-water drains was constructed with numerous catchbasins and inlet connections. By this means it is expected that the subgrade will be kept permanently dry, and if this end is achieved there can be little question but that a vitrified brick 4 in. in depth, with a 2-in. mortar base under it and built as a monolith, will be amply strong for any traffic which it may receive. No more underdrains were required, however, than should be put under any properly designed pavement. The roadway widths are 22 ft.

Specifications for Wearing Surface

The specification under which the wearing surface was laid is as follows:

The brick shall have been carefully piled along the sides of the improvement so that it may be rapidly laid on the mortar bed, as it is the intention of these specifications to provide for the construction of the brick wearing surface simultaneously with that of the mortar foundation, thus insuring a monolithic pavement.

The mortar bed shall consist of a layer of Portland cement mortar 2 in. in thickness and composed of 1 part of the best quality of Portland cement and 3 parts of clean, sharp sand of the same quality as specified for curb and gutter. The sand and cement shall be thoroughly mixed dry to an even and unbroken shade, and then water in sufficient quantities added so that the resulting mixture will be a fairly stiff plastic mass, neither so wet that it will run freely nor so dry that it needs to be tamped to bring the water to the surface. Extreme care must be taken in this mix, and if it is not possible to get the proper mix in a concrete mixer the contractor shall proceed to mix and spread this material entirely by hand. This mortar shall be spread over the subgrade and lightly tamped with a hand tamper and then brought to an absolutely true surface with the approved template. All dry spots or sloppy wet spots must be avoided, and if they occur must be eliminated at once. If necessary, the contractor shall perform a series of experiments under the direction of the engineer so as to insure the proper, even, hemogeneous mix required for this improvement.

The blocks, after having been set, shall be rolled with a hand roller 30 in. wide and weighing not more than 50 lb. per inch of width nor less than 30 lb. per inch of width until the surface is smooth and even and the blocks are well embedded in the cement mortar. Particular care shall be taken by the men laying the blocks to eliminate imperfect blocks. After rolling once the inspector will cull all other imperfect blocks still left in the pavement, and immediately after this culling the surface of the pavement shall be swept clean, and the joints between the blocks shall be filled with Portland cement grout as described under the paragraph "Cement Grout Filler."

SMALL LIGHT ROLLER USED TO SHAPE CEMENT MORTAR BASE

It was realized that the specifications for the mortar bed were not ideal, but actual knowledge of the best mix for this mortar for use under city conditions was not available. Hence the necessity of experimentation. Events fully justified the form.

After the construction of the storm-water drains the roadway was graded and finished with a rigid template; the crown was established at 4 in. It was at first endeavored to have the crown less than 4 in., as a flat crown is an ideal to be approached, but it was found during construction that when less than this amount was used on this width of street it was almost impossible to avoid small depressions in the completed surface.

The contractor had on hand a small continuous mixer, and this was tried with great success. With this type of mixer, the mix being in sight the entire time, it was easier to obtain uniform mortar than with the batch mixer. With the batch mixer a uniform product can be obtained and its capacity is greater, but it requires constant attention to the water and timing of the hopper. The usual criticism against the continuous mixer is believed to be uncalled for. The character of the sand, the amount of water in the mix and the length of time in which the machine mixed the mortar were found to be very important.

Test Sizes of Sand

Various kinds of sand were experimented with in order to secure the best results. It was demonstrated that the mortar, in order that it may be handled in the best way and to eliminate dry spots or wet spots, should have just enough water in it so that when patted with a shovel the water would flush to the surface. More water than this would collect in pools and would make soft spots and the brick would go down under the roller. This is a vitally important point in securing a smooth surface.

Several samples of what was considered ideal mortar were tested for amount of water contained by taking samples, drying them out and weighing them both before and after they were dried. The amount of water in normal sand was also determined. It was demonstrated that the total amount of water should be from 19 to 23 per cent by volume of sand.

Various sized sands were used in order to find out whether a fine sand or a coarse sand produced the best results. Sand which is too fine—that is, which contains practically no pebbles even though it is what is ordinarily passed as a first-class mortar sand—would tend to hold the water in pockets. And sand which is too coarse, with too many pebbles, or too great a proportion of voids, would discharge the water too rapidly after being laid on the subgrade, and it would all drain toward the gutter. An evenly graded coarse sand, with a considerable percentage of pebbles the size of a pea or under, was decided to be most suitable. While no facilities were at hand properly to sieve the sand, yet from the writer's experience in filtration work he believes that sand which has an effec-

BRICK WERE DELIVERED FOR LAYING BY ROLLER CONVEYOR

tive size of about 0.02 in. and a uniformity coefficient of 3.0 is about the best graded for the purpose.

For this type of pavement the size and grading of the sand are most important considerations and too much emphasis cannot be placed on this point.

Mortar was delivered directly on the subgrade by the continuous mixer and shaped with shovels and template, and was not on an average more than 20 ft. ahead of the brick work.

Tamping of the base was provided by the specifications, but it was found that a little roller weighing about 3½ lb. per inch of width made the best tamper. The mortar was deposited on the subgrade by the mixer, the template drawn over it and then rolled with this light roller, and the template drawn over it again, forming a fine, even, dense and smooth surface with a minimum of wet or dry spots.

The brick, which had been previously piled alongside the work, was delivered to the workmen on roller conveyors, the bricklayer taking them directly from the roller. This method of delivering the brick to the men is practical up to a 40-ft. width of roadway, using on a street of this width two conveyors, trussed, one end resting on each curb. The bricklayers objected at first to laying directly from the conveyor, preferring to have them delivered to them by the men, but this means tramping over the new-laid brick with its soft mortar bed and a consequent disturbance of the surface. When the bricklayers became accustomed to this method of laying they preferred it. It also tends to speed up the work.

Closely following the bricklayers was a hand-roller. This roller was of the brand known as "Anyweight," the weight being varied by means of sand, water, etc., put inside of the roller. However, it is believed that a hand-roller for this type of work on streets of this width, or wider, is inferior to a very small self-propelled roller of, say, 1-ton weight on two wheels. The Anyweight can be loaded up to about 900 lb., or about 30 lb. per inch of width, but it is believed that a slightly heavier roller would secure better results. When it is loaded up to 900 lb. it is hard to keep a roller man because of the heavy labor of rolling. Hence the foreman's tendency is to reduce the weight instead of increasing it. If there is much work of this character there can be little question that a small self-propelled roller is the thing.

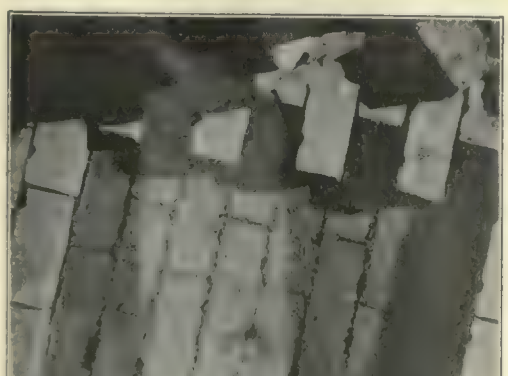
The brick were pushed ⅛ to ¼ in. into the mortar base by the rolling, and some bond was secured even before the grout was applied. This was demonstrated when, for some reason or other, it had not been possible to keep the grout up to the front, and on the following morning it was found hard to extract a brick from the mortar bed.

Grouting Followed Closely

The grouting followed the rolling and culling of the brick as closely as possible and usually was within a few feet of the end. Here again it seems that if a small self-propelled roller had been available the thoroughness of the grouting might have been improved upon by rolling after the first coat of grout had been applied, thus insuring an even and uniform penetration of the grout to the surface of the mortar bed and into all crevices.

It is believed that the finished pavement should be covered with earth between May 15 and Sept. 15 to secure better curing, but that before and after that period this covering is not so essential.

The final surface secured on this work, after the men had become accustomed to the construction, was beautifully smooth. In fact, during a period extending over a good many years the writer has never seen a smoother or more even new brick pavement. A depression in the surface was rare, and wherever discovered it was promptly brought up to grade.



BRICK REMOVED TO SHOW HOW MORTAR BASE ENTERS JOINTS AFTER ROLLING

No cross-expansion joints were used, nor does the writer believe they are necessary. It is believed they are a source of weakness in this type of construction. A large percentage of failures of brick pavements in which the cement-grout filler was used can be traced to cross-expansion joints. With an expansion joint across a roadway surface when expansion occurs the joint filler at one end or the other of the joint will yield first because of lesser width, the partial filling of part of the joint with an incompressible material such as sand or some similar reason. The result is an unbalanced couple and a sort of rotation about the rigid point. The brick back from the expansion joint crack, the joints spall and at the incompressible point the bricks crush. If there had been an even, uniform bearing the internal stress caused by the expansion could have been taken up by the block, or in the case where contraction takes place the crack formed is too narrow to cause any serious trouble, and in any case is promptly filled up with incompressible matter such as sand.

Lessons Learned

As a result of experience with this type of construction the following suggestions are made with the idea of increasing the practicability and decreasing the cost of construction:

1. A thickness of less than 2 in. of mortar base in a city street is hardly practicable because of the conditions which must be met, the expense of exact fine grading and the trouble at intersections where other improvements must be met.

2. The sand should be of the character described above, but a possible substitute for it would be a concrete composed of 1 part cement, 2 parts sand of the size previously mentioned and 4 parts pea gravel.

3. The water must be very carefully regulated, and the best results are secured when it amounts to about 22 per cent, by volume, of the sand.

4. The weight of the roller should be about 50 lb. per inch width, and a small self-propelled roller would be a great advantage.

5. It would very probably improve the construction if the brick were rolled after the first coat of grout had been applied.

6. A crown of 2 per cent of a street 20 ft. in width, decreasing to 1 per cent on a street 15 ft. in width, is about the minimum that can be handled successfully. Smaller crowns than this tend to cause the accumulation of water pockets and soft spots with their attendant depressions in the finished surface.

7. As far as possible no men should be allowed on the pavement behind the roller. This applies to everybody, including the men pushing the roller. The weight of these men coming on the individual brick tends to make depressions.

8. It is quite probable that a light mixer for grouting, the grout being spouted onto the brick, would tend to make a smoother surface.

There are great possibilities in this type of construction in small cities and in the residence streets of larger cities. A very smooth, attractive pavement is the result. The cost of this class of wearing surface is materially reduced. The cost of the pavement in question was $1.45½ per square yard, exclusive of grading. With care and thoroughness it is believed that the

strength of this construction is fully equal to that of ordinary grouted brick surface on 4 or 5 in. of concrete with a 1 or 2-in. sand bed. It is also believed that it is superior to the concrete pavement because it practically equals in thickness the concrete pavement, while its resistance to wear is considerably greater. Less trouble from expansion and heaving is anticipated.

It cannot be too often reiterated that the essential element of success is extreme care to the details of construction. However, this is true of any type of pavement. In this case it is the attention to the fine details of the sand grading, the amount of water, the rolling and the keeping of men off the finished product before it is grouted that make for success. The rolling should be not only longitudinal but also horizontal and diagonal. It is necessary in this type of construction to co-ordinate carefully the delivery of material, since if all material is not on the ground ready to be used at the same time the entire gang must be laid off. Once these points are understood and appreciated, however, the work proceeds wonderfully rapidly and satisfactorily.

The contractor for the work was Charles S. Upham of Odell, Ill. Mr. Upham is an extremely ingenious man and had many little labor-saving tools and appliances on the work. One of the most interesting of these and one which was absolutely new to the writer was an adjustable trowel for finishing concrete curb and gutter, described in the Hints for the Contractor section, page 812.

To the writer one of the novelties on this particular job was the grader and ditcher. This was a sort of a small light steam shovel manufactured by the Keystone Driller Company. It can be used either for digging a ditch and backfilling the same or for rough grading. The shovel travels on a boom, which is a double I-beam, and is raised, swung to one side or lowered through a universal joint at its base, the whole machine operating like a steam shovel, but being much less cumbersome and much more flexible. It is a very handy machine for a general contractor. In this particular job ditches from 2 to 9 ft. in depth and 40 in. wide were dug for the underdrainage. The subgrade also was graded with it, it being possible to manipulate the grade to within ½ in. of the final contour. The machine would load a 1¼-yd. wagon in from 40 seconds to 1½ minutes and would dig a ditch up to 40 in. in width and 20 ft. deep without any trouble. When digging a ditch the shovel bucket is reversed and works toward the machine, but when grading it works away from the machine.

M. A. Peiser was resident engineer on the work. Much of the success of the work was due to his intelligent care and interest.

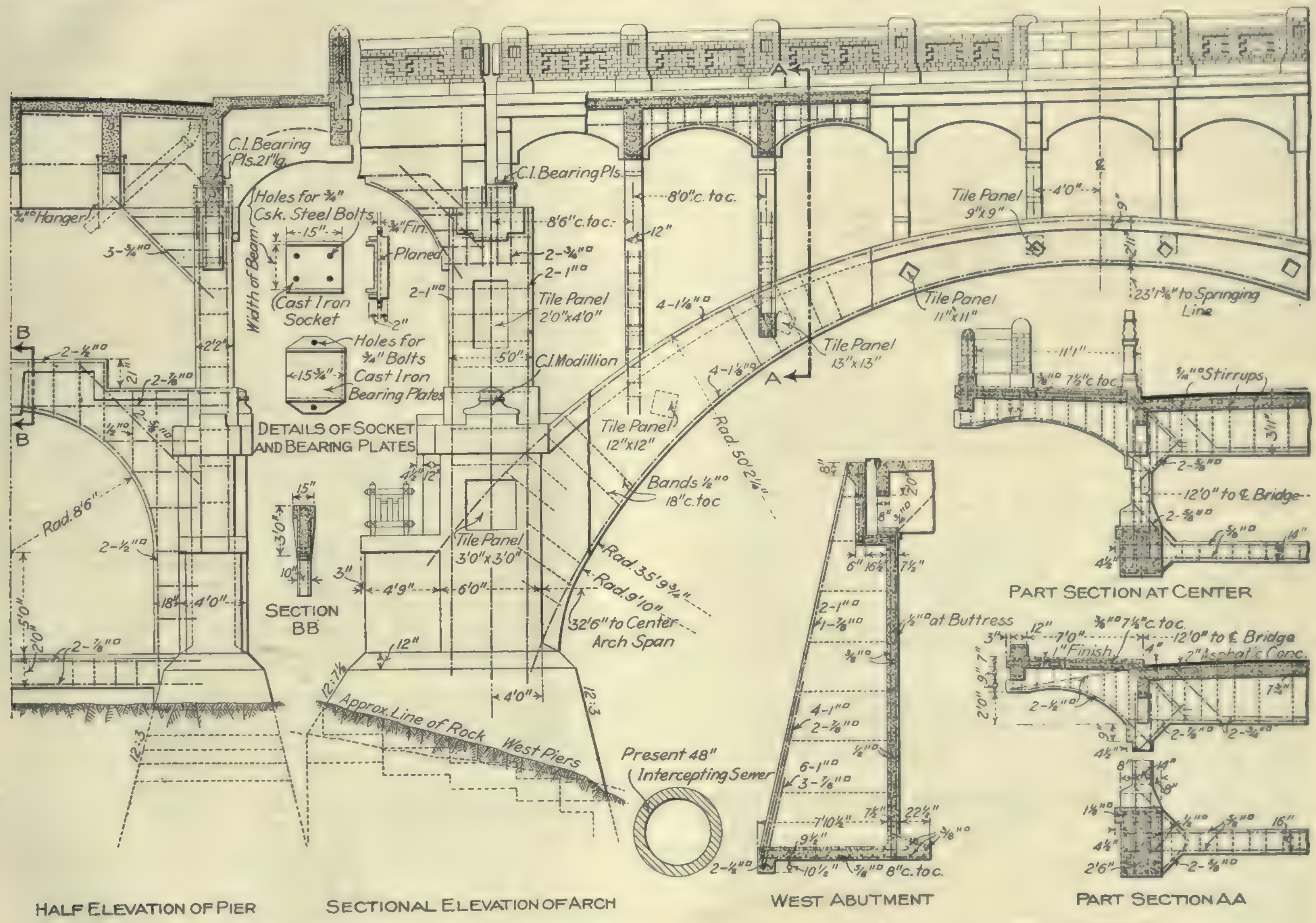
Every Day Is Pay Day in Pennsylvania

Contractors in central Pennsylvania have solved the problem of keeping labor on the job. The force of one contractor who began paying his men off every day instead of at the end of the week was so pleased with the arrangement that it stuck by him, and other contractors have adopted the same plan. According to reports, the plan has met with success wherever tried.

Inlaid Tile Used in Arch Span of Park Bridge

Atlanta Structure with Counterfort Retaining Walls and Cast-Iron Expansion Details for Reinforced-Concrete Stringers

CURVED sidewalk brackets and spandrel openings, inlaid panels of colored tile or mosaic in the main piers and arch ribs, and pier offsets supporting plant tubs mark the new Piedmont Park bridge in Atlanta, Ga., as another engineering structure in which architectural considerations have been given due prominence. Counterfort abutments, with the buttresses on 6-ft. centers to conform to the spacing of the stringers of the end spans, and cast-iron sockets and bearing plates at the expansion ends of the stringers are other features of this highway bridge built to carry a new boulevard over Clear Creek and the Southern Railway tracks.



HALF ELEVATION AND SECTIONS OF 73-FOOT MAIN ARCH OVER CREEK—DETAILS OF PIER AND WEST ABUTMENT

General Dimensions

The total length of the bridge is approximately 625 ft., consisting of four 36-ft. 6-in. concrete girder spans, one on the west end and three on the east end flanking the main arch of 73-ft. span and 23-ft. rise over the creek, and two approaches. The west girder span is over a future roadway, and the three east skew spans are carried over tracks of the Southern Railway—one present track and four planned for the future. Overhead clearance of 22 ft. is required at these tracks. An existing intercepting sewer on the west side of the creek determined the location of the west pier or arch

abutment, which was placed just far enough west of the sewer to avoid interference.

The design was prepared with a view to harmonizing the picturesque surroundings with economic layout and simple details. To add æsthetic features, not only were curved outlines in the spandrel openings of the main arch span adopted, but panels of inlaid colored tile are used in the piers and on the outside of the main arch ribs, also cast-iron modillions painted a dusk color, as noted on the accompanying drawing. The main piers have large pedestals with creosoted-timber plant tubs. Another element of variety is introduced by the paneled red brick railing with a white concrete coping cast in units.

For the west or park approach the bridge is provided with two large granite portals and white ornamental flower urns on top. The stones used in the portals are the granite blocks of Atlanta's first pavement of 1882, and the lampposts are from Atlanta's first street-lighting system of 1855.

One of the details which will be noted as exceptional is the cast-iron socket and bearing plate at the expansion ends of the concrete stringers where they bear on the abutments. These are shown in the drawing herewith. The socket is attached to the bottom of the stringer by four countersunk bolts, and its planed lower face slides on the planed upper face of the bearing plates bolted to the abutment.

The design was made by C. E. Kauffman, engineer of bridges and estimates, Department of Construction, city of Atlanta. The contractors are Case & Cochran, of Atlanta.

Ninety-two City Managers Now

According to statistics given out at the recent convention of the City Managers' Association there were on Nov. 1 of this year 92 cities in the United States operating under the city manager form of government.

"South Station Under" of Boston Rapid-Transit System Has Ample Traffic Facilities

Stairways and Escalators on All Sides of Square Insure Rapid and Direct Transfer of Passengers—Large Lobby Above Tracks

By WILLIAM W. LEWIS
Assistant Engineer, Boston Transit Commission, Boston

AMPLE PROVISIONS for accommodating large crowds on special occasions were made in the design of the recently completed "South Station Under" of the Boston Rapid-Transit System, located at Dewey Square. In fact, these special requirements governed the dimensions and layout, the number and capacity of the combined entrance and exit openings, and the escalators, rather than the estimated usual daily or average traffic, either at present or for the future. Two classes of traffic were considered in the design—passengers desiring access to and from the streets and railroad passengers transferring to and from the South Union Station. The governing conditions and some of the details of construction are here given.

Location of Station

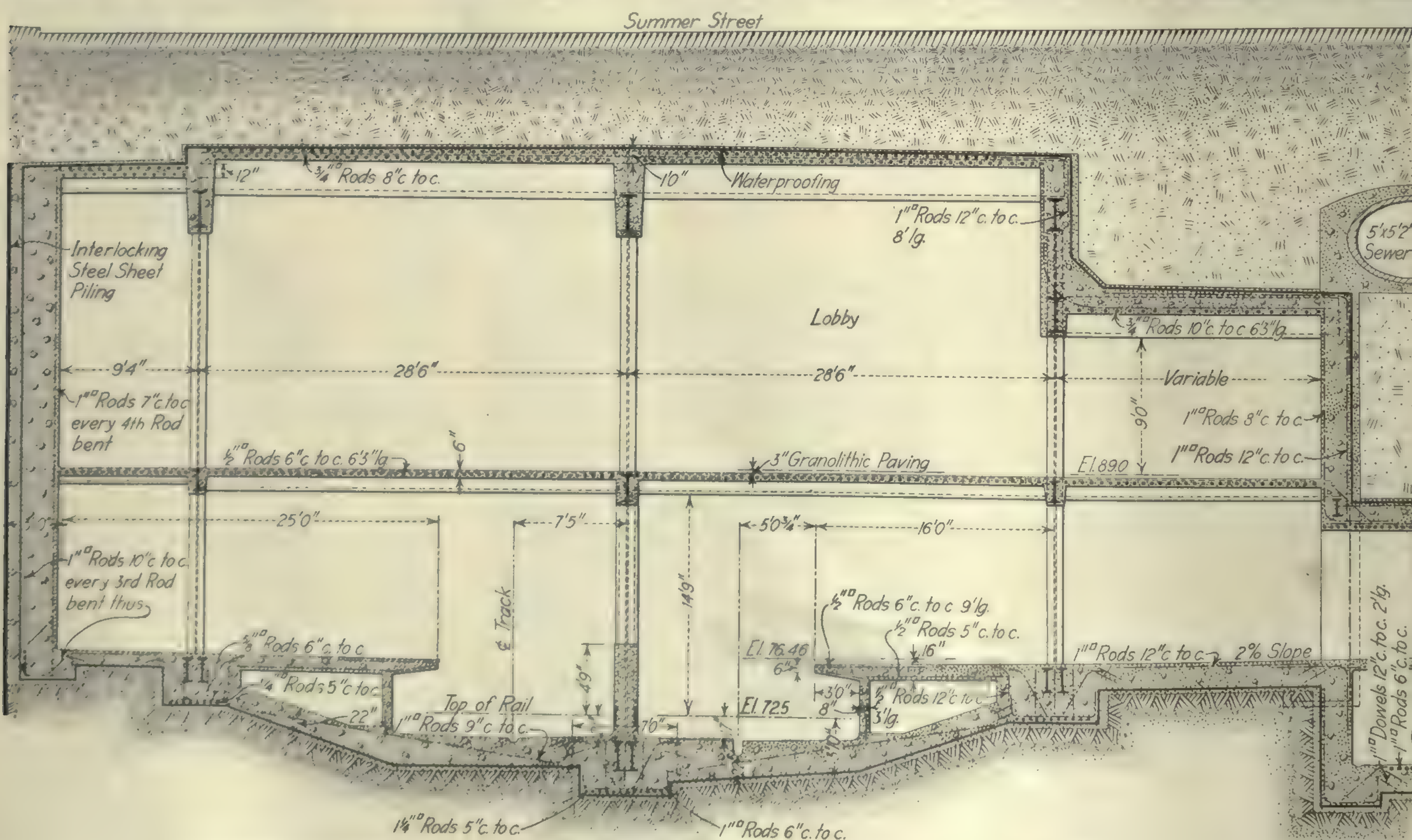
The portion of Boston's rapid-transit system recently opened to public travel is a part of the subway known as the Dorchester tunnel, an extension or continuation of the Cambridge subway. The Dorchester tunnel begins at "Park Street Under" station under Boston Common and continues in an easterly direction under Winter Street and Summer Street to and through Dewey Square. Here it turns in a southerly direction, running through a part of South Boston to Andrew Square. This tunnel, from the Cambridge subway at Tremont Street to and including the Washington Station near Washington Street, was opened to public travel on April 4, 1915. The part recently put in service adjoins this section and extends from the Washington Station to and including the station in Dewey Square.

At Dewey Square is located the South Union Station of the New York, New Haven & Hartford Railroad Company and the Boston & Albany Railroad Company—one of the two railroad stations which handle all the downtown railroad traffic of the city. Running through the square are many lines of surface cars and the Atlantic Avenue loop of the elevated system. The subway station in this square will thus be a very important feature in the rapid-transit system. It will serve to connect the Tremont Street subway, the Washington Street tunnel, as well as the Cambridge and Dorchester districts, with the South Union Station.

Design Conditions

The subway station called the "South Station Under" is designed to serve two classes of traffic—first, those persons entering or leaving the station from or to the public streets, and, second, those persons wishing to transfer between the tunnel station and the South Union Station. The square being large and the vehicular and pedestrian traffic much congested at times, entrances are placed on the four corners of the square, as seen on the plan.

These entrance stairways are each 8 ft. wide and are planned to be used by passengers either entering or leaving the station. Owing to the high value of the property in this locality, it was deemed best to locate them on the sidewalks of the streets,



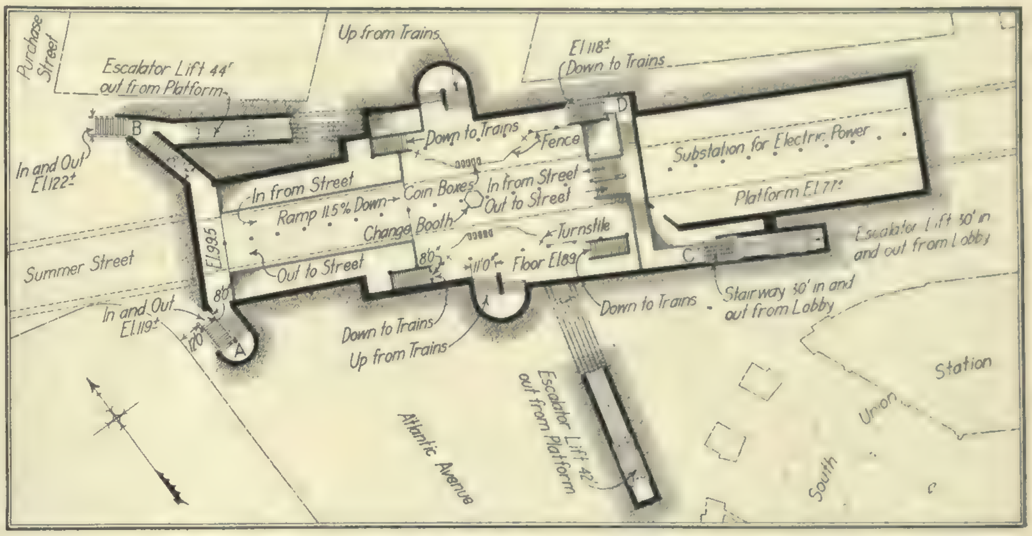
TYPICAL CROSS-SECTION SHOWS THE STEEL FRAMEWORK AND RELATIVE POSITION OF PLATFORMS AND LOBBY

which in all but one case have been widened for the purpose. Passengers coming from or going to any of the streets leading into the square can enter or leave the station without crossing the square. One of these stairways is located on the sidewalk adjacent to the South Union Station and is especially convenient for passengers wishing to use the railroad station. An awning or covering may be built between this stairway and the railroad station to protect passengers from rain or snow.

The two stairways at the westerly side of the square lead to a common landing beneath the street at the upper end of a ramp about 28 ft. wide, sloping down on an 11.5-per cent. grade to the westerly end of the station lobby. The two stairways at the easterly side of the square lead to a common landing at the upper end of a flight of stairs about 16 ft. wide. These stairs land at the easterly end of the station lobby.

This lobby is a large room or chamber about 30 ft. below the surface of the street, about 65 ft. wide and 100 ft. long, located over the tracks, to be used in common by the passengers going or coming in either direction. A different treatment at the two ends of the lobby was necessary because of the different relative location of the surface stairways, fixed by the streets, to the station lobby.

From this lobby there are six stairways, three at each side, one 11 ft. wide and two 8 ft. wide, leading down to the two station platforms. All these stairways are used in common by passengers going down to or coming up from the trains. The entrance to these stairways on each side of the lobby is guarded by an iron fence and a set of coin boxes where passengers pay their fare before descending further to the station platform. Located in this iron fence at convenient places are turnstiles and gates for the use of passengers coming up from the trains. The turnstiles will be in use all the time and the gates will be available to supplement them in times of heavy traffic. The space between the two fences, used in common by passengers going in either direction, contains a "change booth," as indicated on the plan drawing.



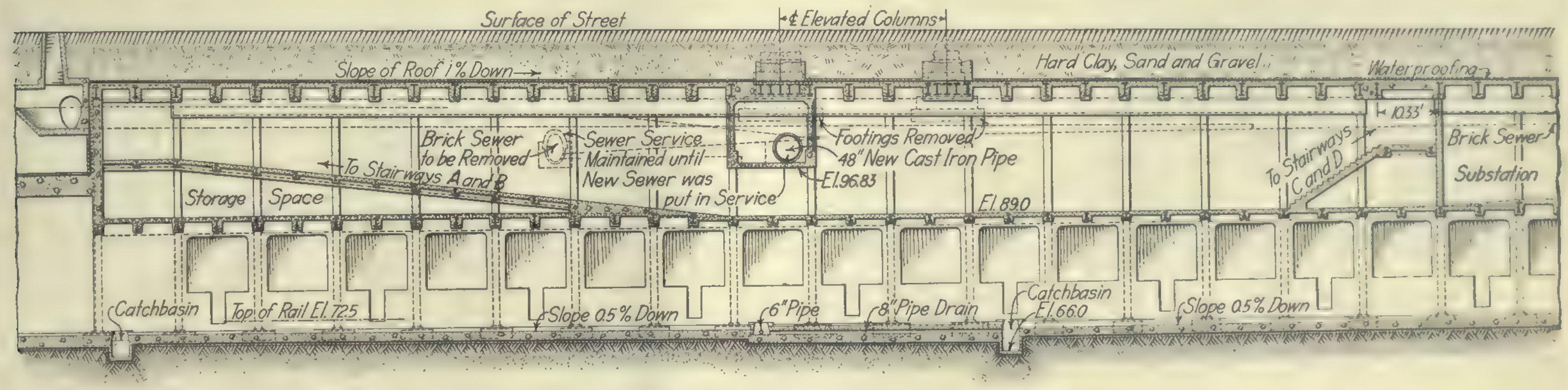
SECTIONAL PLAN THROUGH THE STATION AT THE LEVEL OF THE LOBBY

STATION PLATFORMS—ESCALATORS

The station platforms are located 13 ft. below the lobby and 43 ft. below the surface of the square. They are about 355 ft. long and have an unobstructed width of 15 ft. For a length of about 147 ft. near the middle the platforms have an additional width varying from about 10 ft. to about 18 ft. where the stairways from the lobby land.

Lighting is especially effective. It is produced by locating the lights in the slabs between the beams. Looking along the platform, the lights are out of sight, giving the effect of indirect lighting, as seen in the accompanying illustration.

Leading from each platform, in addition to the stairways mentioned, there is a double-file ascending cleat-type escalator running to the surface of the street for the use of outbound passengers only. Each of these escalators has a capacity of 7200 passengers per hour. There are also two single-file cleat-type reversible escalators which run from the lobby level to the surface of the street. Each of these escalators has a capacity of 3600 passengers per hour, and one can be run ascending and one descending. They are located on the south side of the lobby and have their surface landing on the sidewalk near the entrance to the South Union Station, for the special purpose of serving passengers transferring to and from the railroad station.



PART PROFILE ON CENTER LINE OF SOUTH-BOUND TRACK SHOWS EXISTING SEWERS, DRAINAGE AND STRUCTURAL FEATURES

The station is built with a length of about 200 ft. on a curve of 5000-ft. radius, and the remaining 155 ft. on a straight line. The depth of the top of rail below the surface of the square, about 47 ft., was determined by the conditions existing east of the station, where the tunnel passes under a part of Boston Harbor called the Fort Point Channel. Here the minimum depth of the top of the tunnel below mean low water of the sea was fixed by the War Department. At the Fort Point Channel the tunnel was placed as high as the limitations would permit. Then running westerly toward the station the tunnel was built on the maximum allowable ascending grade of 3 per cent. until it reached the station, thus fixing its elevation. The grade of the rails through the station was required to be level.

As various schemes have been suggested from time to time for a tunnel or subway

LOOKING EAST ON SOUTH PLATFORM—LIGHTING OF STATION EXCEPTIONALLY GOOD

to run from the South Union Station across the city to the North Station, across the line of the Dorchester tunnel, it was also required that so far as possible the grade of the tunnel and the location and details of the station should not be inconsistent with these schemes.

PROVIDING FOR SEWERS

Running through Dewey Square across the location of the station and serving a large district was a very important main intercepting sewer. Its location and elevation were such that it was decided to carry it through the station. This was accomplished by building a concrete chamber in the upper part of the lobby, in which was laid a 48-in. cast iron pipe. The chamber was built large enough to carry an additional 48-in. pipe, if found necessary.

There were other important sewers that interfered with the construction of the station and whose service could not be interrupted. They were connected to a new 5 x 5 ft. 2 in. sewer around one side of the station, built before the old sewers were abandoned.

RAMP TO STREET AT WEST END OF LOBBY

ELEVATED RAILWAY COLUMNS

Two columns carrying the elevated-railroad structure passing through the square were located directly over the station and four others were located very close to the excavation. The two directly over the station were temporarily supported by a system of steel beams, all below the surface of the street, placed one at a time under the footing of the column. These beams were supported on timber posts resting at the bottom of pits located on one side of the column foundation and excavated to the bottom of the tunnel. The new foundations rest on two groups of I-beams provided for the purpose and built into the roof of the tunnel. The foundations of the four columns close to the station were not disturbed. The service on the elevated structure was not interrupted during the construction of the station.

Besides the elevated-railroad and surface tracks, there was one track of the Union Freight Railroad passing through the square. This railroad is engaged in transferring freight cars from the steam roads to the docks and warehouses and carries very heavy loads. By the use of heavy bridging and great care its service was maintained throughout the period of construction. The average depth of the excavation below the surface of the street was about 50 ft. The deepest point was at the pump well, where the excavation was carried to 60.5 ft. below the surface of the street.

The design was made under the direction of the Boston Transit Commission, of which George F. Swain is chairman and Edmund S. Davis chief engineer. The contractor was the Hugh Nawn Contracting Company of Boston. The writer acted as assistant engineer in charge of the design.

Dredging Contractor Must Keep in Close Personal Touch with Work

Simple and Accurate Reports and Good Business Methods of Accounting Necessary If Balance Is to Be Kept on Right Side of Ledger

By ARTHUR M. SHAW
Consulting Engineer, New Orleans, La.

[THIS ARTICLE CONCLUDES *a series outlining the principles governing the selection and operation of dredges. The first article, which appeared Dec. 16, described the application of different types of plant. The second, published last week, dealt with the human element.*—EDITOR.]

NO CONTRACTOR can expect to remain long in business if he cannot maintain a proper relation between his receipts and his expenditures. This relation cannot be secured without a comprehensive knowledge of the items which make up the expense budget. In the case of an engineer superintending a project for a client or employer, immediate financial disaster to the one in direct charge may not be so certain to follow a failure properly to analyze his expenditures, but the moral obligation to acquaint himself with conditions is even greater. Moreover, his future advancement in his profession will depend just as fully on his grasp of the business and economic questions which may arise as on his technical ability. An engineer so employed should keep careful cost records in order that he may intelligently direct the work; but in addition to this, the records which he keeps of projects that are under his supervision will be found to be of infinitely more value for future reference than volumes of similar data secured from other sources.

Whether for the use of a contractor-owner or an engineer-manager, the manner of collecting and recording data may be identical. No absolute system of records and classification can be devised, as local conditions will affect the amount and kind of data which should be collected. For instance, on work of regular section, which will be measured by a survey party, no report need be made by the dredge superintendent of average depth and width dug each day. On the other hand, if there is a possibility of dispute as to quantities handled, a daily record of such data, made by the dredge crew, may be invaluable. Actual measurements, systematically taken and properly recorded, are very convincing even though they may not have been taken by a highly educated man.

DAILY REPORT—DREDGE

Day Shift. ______________ 191

Working on ____________ Canal.

Began at Sta.__plus____. Ended Sta.__plus__

(a) Average depth dug ___ ft. Width dug ___ ft

(b) Renewed ______________ cable.

Number men employed this shift _____

Delayed ____ hours account ______________

Remarks: ______________

Signatures: ______________ ______________

Operator Captain

REPORT FORMS SUITED TO HEAVY HAND AND SOFT PENCIL

Report forms which are to be filled out by men who are engaged in hard manual labor must be clear and concise and must call for a minimum amount of clerical work. It should be remembered that such a man will write with a heavy hand and a soft pencil. In the accompanying form, suggested for daily reports, item "a" should be omitted if the information can be obtained from other sources. Item "b" is considered to be of enough importance to justify a separate record. Cable renewals are an important item in dredge operation, and an exact record of the performance of cables of various grades and makes may assist in effecting an economy in this item. Low-grade cables may give good service under certain conditions, while in other cases the highest-priced cable may be the cheapest one to buy when the cost per yard of material handled for cable renewals is calculated.

Conditions may require that other data—such as the weather, the amount of fuel used and on hand, or the character of material handled—be shown on the daily report. As already stated, however, all unnecessary matter should be eliminated. While the information forming the report should be reduced to the bare essentials, a systematic daily preparation of the report should be rigidly enforced. Forms of distinctive color may be used to advantage for day and night shifts. Cards are preferred to paper forms, as they are easily filed. Also, if it is necessary to transmit them by mail, they may take the form of a private mailing card.

GIVE SPECIFIC INFORMATION IN ORDERS

All orders made out by the captain, especially for repair parts, should contain, in detail, specific information as to what is desired. As a further safeguard against error, the manager should have on file in his office as complete a record of the details of equipment as practicable. This record should include such information as the size, shop number, and name and address of maker of all engines, pumps and other special machinery. It should also contain detailed information relative to boiler, including diameter and length of flues, and complete dimensions of all sheaves. Manufacturers of sheaves have developed certain standard dimensions, but these are not always adhered to, and expensive delays may be avoided by indicating all dimensions. A statement should also be made of the bush-

ings required. Such parts as need frequent renewal may often be secured from local sources more satisfactorily than from the manufacturers. For these parts detailed tracings should be made and extra prints kept on hand. These may include boom pins, sheave frames, friction blocks, etc.

VOUCHER SYSTEM RECOMMENDED

The voucher system of recording and distributing expense items is admirably adapted to almost any class of construction work. The accompanying table is suggested as a typical example of the distribution of items required in connection with dredging work. However, it by no means covers all the distributions which should be made under special conditions. It may often be desirable to keep separate accounts for other items, such as transportation of fuel, maintenance of barges, construction work other than dredging, etc. The use of a

DISTRIBUTION OF ITEMS REQUIRED IN CONNECTION WITH DREDGING WORK

1. Operation of dredge
2. Fuel
3. Board (includes time of cook)
4. Miscellaneous supplies
5. Renewals, main hoisting cables
6. Other repairs and renewals
7. Moving
8. Interest
9. Depreciation
10. Insurance
11. Proportion of overhead expenses

combination check voucher is recommended. In issuing vouchers, sufficient memoranda should be made to render possible the closing of all accounts at the end of the month without waiting for the return of canceled vouchers. The record books of such a system would consist of a combined day book and journal, a voucher distribution book and a ledger. All receipts, transfers of accounts and other transactions not appearing on the vouchers should be entered in the journal and posted to the ledger, using the double-entry system.

The vouchers are distributed to the various accounts through the voucher distribution book, which is ruled with a series of vertical columns, each column being headed by a name of an account. After all vouchers for the month have been posted in this book, the total of each column is posted to the ledger as a debit against the account under which it appears and the total of all vouchers is shown as a credit to "Cash." No entries originate in the ledger.

OBJECT OF SYSTEM TO MAKE CLOSE WATCH ON BUSINESS POSSIBLE

A trial balance sheet should be taken off at least once a month. From this can be learned the true financial status of the business, provided proper care and discretion have been exercised in gathering and recording the data from which the book record has been prepared. Whether the project is small—in which case the man in charge may act as his own bookkeeper—or so extensive that a large clerical force is required, the manager should keep himself fully posted as to all important details. This entails not only carefully prepared records, but intelligent analysis of these records.

While such a system of cost recording and cost analysis is essential to the best results, nothing can take the place of frequent visits to and a full acquaintance with the work itself. Interpretation of written records and remedy of such defects as may be found can intelligently be made only by means of personal contact with men and things as they actually exist.

Reinforced-Concrete Garage Has Cantilever Floors

Design of McMillan Building, Detroit, Fixed by Wide Column Spacing for Parking Cars —Inclined Slabs on Second Floor

DESIGN of the floors for a new reinforced-concrete building, the McMillan garage, at the corner of Cass Avenue and Congress Street, Detroit, Mich., was determined by the requirement for open spaces between columns and proper provision for parking cars. The available space of 130 ft. in the width was, therefore, divided by three rows of columns spaced nearly 39 ft. apart, and the upper floors were designed as cantilevers 14 ft. long on the outer ends, just the amount necessary to allow parking of cars against the outside walls to bring their ends even with the columns. The cantilever floor beams are designed as continuous beams over three supports. In two panels on the second floor an inclined slab was necessary to give access to a rear alley in one case and to Cass Avenue in the other, the steep grade of the latter bringing it and the alley nearly to the second-floor level, where entrances for cars are provided.

DETERMINING CONDITIONS

The requirement for wide working and parking spaces for cars in the center of the 106 x 138-ft. building led directly to the selection of the widest practicable column spacing, nearly 39 ft., the floors to be supported on continuous beams extending the full width of the building. Owing to the relatively low specified live load of 80 lb. per square foot, it was found that the short outer spans would subject outside columns to a negative reaction. In other words, the weight of the upper walls, without any supporting columns, would be an advantage in economy, and simplify the design. The first-floor wall is therefore independent of the second-floor spandrel beam, which supports the upper wall, and the floorbeams are designed as cantilevers without support at the ends.

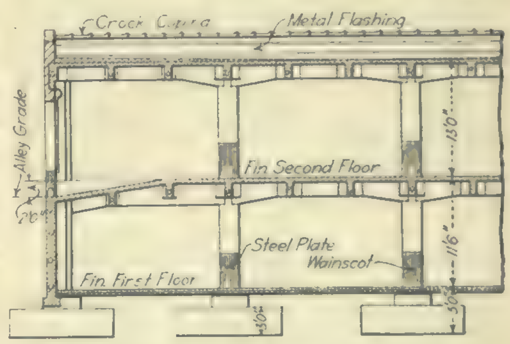
The building is designed for five stories, but at present only two stories are to be built. If a heavier live load had been specified, or if heavy concentrated loads on the cantilever parts of the floors were probable, the use of exterior columns would have been advisable.

DETAILS OF FLOORS

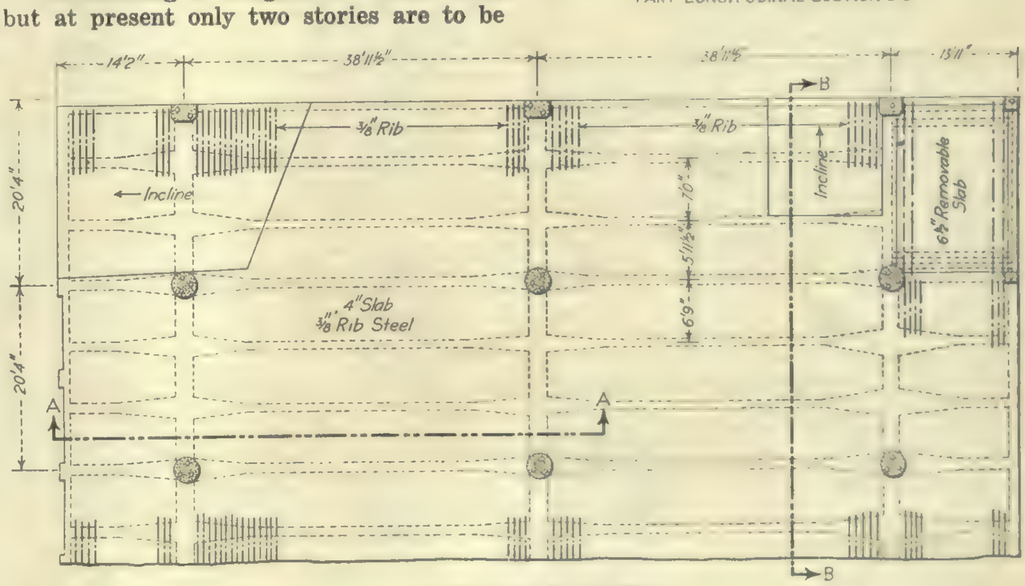
The continuous floorbeams are spaced about 7 ft. apart to support a 4-in. slab, as noted in the drawing. At the columns the beams are flared laterally to increase the resistance to shear. The reactions, shears, and bending moments were computed by the application of the theorem of three moments, assuming constant moment of inertia. The reinforcement consists of bent and straight bars and stirrups, placed as indicated for continuity over the supports.

The inclines in two panels of the second floor are provided by sloping the floor slabs and the supporting beams, the reinforcement in the latter being bent to conform to the outline of the beams. While the first floor is at the level of Congress Street on the south, the second floor is only about 2 ft. above the alley in the rear, owing to the steep grade of Cass Avenue on the west. Entrance for cars from the latter can, therefore, be obtained by an incline in one bay of the rear panel. Retaining walls are required on the north and west sides. These are designed as vertical slabs supported at top and bottom.

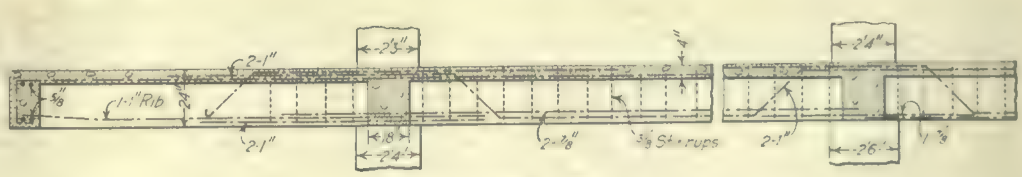
As each half of the building on the lower floors is to be operated independently, entrances being provided for that purpose,



PART LONGITUDINAL SECTION B-B



PART SECOND FLOOR PLAN



ENLARGED SECTION A-A

PART PLAN AND SECTIONS OF GARAGE, INDICATING CANTILEVER FLOORBEAMS

the cars can be parked both against the outside walls and near the interior row of columns.

The contract for the first two stories of the building was recently let to the Janss Brothers, Boomer, Hame & Crane Company of Detroit, Mich., and the excavation and footings have now been completed. The design was made by Albert Kahn, architect, and Ernest Wilby, associate architect, of Detroit. The reinforcing steel was furnished and details of the same made by the Trussed Concrete Steel Company of Detroit and Youngstown, Ohio.

Chicago Studying Effects of Zoning System

Bill Before City Council Provides for Restriction of New Construction of Certain Locations

AN ORDINANCE is before the Chicago City Council proposing a bill to be enacted by the General Assembly amending the city and villages act and authorizing cities to create industrial, residential and other zones and make property regulations. It is believed that if the bill is passed, real estate values will be stabilized, the city development will be better directed, buildings of different types which do not harmonize will be segregated, and better industrial facilities and home conditions will result.

In its tentative draft the bill provides that the city shall have the power to regulate types of buildings, to regulate lot areas, courts and other open spaces, and to restrict the location of trades, industries and buildings designed for specific uses, giving consideration to the character of the district, its suitability for particular purposes and the conservation of property values.

Power to Form City Districts

It also grants to the municipalities power to divide cities into districts, classify buildings, trades and industries therein, and to create a commission the specific duty of which shall be to investigate and make recommendations as to how the powers conferred by the act may best be exercised. No action is to be taken, however, until after public hearings are held. Permission to co-operate with city councils of other cities in making joint investigations, and to exercise powers conferred in promoting safety from fires, public health and welfare and conservation of property, is also included.

The bill expressly provides that no existing building shall be condemned because out of harmony with the conditions that may be created when the proposed districts are established. The regulations that may be prescribed will, however, affect all new construction.

Gage Heights Decrease as River Rises

The flow of the Colorado River at Yuma has varied from 35,000 to 84,000 sec.-ft. for a gage reading of 125, according to a recent paper by F. L. Sellew. Similar results, he stated, could be shown for other gage readings. The gage reading cannot be taken as evidence of the volume of the flow. In fact, near the crests of high floods, owing to scouring action, the gage has actually fallen while the volume of flow was increasing.

Group of Buildings Designed for Maximum Daylight and Transportation Facilities

Manufacturing Plant in Philadelphia Enlarged by Addition of Structures Connected to Existing Building by Underground Tunnel

ADDITIONS to the existing plant of the Edward G. Budd Manufacturing Company at Hunting Park Avenue and Twenty-fifth Street, Philadelphia, will consist of four large buildings—one reinforced-concrete structure of five stories, two one-story steel structures, connected to the present buildings by a reinforced-concrete tunnel under the Pennsylvania Railroad tracks, and one one-story brick structure.

The design of these buildings was determined by the requirements for the proper handling of material inside the plant. For example, the receiving platform located in building C was designed for the handling of steel, which forms the basis for the products of this company. The shipping platform in building A was designed to handle easily the completed products of the company, such as all-steel automobile bodies, wire wheels, and various types of large and difficult stampings made from sheet steel.

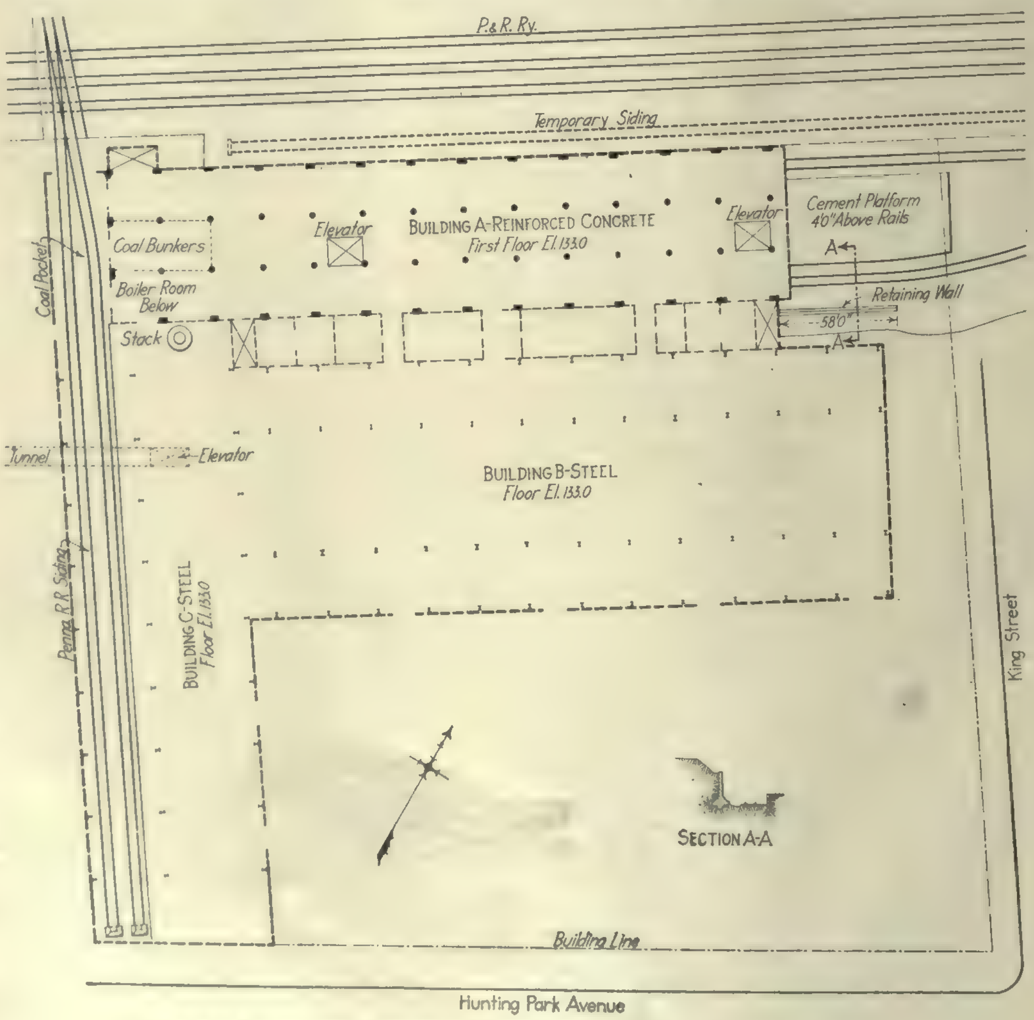
General Design of Buildings

Few buildings have such ideal shipping facilities, as this plant is located on both the Pennsylvania and the Reading systems. The layout by which connections to these railroads were made is illustrated herewith. The tracks connecting with the Pennsylvania Railroad, which are at a higher elevation than the Reading, cross the latter system by means of a separate bridge. From this point they lead over the coal bunkers into building C. The spur tracks from the Philadelphia & Reading enter building A on either side of a loading platform built on the level with the car floors. Great care has been taken to facilitate the rapid handling of freight cars for receiving and shipping material.

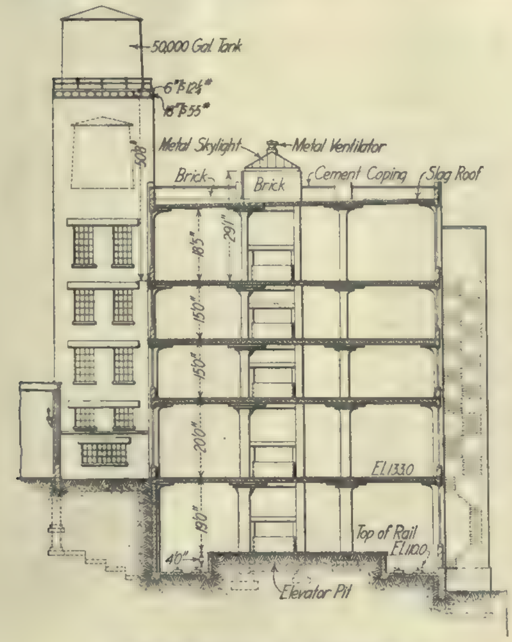
The sidings and the receiving and loading platforms are all in totally inclosed buildings, well lighted and heated. This is made necessary by the nature of the materials to be handled, such as the highly polished steel sheets, which are unloaded on the receiving platform, and the completed polished-steel products, which are packed on the loading platform. In this manner greater care can be exercised in the handling of these materials, and a high grade of packers may be employed for this work.

Features of Design

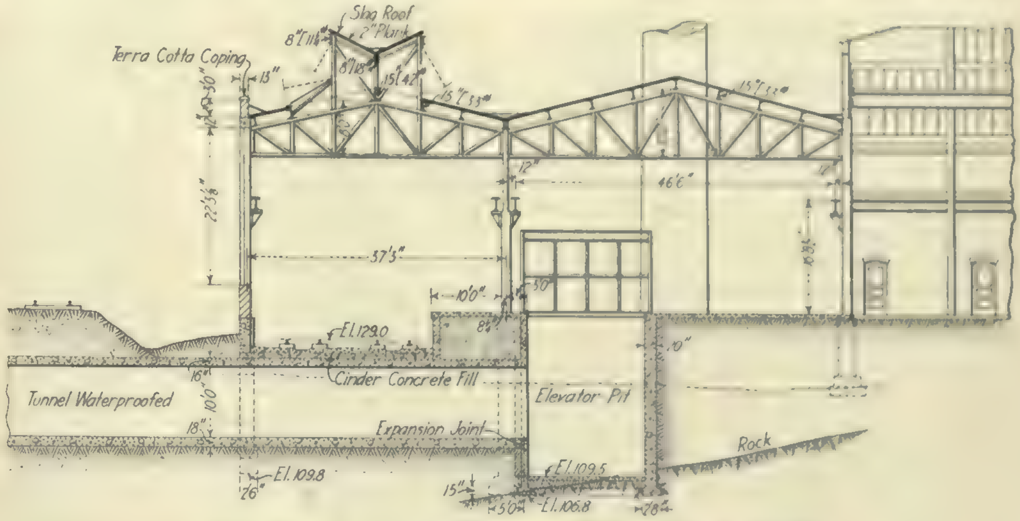
The buildings have been designed with a view to obtaining the best conditions for the workers and to secure well-lighted buildings, as a much higher grade of workmanship is obtained with natural light than with artificial light. The reinforced-concrete building A is five stories in height and 75 x 284 ft. in plan. This building is designed with four-way flat-slab floors of the Norcross system between hooped columns spaced 25 ft. on centers each way. The story heights are unusual, varying from 15 to 20 ft. This variation in height was introduced in order to give ample working space and light for finishing the large units under as perfect conditions as possi-



PLAN OF THREE NEW BUILDINGS FOR BUDD MANUFACTURING COMPANY



CROSS-SECTION OF BUILDING A



CROSS-SECTION OF BUILDING C AT CENTER LINE OF TUNNEL

ble. The east end of the building is so designed as to permit the addition of an extension.

Building A has been planned for assembly work on the two lower floors. The units are then carried to the third floor, where the final assembly takes place. It is the intention to use this building for the manufacture of all-steel automobile bodies and of wire wheels. The work progressing upward, the finished product will be sent, by means of a chute, to the shipping platform, located in the basement. The wire wheels will be carried by a conveyor from the fourth floor to the basement. Wherever possible, trucking has been eliminated, as it is expensive and a slow method of handling material.

Special mention should be made of the method of handling the coal and ashes. In the end of building A there have been erected concrete coal pockets from which a Link-Belt conveyor carries coal to the mechanical stokers. A great saving of labor is accomplished in this way, and excellent facilities are secured for the storage of coal.

Steel-Frame Buildings

The steel-frame building B, 124 x 314 ft. in plan, is of the usual one-story mill type with a high 60-ft. aisle in the center and two lower 31-ft. side aisles roofed by 2-in. planking and slag. To insure maximum light, the rolled steel ventilating sash on the sides of the center aisle are set with a slope of about 30 deg. with the vertical, as shown on the cross-section drawing, so that it will be practically unnecessary to use artificial light except at night.

Building B will be used as a press shop. It consists of three bays, the central bay being planned to accommodate large presses. The side bays will be used for smaller machines, such as rotary shears and small punch presses. Across the center span is a 15-ton crane, which will be used for handling dies and bringing steel to the various presses. Crossing each of the smaller spans are 5-ton cranes installed for the same purpose.

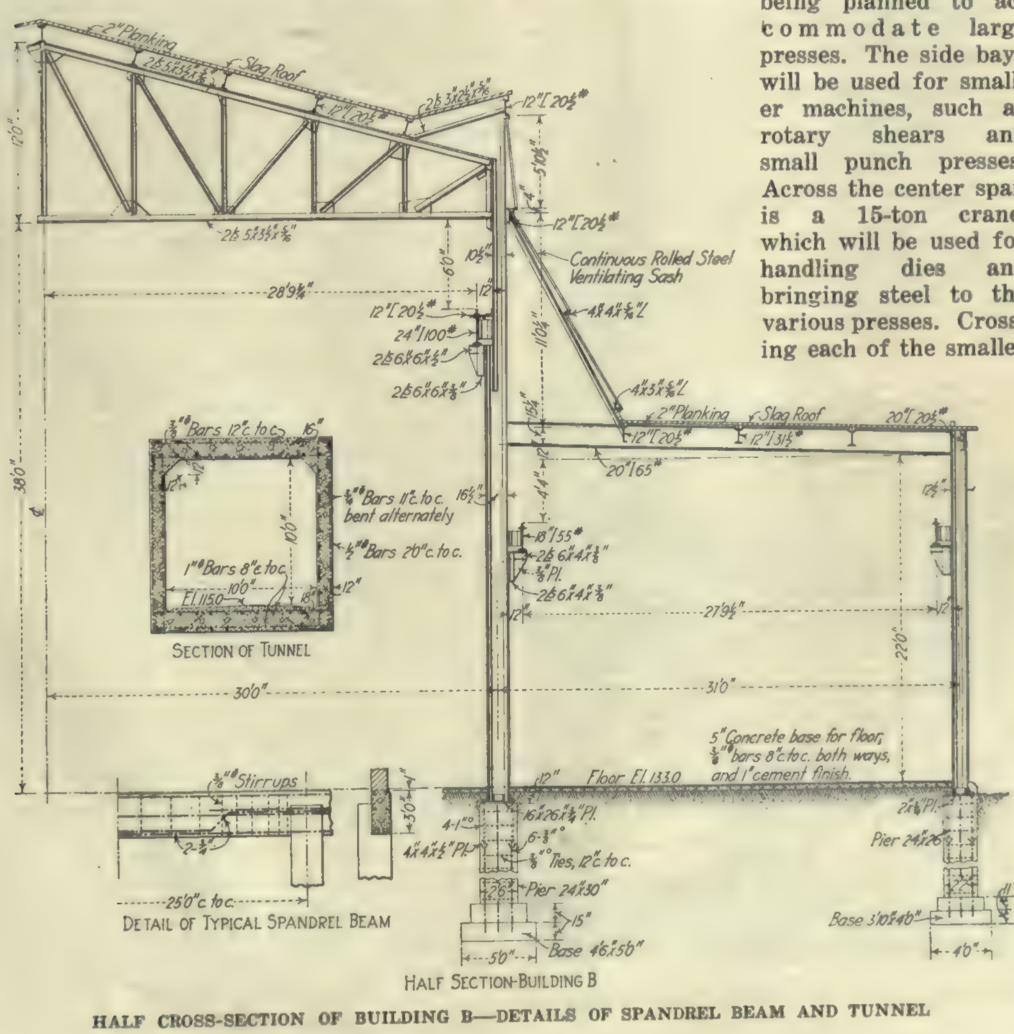
Connected with building B is the one-story steel building C, 303 ft. long and about 90 ft. wide, with aisles of 40 and 50 ft., as shown in the cross-section. The location of the columns was fixed by the necessity for the two siding tracks and the platform space on the west. The railroad tracks are supported upon short 7 x 9-in. wood blocks 2 ft. long, held in place by ¾-in. bolts embedded in the concrete floor. A 12-in. reinforced-concrete wall supports the edge of the loading platform. The brick walls are carried on reinforced-concrete lintels, shown in detail on the drawing of the cross-section of building B. About 30 ft. above the roof is a 50,000-gal. tank carried by steel beams on brick walls. This will be used for the sprinkler system.

Storage and Special Features

Great care has been taken to facilitate the carrying of the steel from the loaded freight cars to a suitable storage, and from thence to the point where it is to be used. The steel is brought in from the freight cars on specially designed trucks. From these it is lifted by the 10-ton crane which spans the storage building, and then conveyed to its proper place.

Among other special features is the reinforced-concrete tunnel, which has been made necessary by the fact that the Pennsylvania Railroad separates the old and the new buildings. This tunnel, which passes under the main line and siding tracks of the Pennsylvania Railroad, is 10 x 10 ft. in inside dimensions. The details of the tunnel are shown on the drawing of the cross-section for building B. The trucking space is amply large for hauling steel from the steel storage building to the present shop.

The buildings were designed by the architects, Ballinger & Perrot of Philadelphia, in conformity with the requirements of the owners, and under the direct supervision of the president, Edward G. Budd. The contract has been let to the F. W. Mark Construction Company of Philadelphia.



HALF CROSS-SECTION OF BUILDING B—DETAILS OF SPANDREL BEAM AND TUNNEL

23,000,000 Square Yards of Concrete Roads Contracted For in 1916

The roads, streets and alleys that have been placed under contract during the present year to be built of concrete total nearly 23,000,000 sq. yd., according to the Portland Cement Association. Owing to many unfavorable labor conditions much of this work will be carried over into next season.

Diagram Facilitates Detailing of Gusset Plates

Unknown Bevels, Sizes of Connection Plates and Location of End Rivets Can Be Easily Determined

ONE of the time-consuming operations in the detailing of roof trusses and riveted-truss frames is the determination of the size of gusset or connection plates, the end-rivet location and in some cases the bevel of the diagonal connecting members to give economical connections. The diagram here shown can be constructed either full size or to a large scale, and makes layouts entirely unnecessary. Those familiar with detailing will understand its operation by the following description of its application to the simple example illustrated.

When the location of the working point P is known, the bevel for the diagonal member is known, and the movable diagonal scale, drawn on tracing cloth to represent

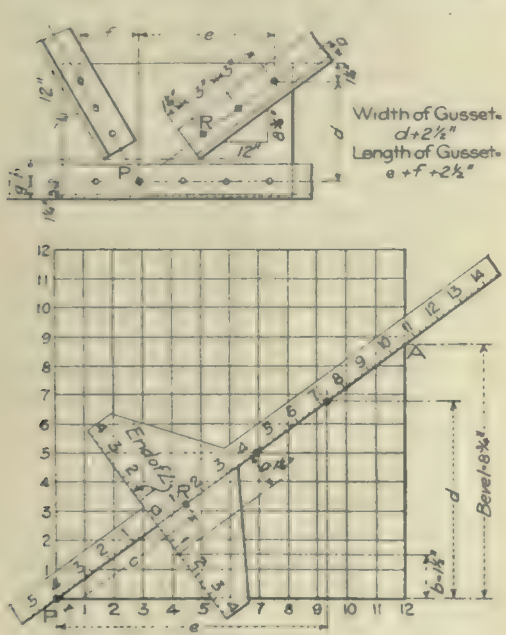


DIAGRAM FOR GUSSET-PLATE DETAILING

Diagrams should be drawn full size, with division lines to eighths of an inch

the diagonal angle (with lengths laid off each way from the end of the angle), can be placed on the diagram in the proper diagonal position PA fixed by the bevel. The distance *b* for clearance should allow for the over-run of the chord angles and clearance between the angles, and the distance *a* is fixed by the gage in the diagonal angle. These two distances are located on the vertical scale and the normal diagonal scale respectively. This movable scale is then shifted parallel to itself until it is in the position shown. The desired values *c*, *d* and *e* can then be obtained when the rivet spacing and edge distances are known. From the value of *d* the width of plate follows by adding the edge distance on each side, say 2 x 1¼ = 2½ in., as indicated.

The length of the gusset plate of course depends on the slope of the two diagonals, and the value of *f* for the left diagonal can be found by the diagram if the slope is laid off to the right instead of to the left. The required length of gusset is then $e + f +$ 2½ in., as noted.

Working Point to Be Found

When it is desired to reduce the size of the connection plates and the location of the working point is not specified at the intersection of the working lines, the working point for the diagonal is usually taken at the end rivet R. The co-ordinates for this point can be found by simple trial, obtaining the approximate bevel by the known position of panel points, reading feet on the horizontal and vertical scales as co-ordinates of the total length of the diagonal. By shifting the upper scales representing the angle, with edge distances known, the working point R can be located with required clearances between the members meeting at the joint. The desired co-ordinates are then easily read from the diagram, allowing for the inaccuracy in the bevel, and the exact bevel can be computed.

For angles with double gage lines and many rivets in the joint, it is best to extend the plotting of the diagram and the upper scales to insure sufficient length, or else the size of gussets can be found by adding quantities taken from the smaller diagram shown.

New Ditch Excavated in Bank of Old One

Concreting Costs $8.25 per Yard Excluding Excavation—Water Loss Reduced and Money Formerly Spent on Maintenance Saved

By C. D. CONWAY
Superintendent, Los Molinos (Cal.) Land Company

THE IRRIGATION system of the Los Molinos Land Company, in Tehama County, California, comprises 120 miles of ditches with capacities ranging from 5 to 100 sec.-ft. In the main canals and primary laterals, where the water is running constantly during the irrigation season, the seepage losses average less than 1 per cent per mile. In the secondary laterals, in which the water is running only at intervals, the losses are as high as 50 per cent per mile. This excessive loss is owing to the character of the soil through which these laterals pass—a Sacramento silt loam underlain with gravel in which vegetation grows very rapidly and gophers thrive. As the cost of maintenance and the loss of water are very high the company is lining these ditches with concrete. During the spring of 1916 4000 ft. was lined.

Instead of reducing the size of the earth ditch, the writer decided to excavate a new ditch within the bank of the existing one, as shown in the drawing. Stakes were set at the outside edge of the base. That section was taken out vertically, after

CONCRETE MIXED ON PLATFORM AND PLACED BY BUCKETS

TABLE 1—TOTAL COST PER FOOT OF 3050-FOOT DITCH

Excavation	$0.066
Forms (labor)	.021
Lumber	.014
Mixing and placing	.087
Cement	.171
Sand and gravel	.066
Engineering	.004
Superintendence	.010
Miscellaneous	.015
Total	$0.454

TABLE 2—COST OF CONCRETE PER YARD, EXCLUDING EXCAVATION

Sand and gravel	$1.45
Cement	3.75
Carpenters	.44
Lumber	.33
Labor	1.90
Equipment and team	.42
Total	$8.29

which two men with templates trimmed the bottom and sloped the sides. Grade stakes were set every 16 ft. Movable wooden forms in 16-ft. lengths were placed and supported as shown in the picture.

The concrete was mixed by hand on a board large enough for 1-yd. batches. The platform was built on runners and moved along the ditch for each batch, the gravel being distributed far enough from the ditch to leave room for the board to pass. Water was hauled in a wagon, and the same team moved the mixing board. Six men were

NEW DITCH WAS EXCAVATED IN BANK OF OLD ONE

employed in mixing and placing the concrete with buckets.

The aggregate used was a natural mixture of river sand and gravel screened through 1½-in. mesh. Five sacks of Portland cement to a yard of this aggregate were used. The concrete was mixed very wet and was well worked with a small specially made spade.

Expansion and contraction were provided for by placing ⅜-in. pine boards between forms. These were afterward broken off flush with the concrete. Though the temperature reached 110 deg. Fahr. in the shade at a time when the ditch was dry, no cracks have been noted.

Costs Tabulated

The cost per linear foot, including the cost of intake, outlet and a check and take-out every 660 ft., is given in Table 1. While the schedule of wages was low, the laborers were all inexperienced. The average progress was 170 ft. a day with a crew of six laborers and one carpenter, who acted as foreman. Toward the latter part of the job as much as 230 ft. per day was lined.

The itemized cost of concrete, exclusive of excavation, is given in Table 2.

This ditch has been satisfactory in every respect. In the opinion of the writer this method is much cheaper, where the banks are of sufficient size, than reducing the cross-section of the original ditch. The capacity of the earth section was 10 sec.-ft.; that of the concrete is 9.6 sec.-ft., using 0.15 for the value of *n* in Kutter's formula and a depth of water of 1.5 ft. The grade of the ditches is 0.08 per cent. Laborers on excavation were paid $2 for a nine-hour day, those handling concrete, $2.25, and carpenters received $3 a day. Lumber cost $20 per thousand and cement $3 per barrel delivered at the job.

Improvements Made in Signposts for Roads

Data on Economical and Permanent Types Collected from Highway and Automobile Organizations

THE need for permanent highway signposts is an outgrowth of progress in road-building throughout the country. The wood signpost has proved costly in most cases, because it must be repainted frequently; it is also subject to damage by vandals. The problem, therefore, has been to devise a post which will act not only as a guide but will be permanent. The following information regarding signpost practice has been obtained from the Highway Commission of New York State, through its first deputy commissioner, H. E. Breed, the Lincoln Highway Association, the Automobile Club of Minneapolis and the Automobile Club of Southern California.

NEW YORK STATE SIGNS

In 1909 the State Highway Commission of New York, after various experiments, began to install metal signs bolted on 2-in. galvanized-iron posts, which were set in concrete. The post shown in Fig. 1, according to Mr. Breed, represents an average cost of $6, this price including post, excavation and concrete for the necessary work connected with its installation. The average cost of the highway number sign placed upon it was $1. This included the signboard and attaching the board to the post. The average price for the guide sign was 17 cents a letter. This included the signboard and attaching the board to the post. For example, the New York State Commission gets the cost of the post with the road number of 100 and with the guide sign, "Albany, 6 miles, and Troy, 1 mile," attached—that is, in 1909 and 1911, when these types were in use—estimated as follows: 1 signpost, $6; 1 highway number sign, $1; two guide signs (14 letters or numbers at 17 cents each), $2.38; total cost, $9.38.

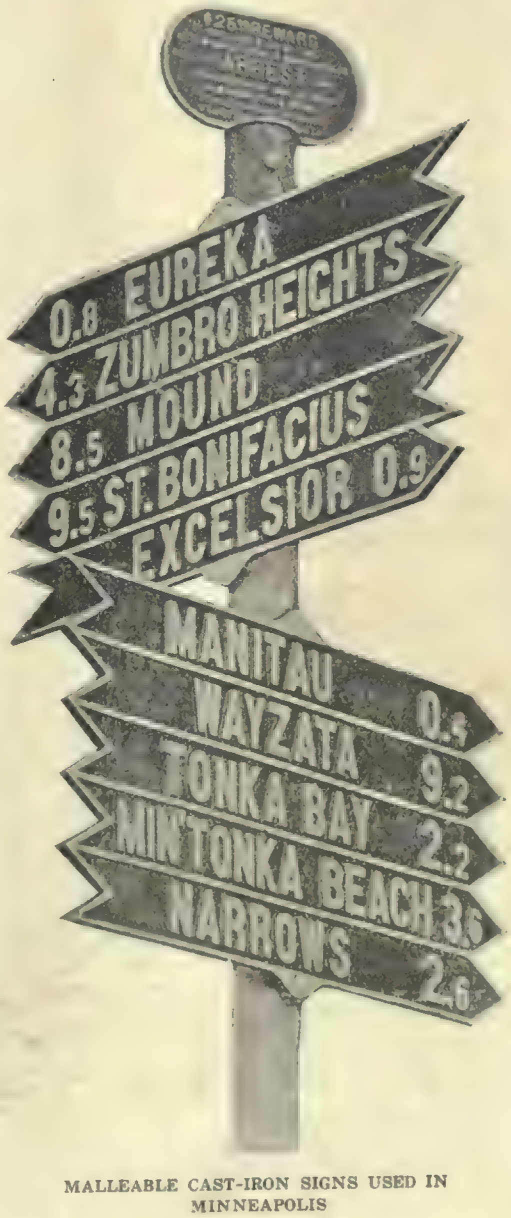
Recently, however, the New York State Commission has installed a number of concrete signposts at a cost of $10.40. The details are shown in Fig. 2. The price covers all concrete, reinforcement, forms, excavation and backfill and the furnishing of all material and labor necessary to installation. The cost of the guide signs, $2.10, covers everything necessary to installation. An estimate of this signpost, with one highway number sign and two guide signs, as given under the other type, is: 1 signpost, $10.40; 1 highway number sign, $2; 2 guide signs, $4.20; total cost, $16.60.

ADVANTAGES OF NEW TYPE

These prices as given are from the averaging of cost on roads built in 1915. These two types cannot be compared in regard to cost, as the payment by letter in the first type makes the cost variable, but in general the present type would cost almost twice that of the old. The advantages in the new type at its increased cost are that for permanency the concrete post far outlasts a 2-in. galvanized pipe and is not subject to bending or being forced out of place. In regard to utility, Mr. Breed believes that the latter type is more easily read at speed than the old, as the letters on the metal plate, as well as the plate, are not as legible after they have been in service some time as are the painted boards. Of course, with the painted boards as used in the latter type there is the expense of maintenance, but from the advantages derived this maintenance charge is offset by the increased facilities that the public has. This type of sign is not patented and consequently there is no royalty to pay, which increases the cost of most patented signs. In the danger sign that is shown for use now, the board is rectangular, with a large red arrow in the field. The word "Danger" appears in this in black letters, as well as the reason for the danger sign shown by words in black on a white field. This sign has a peculiar advantage of gaining at once the attention of the driver and can be seen at great enough distances to be of much use.

LINCOLN HIGHWAY SIGNS

The Lincoln Highway, according to information from Secretary A. F. Bement, is now very thoroughly marked from New York to San Francisco and can be followed by the tourist who has never driven over the road without at any time losing his way or being in doubt as to the correctness of his course. The present marking of the Lincoln Highway is the result of three years' effort, and during that time experiments have been made with different kinds of markings in different communities. The Lincoln Highway Association had purchased inexpensive steel signs with the emblem painted on them, but they rapidly rusted out and required frequent applications of paint, and soon became useless.



MALLEABLE CAST-IRON SIGNS USED IN MINNEAPOLIS

Mr. Bement says: "We have also, at different times, bought more expensive signs, running from $1 to $1.50 apiece, on heavy 16-gage steel, with baked-on enamel letters, but these have been too expensive for our organization to purchase in the quantities necessary and we have come to a standardized marking which is done by the application of the paint directly on the telephone poles on the route, and which is giving very satisfactory results, it being only necessary to repaint these markers every two years, and this only in the interest of appearance and not because it is absolutely essential."

From time to time different organization wishing to co-operate with the association have sent crews over the Lincoln Highway, placing warning signs before railroad crossings, indicating right and left turns, etc. One thing which is very striking is that any large circular sign set on a post invariably becomes a target for vandals, and it is almost in every instance found to be defaced after a year of service. The tendency to shoot at these signs with a shotgun or rifle and throw stones at them has caused some of the concerns erecting them to place a small bull's-eye directly below the sign, giving the directions, "If you must shoot, shoot this." This warning has in many instances saved the signs from mutilation.

In the West, where there are no telegraph poles for the placing of Lincoln Highway markers, it has been found most practical, according to Mr. Bement, to sink 2 or 3 in. iron or steel pipe into the ground so that it stands out 3 or 4 ft., and paint the marker on that.

MALLEABLE-IRON POST FOR MINNEAPOLIS CLUB

The Automobile Club of Minneapolis, according to Joseph H. Prior, chairman of the signs committee, first tried wood posts. Then sheet iron, galvanized iron and cast iron were each tried and found wanting. Finally malleable cast-iron signs were tried, and there has not been one broken up to the present time. The signs, 30 in. long and 5/8 in. thick, are bolted on a 2½-in. galvanized-iron pipe 12 ft. long, which is set in concrete. With a 3-ton motor truck hauling the signs and all material except sand and gravel, which are available along the road, three men have set 27 signposts per day. The average cost for the signs and the labor of placing them is $7. For painting the signs a special paint is used that is said to give promise of great durability. The signs, having been galvanized at the foundry, are painted two coats of white. The letters, figures and border are painted black, and the whole is finished with a coat of spar varnish. Several colors and combinations of colors have been tried, and it has been finally decided that a white background with black letters and border makes the most legible and neatest finish.

14,000 SIGNS IN SOUTHERN CALIFORNIA

The Automobile Club of Southern California, according to its secretary, Standish L. Mitchell, has erected more than 14,000 road signs on more than 12,000 miles of

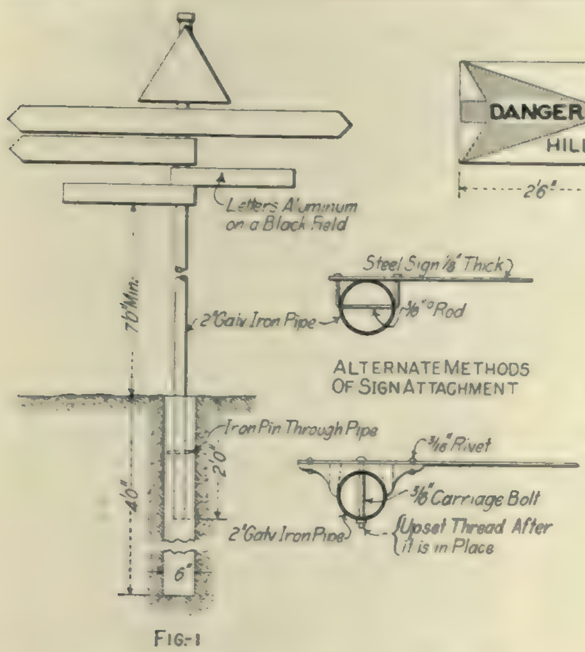


FIG. 1—METALLIC SIGNPOST USED BY NEW YORK STATE AND NOW SUPERSEDED

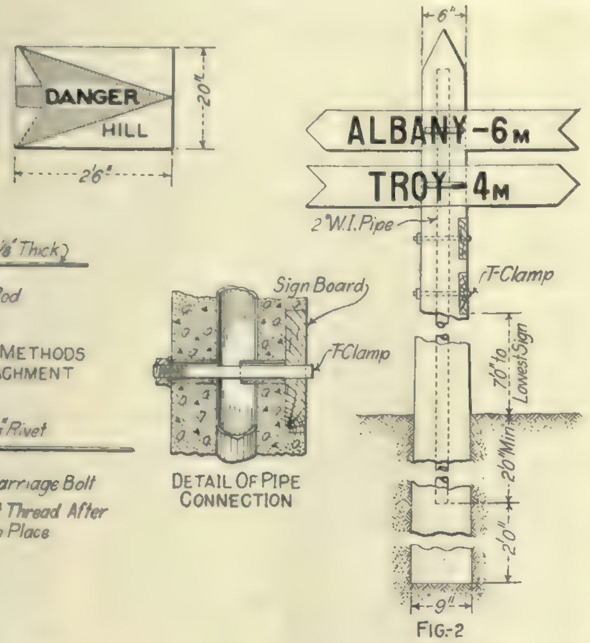


FIG. 2—CONCRETE POSTS WITH WOODEN DIRECTION POST NOW USED IN NEW YORK STATE

road. It has placed signs in cities, in mountains and in the desert places. Wherever the motorist travels in Southern California (a section larger than the five New England States), he will find the road signs of this club, and he will find them stretching across the continent from Kansas City to Los Angeles.

For fifteen years the Automobile Club of Southern California has been marking highways. At first the work was necessarily crude, as it was pioneering in a new field—that of systematic highway posting. The first signs were of wood, erected on wood posts, but in the last two years the entire system has been revised and metal signs and posts have been substituted.

According to the club's engineering department, enameled metal has proved entirely satisfactory, as it is practically impervious to weather conditions and will last indefinitely if not "shot up" by careless or thoughtless hunters.

The club is now using 12-ft. scrap boiler tube anchored at the bottom with two redwood blocks, 1 ft. long, 2 in. thick and 6 in. wide and placed at a depth of 3 ft. In signposting work on the desert or where the soil is loose or "shifty," the posts are set at a greater depth.

Warning Sign

One of the features of the club's signposting work is its "warning" signs placed on city streets approaching schoolhouses, where children might be playing in the street; at approaches to hospitals, where they read: "Hospital; Quiet; Close Mufflers"; before fire engine houses, and at dangerous street curves or crossings.

It has been found that the fewer the words on the signs the better they serve the purpose, as it is difficult to catch at a glance the meaning of long paragraphs. In Southern California, where highway conditions have been constantly changing because of improvements, it has been found practically impossible to place mileages on the signs until the highways become permanently located. The majority of the club signs carry the name of the route: "Coast Route"—an arrow pointing to the next town, with the name of the town in large letters and the club's emblem.

Signs larger than the regulation "direction signs" are used at railroad crossings to warn motorists, and at the bottom and top of mountain grades to advise the free use of the horn and slow driving. On mountain grades where there are many curves the club uses warning signs liberally in keeping with its policy of "safety first."

Uniformity in signposting for any territory is most advisable, as the motorist becomes accustomed to one type of sign and the driver's eye is caught most quickly by the familiar appearance of it, and it becomes almost second nature to read the well-known sign at a glance, as frequently changing letter-type and sign-shape proves confusing.

Metal signs and posts have proved most satisfactory on the desert and in mountains, as campers have been prone to chop down wooden ones and then use them for firewood. At first it was feared that the bright enamel would prove too great a temptation

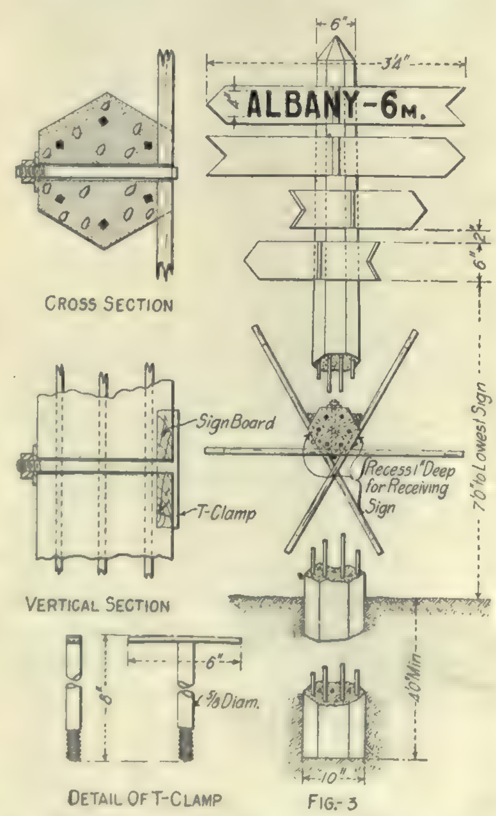


FIG. 3—ALTERNATE TYPE OF CONCRETE POST IN NEW YORK

to itinerant hunters, but the automobile club has found that sentiment in regard to "shooting up" road markers has changed, and it is seldom if ever done in Southern California.

Two Crews Erect Signs

The actual work of erecting the signs is done by two crews. The first is known as the charting crew, which travels over the roads to be marked and indicates on a club map the location for each sign and what it shall say. The data are returned to the club headquarters and the "sign orders" are made out and sent to the enameling works, where each sign is stenciled. These signs then, with their posts, are loaded into club trucks and set out in charge of a second crew, which places them according to the data supplied by the charters. Often when the second crew is out on the road in a certain territory the signs as posts are shipped to them, so that they do not need to leave the field in which they are working.

In designing the signs for out-of-town highways the club keeps in mind the fact that the average motorist is traveling at a fair rate of speed and does not wish to lose time by slowing up to read road signs, and for that reason each sign is simple and carries its message in as few words as possible, and these are printed in the largest possible type.

It is shown by club statistics that the erection of signs averages a little better than one sign to every mile of road. Very often there are several signs to every mile, determined by the number of turns and branches.

Estimates Expenditure on Lincoln Highway for 1916

$6,000,000 Spent by Eleven States Does Not Include City Pavements—New Hotels Total $5,406,000

THE FUNDS expended for road improvements along the Lincoln Highway last year are conservatively estimated by the Lincoln Highway Association at $6,000,000. A detailed report by H. C. Ostermann, field secretary for the association, summarizes the amounts spent last year in each state along the Lincoln Highway as given in the accompanying table:

Funds Spent in 1916 on Lincoln Highway

State	Amount
New Jersey	$183,678
Pennsylvania	193,034
Ohio	925,000
Indiana	706,108
Illinois	256,800
Iowa	904,955
Nebraska	367,300
Wyoming	60,650
Utah	275,500
Nevada	69,140
California	256,000
Total	$4,198,165

The figures do not include money spent on street improvements in many of the cities on the coast-to-coast highway. In many instances it was impossible to secure a record of the amounts expended, which explains the discrepancy between Mr. Ostermann's estimate and the total of the figures given in the table. The expenditure for new hotels along the famous route totals $5,406,000 for 1916. That sum includes the Fremont Hotels in Fremont and Grand Island, Neb., the total cost of which was $450,000. These hotels will be opened early in 1917.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Is Uniformity Possible in State Motor-Truck Legislation?

SIR: I have read the editorial, "Is Uniformity Possible in State Motor-Truck Legislation?" in the Engineering Record of Dec. 9, page 699. I am very strongly of the opinion that uniformity is not only necessary but possible. Whatever may be the wishes of motor-truck manufacturers, it is absolutely necessary that there should be an understanding between the designers of the vehicles and the designers of the highways which are to carry them. Roads and bridges designed six years ago, with the most careful study of the then existing conditions, are to-day unable to bear the increased loads that have been imposed upon them by the heavy trucks. I am not now alluding to road failures due to surface defects developed by the increase in the number of vehicles, but to those arising from the overstrain of bridges and lack of road foundations due to the excessive axle loads.

I believe that at present it would be possible immediately to regulate the weight to the loading gage under which motor trucks will have to pass. It would seem to me, if no other means are possible, that a congressional statute fixing the maximum limits of width, height, length and weight for trucks and tractors engaged in interstate commerce would be entirely practical. It would appear to me that a conference between the motor-truck and tractor interests, the United States Office of Good Roads, and the Association of State Highway Officials would be productive of much good. This latter association would represent both the American Highway Association and the American Road Builders' Association, as its members all belong to one or both of these bodies.

E. A. STEVENS,
Commissioner, New Jersey Department of Public Roads.
Trenton, N. J.

SIR: It is generally admitted that the planning and the improvement of public highways is not a problem to be solved by each town or county independently of adjoining districts. It is even admitted that the system of improved highways of one state should be so articulated with those of an adjoining state that an interstate or national system of highways will be created. It follows that regulations governing the use of highways in adjoining states should be reasonably uniform. The embarrassments of the railroads engaged in interstate commerce which result from inconsistent or conflicting regulations in adjoining states are quite apparent, and the need of more uniform laws or of placing control over railroads engaged in interstate business in a body, the jurisdiction of which would not be confined to a single state, is frequently emphasized.

There appears to be the same necessity for harmonizing regulations affecting the use of interstate highways, and this could probably be accomplished by making regulations adopted by the different states as consistent with one another as the varying conditions and requirements of traffic would permit. The suggestion of the Engineering Record that organizations especially interested in this subject co-operate in the framing of a model motor-truck law appears to be a timely one.

NELSON P. LEWIS,
Chief Engineer, Board of Estimate and Apportionment.
New York City.

SIR: The suggestion contained in your editorial of Dec. 9 that legislation be as uniform as possible throughout the states is a most excellent one for many reasons which it is not necessary to dwell upon, as they are so obvious.

Your idea of having co-operation between the various highway associations and those representing the motor-vehicle interests is undoubtedly the best way to arrive at a solution of this very important question. Without uniformity of legislation, many hardships will be inflicted upon the users of motor vehicles, and in the last analysis the taxpayer, as usual, will pay the bill.

EUGENE W. STERN,
Chief Engineer in Charge of Highways, Borough of Manhattan.
New York City.

SIR: The following is my opinion on the motor-truck question:

If there is a universal demand for extremely heavy motor units the states must build roads sufficient to withstand these peculiar classes of vehicles. Nevertheless, there must be reasonable restrictions as to the type of vehicle, the character of tires and springs, of the amount of unsprung weight, the speed at which the vehicle should travel and possible restrictions as to the roads upon which the heavy vehicles might be used.

C. J. BENNETT,
State Highway Commissioner of Connecticut.
Hartford.

SIR: I beg to acknowledge your favor of Dec. 13, calling my attention to an editorial in the Engineering Record of Dec. 9, page 699, entitled "Is Uniformity Possible in State Motor-Truck Legislation?"

Up to the present time we have had very little experience with motor trucks in this state, and consequently have not found it necessary to pass legislation governing their use. From what little experience we have had, however, I am of the opinion that uniformity is both necessary and possible. There should be a full understanding between the manufacturers of motor vehicles and the constructor of highways on which the motors are used. I am satisfied that both bridges and roads as designed six to eight years ago are unable to carry the increased load of the heavy trucks. The road failures in this state from this source were due, in my judgment, to the lack of proper foundation rather than to increase in the number of vehicles used.

I believe that some uniform regulations are possible, regulating within certain limits the height, weight, etc., of tractors and trucks, and to this end would suggest a conference between the motor and tractor manufacturers and the highway departments of the United States. I believe that this could best be accomplished through the executive committee of the American Association of State Highway Officials, to whom I will refer the matter at their next meeting.

G. P. COLEMAN,
Commissioner, State Highway Commission of Virginia.
Richmond.

Slab-and-Beam Floor Without Shear Stirrups

SIR: In the article "Slab-and Beam Floor Without Shear Stirrups," in the Engineering Record of Sept. 9, 1916, page 324, J. H. Byrd emphasizes the advantages of a flat-slab floor construction. We certainly agree with Mr. Byrd that the predominating characteristics of flat-slab construction, such as clear headroom, lighting, ventilation, appearance, placing of future partitions, more sanitary conditions, etc., are thoroughly appreciated not only by architects and engineers, but also by the building public of to-day. The type of design outlined by Mr. Byrd and applied to the building of the Firestone Tire & Rubber Company has undoubtedly some of the advantages of the flat-slab system. So far as the "large economy" claimed by Mr. Byrd for this type of construction is concerned, we cannot agree with his statements.

In the first section of Mr. Byrd's article we read the following: "This type is claimed to be more economical than flat-slab design, according to the Chicago building ordinance." This statement may be misleading, since it does not express clearly whether the expression "designed according to the Chicago ordinance" pertains only to the flat-slab design or to both designs.

It seems to us that a comparative design of this kind, which is supposed to convey reliable information to engineers throughout the country, since it is published in a magazine of national distribution, should be based upon the same building code in both cases, if strict impartiality is desired. The relative economy of different types of construction does not depend on quantities of materials only, as Mr. Byrd implied, but also to a large extent on the respective cost of forms, cost of handling the material, cost of bending of reinforcement, and the degree of safety against possible faulty construction. Comparing the design outlined by Mr. Byrd with a standard flat-slab design from this viewpoint, we find that the question of economy is considerably in favor of the flat-slab design.

Analyzing the beam-and-joist system according to the Chicago building ordinance, we find that considerable changes would have to be made in the design in order to pass the Chicago building department. Using a live load of 200 lb., and a typical panel 24 ft. 6 in. square, we get the following results:

Fig. 1 is an exact copy of the sketch accompanying Mr. Byrd's article. Fig. 2 indicates the dimensions of the same type of design as required by the Chicago building department, and Fig. 3 shows a standard cantilever flat-slab design used for comparative purposes. The 3-in. slab between

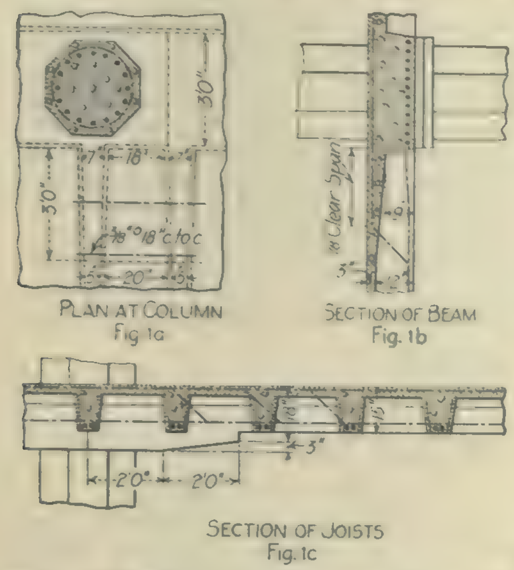


FIG. 1—CONCRETE JOIST DESIGN ACCORDING TO J. H. BYRD

the joists, Figs. 1a and 2a, would have to be reinforced, spacing the reinforcing rods at least 9 in. apart. This reinforcement, however, could be considered at the same time as temperature reinforcement. The joists, Figs. 1c and 2c, if considered as beams, will have to be treated as such in their design. If not considered as beams, we would not be able to make a reduction of 15 per cent on the live load in computing the girder. If we do consider these joists as beams, the maximum T-section used in the computations shall not be wider than 20 in. and the rods will have to be 1½ in. clear from the bottom and sides of the beams. The bending moment will have to be figured as $wl^2/12$, l being the span from center to center of the supports, or 24 ft. 6 in.

In redesigning the girder, Figs. 1b and 2b, we find that it will be prohibitive, from the viewpoint of economical design, to make the girder 15 in. deep, since this would require a beam with either an effective width of 184 in. or about 16 sq. in. of compressive reinforcement, both of which are not generally considered good practice. Therefore we will have to increase the depth of the girder to 24 in., thus omitting the bracket over the columns. In spite of the additional depth, we find that the girder will have to be reinforced for shear with stirrups, since 40 lb. per square inch shearing stress in concrete shall not be exceeded. The beams, being still comparatively shallow, will have to be reinforced with stirrups not larger in size than ½ in. in diameter, which requires for a reasonably close spacing a stirrup of six prongs, and we would need eighteen stirrups of this type at each end of the girder. We also need compressive reinforcement for the negative moment over the columns, placed as indicated in Fig. 2c, and not near the neutral axis, as Mr. Byrd shows his compressive reinforcing bars in Fig. 1c. Making these required changes, we would have to do away with the two principal claims for this type of design—namely, the flat ceiling and the omitting of shear reinforcement.

For a comparative design we used a typical cantilever flat-slab construction with a panel size of 24 ft. 6 in. square, and 200 lb. live load. The slab will have to be 10 in. in thickness, and a 5-in. drop panel is required. Estimating the cost of the two different systems, we use Chicago market prices for material, as well as standard Chicago prices for labor, both derived from records of actual construction work. It is a well-known fact that the form work for flat-slab design is considerably easier to build, and consequently from 15 to 18 per cent cheaper than for beam-and-girder construction. The advantages of using the forms several times holds for both systems. The price of concrete, due to the more difficult placing in beam-and-girder design, is about 10 per cent higher than in flat-slab design. There also is a difference in the price of steel, since the flat-slab construction does away with difficult bending of heavy sizes of rods. From a strictly impartial estimate of a typical panel of both types, we find the cost of the concrete joist system about 20 cents per square foot higher than the cost of a cantilever flat-slab construction. Local conditions at Kansas City may be extremely favorable to the type of design applied by Mr. Byrd; however, it seems hardly possible that such a large difference of 50 per cent in price could be offset by local rulings of the public-building department.

Mr. Byrd does not give sufficient information as to the methods of the test loadings, and the fact that the tests gave apparently satisfactory results does not indicate that the required factor of safety of four has been maintained. It would be interesting to learn more in detail the principles of designing applied by Mr. Byrd on his system, in order to modify our opinion of this type of construction, if possible.

CURT VON MUELLER,
Concrete Steel Products Company.
Chicago.

[The foregoing letter was submitted to Mr. Byrd, and his reply follows.—EDITOR.]

SIR: In reply to the letter by Curt Von Mueller, of the Concrete Steel Products Company, we know that the ordinances governing the design of flat-slabs were evolved from the results of test loads and a reasonable theory of bending formulas worked out to meet the tests. Several engineers have pointed out in various papers that other designers would be allowed the same liberties if their designs were governed by the results of test loads. Our present ordinances are certainly unfair in this respect.

In reference to the Firestone Building under discussion: The flat-slab which we designed as a comparison in cost was practically the same as given by Mr. Von Mueller. As stated in the paper now being criticised, various reasons, such as future

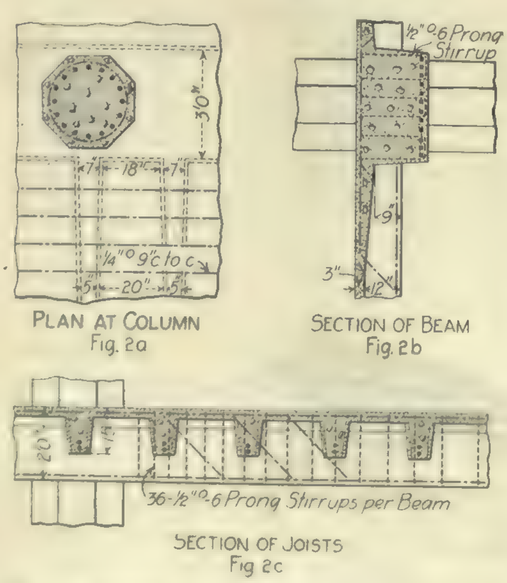


FIG. 2—CONCRETE JOIST DESIGN ACCORDING TO CHICAGO BUILDING ORDINANCE

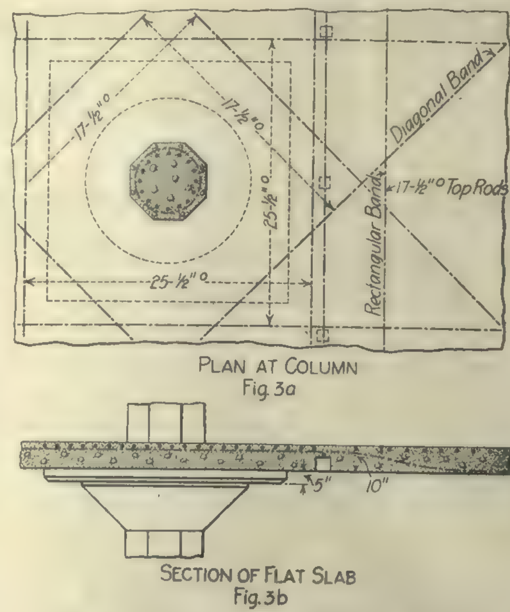


FIG. 3—CANTILEVER FLAT-SLAB DESIGN

openings, present stairs, elevators, etc., would have produced few panels of flat-slab effect, and the straight slabs and beams for the remainder of the building would have produced deep beams, which were undesirable. The cost of a typical flat-slab panel and a typical joist panel favored the joist type of construction.

Since this building was designed and constructed, further study by engineers in Kansas City has resulted in improving the joist system of design in the substitution of mesh in the slab in place of ⅜-in. bars and the taking advantage of some of the theory advanced by the flat-slab designers in our treatment of beams and joists. In a building at present being bid upon, the joist system showed a saving of $10,000 over the flat-slab, at the same time producing compressive stress in the flange sections of joist and beams not exceeding 400 lb. per square inch.

Buildings designed by the flat-slab method, if strictly following the ordinances, have undoubtedly a sufficient factor of safety. The joist design bases its claim to economy on the principle that a 4 x 14-in. member of any material if placed on edge has a decided advantage over the one laid on its side.

J. H. BYRD,
Structural Engineer.
Kansas City, Mo.

Reinforced-Gypsum Roof Decks a Modern Development

SIR: With reference to the article written by me upon "Reinforced-Gypsum Roof Decks a Modern Development in the Structural Field," appearing on page 745 of your issue of Dec. 16, would state that there are two typographical errors which I trust you will correct. Such corrections are necessary for the proper understanding of the principles involved, as the statement has been made that the usual formulas for reinforced concrete have been used in the determination of stresses upon reinforced-gypsum construction.

In the second column at the bottom of the last paragraph you state the effective depth to be *id;* this should read *jd*. Also at the top of the third column, when referring to flange computations for rectangular beams you show $p = A/^{r}d$, whereas it should read $p = A/b'd$.

VIRGIL G. MARANI,
Consulting Engineer.
Cleveland.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

Contributions to this section are solicited, and if found available will be paid for. They must be SHORT, *and should be accompanied, if possible, by photographs or sketches.*

Utilize Backfiller for Pulling Sheet Piles

A SEWER contractor in Clintonville, Wis., is using an Oshkosh backfiller to pull sheet piling by rigging up a tripod with the pulling cable running over the block, as shown in the photograph. With this rig 12-ft. wood piles are pulled at the rate of 200 ft. per hour with considerable saving in time and labor cost over the usual hand methods, according to R. Mierswa & Sons, contractors for the work.

HAULING LINE FROM BACKFILLER RUN OVER BLOCK ON TRIPOD TO PULL WOOD SHEETING AT RATE OF TWO HUNDRED LINEAR FEET AN HOUR

Unique Concrete Blocks Built by Home-Made Traveler

A METHOD of making large concrete blocks which produces a remarkably smooth and attractive surface by casting them face down is employed in the new Illinois First Cavalry Armory, now under construction north of Chicago Avenue and near Lake Michigan in Chicago. A handy home-made traveler with two booms is used on the work.

Because the plans for the structure contemplated a more extensive plant than was provided for in the appropriation, only the drill hall and three stories of the five-story headhouse are being built at present, and concrete blocks are being used as the most economical way of securing an artistic exterior. Because of the plans, many blocks with curved surfaces and irregular shapes are required.

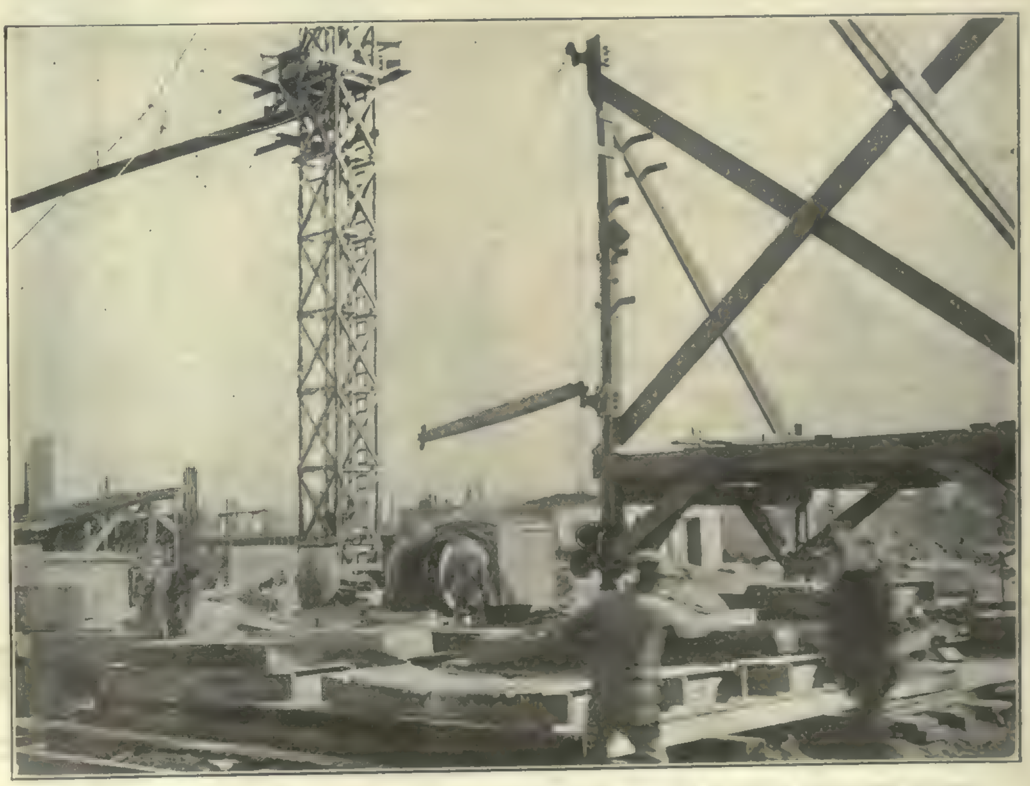
A track was built 100 ft. long with rails 19 ft. apart, on which was constructed a wood traveler, and from the corner posts of which at one end were erected jib cranes, each operated by a hand hoist. The traveler is moved along the track by means of a cable fastened to one of the rails and carried around the drum of a hand winch mounted at the side of the traveler frame. The space between the rails is floored and on this all forms for blocks are erected in convenient reach of the jib cranes. The standard width of each block course is 2 ft., but on account of the semicircular ends of the building and many window openings the lengths of blocks vary considerably, the longest being about 8 ft.

The blocks are cast face downward. The bed of each form is covered with galvanized sheet iron, and great care is taken before casting a block to have the sheet-iron surface perfectly smooth and clean. The side forms are wedged into position inside of wood frames. The surface of the block, about 1 in. in thickness, is composed entirely of fine aggregates, with a large cement content thoroughly mixed, with only enough water so that the material will adhere when pressed in the hand. This mixture is tamped very hard in the forms. The proportion of the aggregates used in the surface of the block is 1 bbl. of limestone screenings to 1 bbl. of sand and three bags of cement. The smooth texture of the surface of the block depends upon having the galvanized sheet-iron bed of the form perfectly clean and without markings or defacements of any kind, upon the fine aggregates, upon a uniform dry mix and upon the hard tamping into the forms. Great care is therefore required in all of this work.

Back of the surface layer of concrete is placed a reinforcement of triangular mesh heavy wire netting. Two heavy wire lifting loops are also placed in each block. The back of each block is composed of standard 1:2:4 concrete, which, while also mixed dry, contains considerably more water than the surface layer. The time required after casting before a block can be lifted depends entirely on atmospheric conditions. In dry, warm weather it was possible to remove the side forms within two hours and lift the block within half a day after casting, but in cold weather two or three days are required. It has been found that the block dries more rapidly when the side forms are removed as soon as possible.

The illustration shows the traveler, a Standard concrete mixer, served by the jib cranes and several curved-face blocks on the bed forms with the side forms removed. These blocks when built into the wall not only have a massive appearance but present a pleasing effect without acid treatment of any kind. This method of construction is held to provide a structure of great durability at small cost.

The general contract was let to the Hanson Brothers Company, Chicago, which designed the equipment for casting the blocks and conducted the experiments for obtaining the smooth block surface. Charles T. McClelland is superintendent for the contractor.



LIGHT TRAVELING CRANE MOVES OVER CASTING PLATFORM TO HANDLE CONCRETE BLOCKS

Heavy Rake Spreads Riprap and Cobbles on Revetment

PULLED back and forth between a locomotive crane and a floating pile driver or dragged up and down the slope by lines from a hoist mounted on a flat car, the heavy rake shown in the photograph was used with great economy over former methods to place riprap and spread cobbles on revetment work done in California by forces of the Southern Pacific Company.

The revetment was made of cobble stones unloaded from bottom-dump cars and spread to the edge of the embankment by a track plow. The heavy rake was then used to drag the stones down the bank and produce a surface with the desired slope. It was handled by two lines from a hoisting engine mounted on one of the railroad company's mixer cars. One line was used to haul the rake uphill, the other was led through a single block on a float anchored at the foot of the slope, and used to pull the rake down with a load of stone.

HEAVY RAKE, HANDLED BY POWER, SPREADS COBBLES AND RIPRAP EFFICIENTLY ON SLOPE

The toe of the slope is protected from wave action by heavy blocks of granite riprap. After being unloaded at the top of the embankment these stones were also dragged down by the rake to the water's edge. The quantity of large stone placed was smaller, progress was somewhat more rapid, and a locomotive crane which unloaded the stone was available. In this instance the rake was pulled down the bank by one of the company's floating pile drivers and drawn up by the crane.

Adjustable Trowel Triples Finishing Progress on Concrete Curb

BY P. E. GREEN
Of Marr, Green & Company, Consulting Engineers, Chicago

WITH an adjustable trowel devised by Charles S. Upham of Odell, Ill., the contractor on the brick paving work at Dwight, Ill., described on page 797 of this issue, concrete curb finishers could do from two to three times as much work in a day as they could with an ordinary trowel or float and at the same time secure a much better job. The curb and gutter was what is called variable curb, that is, there were summits and inlets in the combined curb and gutter itself, so that the height of the curb above the gutter varied from 2 to 10 in. This is necessary for economical construction in a very flat country.

One of the great difficulties which workmen have found in making a good job of finished concrete combined curb and gutter is this variation in the height. Ordinarily it is simply troweled by hand with a wooden float or similar device. Mr. Upham, however, developed an adjustable sheet steel trowel, shown in the accompanying picture. This consists of an L-shaped horizontal piece for the top of the curb and an L-shaped piece for the gutter inside of the curb, the top piece lapping the bottom piece.

The adjustable feature is a slot in the bottom piece by means of which the position of the top piece is varied.

The entire tool is laid directly on the forms filled with concrete for the curb and gutter and pushed along by one man. The front end of it has a decided flare which tends to force the finishing mortar toward the rear end under a considerable pressure, the result being a remarkably smooth piece of finished work.

ADJUSTABLE TROWEL FOR FINISHING CONCRETE CURBS WHICH TRIPLED PROGRESS ON THIS KIND OF WORK

Plow on Dinkey Clears Road of Dumped Material

TO REMOVE aggregate from the narrow-gage dinkey tracks on Section 7 of the road construction in Vermilion County, Illinois, the contractor has placed an improvised plow on the front of the engine, as shown in the photograph. It consists of a 2-in. plank supported by a heavy iron strap, which in turn is bolted to two timbers placed back of the bumper. The plow is also used to a considerable extent in pushing macadam shoulder material off the concrete portion of the road. It is the practice to place the dinkey track on top of the concrete as soon as possbile after the latter has hardened. The Granite City Lime & Cement Company is carrying out the work.

PLOW PUSHES MATERIAL AWAY FROM TRACKS

Steam Shovel Breaks Up Concrete Base Quickly with Drop Hammer

By HERBERT J. GILKEY
Chicago, Ill.

AN ERIE shovel, on which a 2000-lb. drop hammer was rigged without even dismounting the dipper, was used recently in Chicago to break up 12,000 sq. ft. of 6-in. concrete pavement base in less than one day. The pavement broken up was at Sixty-ninth and Leavitt streets, where the former street is being lowered 5 ft. to pass under the Pennsylvania Railroad. The old pavement was of brick on a concrete base, and the bricks were removed before the base was attacked.

The pile hammer was attached to the hoisting drum of the shovel by a wire line passing over the larger sheave in the end of the boom after the dipper had been swung in close to the shovel and tied up. Each blow of the hammer broke up about 50 sq. ft. of concrete base into pieces small enough to be handled in ordinary dump wagons. The contractors for the work were W. T. Keating and E. O'Brian.

Pavement Costs in San Francisco

During the last fiscal year San Francisco has constructed more pavement under public assessment than during a[illegible]her like period of the city's history. The total area paved was 472,253 sq. yd. The average costs for various types were as follows: Asphalt, $1.91; bituminous rock, $2.14; basalt rock, $3.42; vitrified brick, $3.35.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

$9,530,000 Irrigation Project Planned in California

Dam and Reservoir in San Joaquin Valley Will Probably Be Built Without Federal Aid—Hydroelectric Plant Included

The plan of irrigationists in the San Joaquin valley, California, to construct a dam and reservoir to conserve the flood water of Kings River has been indorsed by Louis C. Hill, consulting engineer, of Los Angeles, who was selected by the U. S. Reclamation Service to report on the project when federal indorsement was sought several months ago. It is proposed to construct a concrete dam and reservoir, having a storage capacity of 600,000 acre-feet, in the Pine Flats region of the Sierra Nevada Mountains in Fresno County. A 10,000-kw. hydroelectric plant and the installation of 525 deep-well turbine pumping plants, with eighty reserve plants, in the delta of Kings River, to bring the underground water supply into use, are also included in the plans.

In comparing the Pine Flats project with the Elephant Butte and Arrowrock dams, Mr. Hill estimates that the yardage to be handled will be about twice the amount handled on either of the former projects. Unit costs will probably be much less owing to the availability of construction materials and water supply, the proximity of power transmission lines, and favorable conditions for a construction camp. The short distance to bedrock will make the cost of river diversion small.

Will Cost $9,530,000

The total cost is estimated at $9,530,000 or about $9.53 per acre for the 1,000,000 acres benefited. The dam and storage works, exclusive of surveys, borings, rights-of-way, insurance, interest, camp expenses, hospital, etc., are estimated to cost $5,845,000, itemized as follows: Excavation $325,000; 1,050,000 cu. yd. cement masonry, $4,515,000; gates, etc., $400,000; spillway, $200,000; flume for bringing lumber to the site, $200,000; grouting, $20,000; Cement Gun work, $15,000; extension of railroad, $100,000; roads, $50,000; power substation, $15,000; river diversion, $30,000; pumping, lighting, etc., $10,000; drainage and well drilling, $15,000. The proposed power plant will cost about $600,000 and 30 miles of transmission lines, $150,000. The cost of the 605 pumping plants—all of similar design and capacity, is estimated at $1,815,000.

Preliminary plans for the project were prepared by I. Teilman, of the Fresno & Consolidated Canal Companies. Officials of the six irrigation districts taking water from Kings River have organized the Kings River Reclamation and Conservation District with headquarters at Fresno. This organization has indorsed Mr. Hill's recommendations. It is said that the project will be carried on without federal aid.

Favorable to Increased Diversion

The flood resolution authorizing the Secretary of War to distribute all of the 20,000 sec.-ft. over Niagara Falls due the United States under its treaty with Canada was favorably reported Dec. 21 by the House Foreign Affairs Committee. The measure is identical with the Wadsworth resolution passed by the Senate, except that the committee amended it so that grants under the resolution will expire March 4 next instead of July 1, as was originally proposed.

2200 Applaud Goethals at New York Meeting

Guest at Merchants' Association Luncheon—Recommends Revising Panama Canal Toll Charges—British Ships Have Advantage

Major-Gen. George W. Goethals, as guest of the Merchants' Association, Dec. 21, at one of the largest luncheons in the history of New York City, reiterated that British ships were enjoying an advantage over United States ships in the matter of tolls, and that it was the duty of Congress to revise the rates if the country is to receive benefit from its enormous expenditure in furnishing a waterway between the two oceans.

Gen. Goethals was introduced by William C. Breed as the man who "created the passageway that Columbus sought" and who "accomplished the job" the great discoverer set out to do. Twenty-two hundred attended the luncheon in the grand ballroom at the Hotel Astor. Gen. Goethals was applauded when he laid stress on the "strategic value of the canal to the United States in time of war," and of the right of this country to exert absolute sovereignty over the strip in which it had invested its money. He emphasized the demand for modification of the agreement made by President Taft with the Republic of Panama, under which a duty of 15 per cent is imposed on everything brought to warehouses by merchants or manufacturers, and told of the progress made by the United States in developing trade in coal and oil along the Isthmus.

Tolls Main Subject of Address

Gen. Goethals said the coaling stations established by the Canal Commission at the Atlantic and Pacific ends of the canal are being operated satisfactorily, and that the commission is ready to lease lands to coal dealers who want to do business in the zone. War conditions, he said, had prevented private concerns from entering the field, but it was hoped that the plan would finally meet with success.

After pointing out the difference in the methods of the United States and England in measuring tonnage, and the effect on toll rates at the canal, he added: "The tolls actually collected under our present registered tonnage system are about 30 per cent less than they should be. A bill is now before Congress to have this modified. If it is enacted our revenues will far exceed our operating expenses, and we will begin to pay part of the interest on the investment. In the first fiscal year of the canal our collections exceeded our operating expenses by $350,000. Of course, due to the closing of the canal by the slides, our revenues were kept down, but we are now operating at less cost than the actual revenue notwithstanding that we are losing about 30 per cent that we ought to get."

Contractor Sues for $47,000 on Cleveland Contract

The Walsh Construction Company, builder of the filtered water reservoirs of the new filtration plant, has filed suit against the city of Cleveland to collect $47,041.23, alleged to be due for construction work. The suit was filed in the United States District Court. The city recently awarded to another construction company a contract to rebuild the filtration basins which collapsed last July. The price mentioned in the new contract is above the original agreement with the Walsh company.

Motor-Truck Men Object to Proposed Schedule

State Commission Holds Second Hearing on Measure to Increase Funds Available for State Highway Maintenance

Many objections to the proposed new schedule of motor-truck registration fees, which will become operative in New York State within a few weeks, were voiced by motor-truck interests at a public hearing in the auditorium of the Merchants' Association, Woolworth Building, New York City, Dec. 21. State Highway Commissioner Edwin Duffey and State Engineer Frank M. Williams represented the special commission of three (General W. W. Wotherspoon, state superintendent of public works, being absent) appointed by the Legislature to file on Jan. 1 a scale of charges for commercial trucks based on time and extent of the use of the highways and wear and tear on roads.

Many of the arguments against the new schedule of fees were similar to those advanced at the first public hearing in Albany, reported in the Engineering Record of Nov. 25, page 663. Among those who were present to discuss the measure at the New York hearing there was not a single highway engineer, although the motor-truck manufacturers and users appeared in force.

Asks for Tentative Rules

Speaking as president of the Motor Truck Club of America, Roderick Stephens urged the commission to make public any tentative rules and regulations which it had under consideration, following the practice which obtained at hearings on proposed motor-truck legislation in New Jersey. His argument was that with something definite before them the motor-truck men could be specific in their discussion, instead of talking generalities. Commissioner Duffey, however, refused to accede to his request. Mr. Stephens pointed out that at a recent meeting of the Motor Truck Club of America, Commissioner Arthur Woods of the New York Police Department had gone on record that he would not inaugurate any legislation dealing with motor-truck regulation without first consulting with committees representing the owners and manufacturers of trucks. This precedent, however, was without influence in inducing the state highway commissioner to change his original ruling. Commissioner Duffey thought that "nothing would be gained" by such procedure. He studiously evaded any direct statement which would indicate the lines along which the commission was working, although he did give out the hint that trailers would not be considered in the proposed new code.

Exemptions Requested

Requests for the exemption of certain classes of motor trucks were made, notably those of the Fifth Avenue Coach Company, which operate almost entirely within city limits and pay large taxes to the City of New York, amounting, in the aggregate, to about $500 per vehicle for the 135 vehicles controlled by the corporation. It was argued that the proposed schedule of fees should provide a special classification for vehicles which did not leave city streets.

A tilt between counsel for the National Automobile Chamber of Commerce and Commissioner Duffey occurred on the question of exemption of motor trucks from the personal-property tax. This exemption, it was pointed out, is allowed in the case of pleasure cars.

The commissioner maintained, however, that it was not within the scope of his commission's powers to grant such exemption. Their work, he said, is merely to file a schedule of fees by Jan. 1. He intimated that this schedule would start with a minimum fee and progress upward as the weight of motor trucks increased. It was pointed out by R. H. Johnson, president of the Automobile Dealers Association, that a light truck can often do more damage than a heavy one. He cited the case of the "flying squadron" of the New York department stores—light trucks on pneumatic tires which attain high speed for suburban service. Such trucks, he maintained, are far more of a menace to highways than 5-ton coal trucks properly tired and running at low speeds. Mr. Johnson advocated the retention of the present fee of $5.

Mr. Stephens suggested that Commissioner Duffey file the new schedule of fees merely as a report and ask the Legislature for more power so that it might consider the question of exemption of motor trucks from the personal-property tax. Commissioner Duffey's attitude indicated that there was small chance of such a procedure being followed.

Upon the subject of solid versus pneumatic tires a lively discussion arose. The opinion seemed to be general that the line of demarcation was the 1½-ton truck.

Formula Abandoned

Arthur J. Slade, consulting engineer and member of the Society of Automobile Engineers, told of the unsuccessful efforts during the last seven years to develop a formula for taxing motor vehicles on a basis of road damage. The subject was first considered by the Society of Automobile Engineers in 1910. A formula was proposed in 1914 by a special committee and its recommendations were turned over to the research division of the society. After a year's study the research division reported that so many factors were involved in such a formula that nothing could be devised which would be susceptible of ready application. The same question was submitted to the standards committee of the Motor Truck Club of America, and practically the same conclusion was reached, namely, that a workable formula, taking into consideration all of the factors, was an impossibility. If a formula is to be used, Mr. Slade said, it should be a simple rule of thumb.

Chicago Association of Commerce Awards Prizes for Papers

Twenty-two engineers, representing eleven universities scattered all over the United States, competed for the cash prizes offered in September to undergraduates and graduates in 1915 and 1916 by Subdivision 63, Engineers, Chicago Association of Commerce, for the three best papers on any one of three subjects: (1) "Engineering and Civic Progress," (2) "The Engineer of the Future," (3) "The Business Relation of the Engineer to the Commercial World." Harvey T. Hill, Chicago, a graduate of Pennsylvania State College, 1915, won the first prize, $50. The second prize, $30, will go to Leo Shippy, a mechanical engineer junior at Iowa State College, who wrote on the second subject. H. M. Kistler, a Pennsylvania State College graduate of 1916, will receive the third place and $20 for his paper on the second subject.

The technical schools represented are as follows: University of Illinois, nine; Pennsylvania State College, two; one each from Iowa State College, universities of Michigan, Minnesota, Pennsylvania, Cincinnati, Washington, Cornell, Purdue and Worcester Polytechnic. Two men did not give this information. Nine of the contestants were graduated this year, four in 1915; five are undergraduates. The remaining four did not give their year. Only ten men spoke of their course in college. Of these, five were electricals, three mechanicals and two were civils. Subjects 1 and 2 were each chosen by nine men; only three wrote on the third. One man sent a semi-popular engineering story. Three men mentioned seeing the notice in technical journals.

The judges of the contest were Prof. F. H. Newell, University of Illinois; Dean John F. Hayford, Northwestern University, and John W. Alvord, consulting engineer, of Chicago.

Wood Preservers Meet January 23 in New York City

The American Wood Preservers' Association will hold its annual convention Jan. 23 to 25 at the Hotel Astor, New York City. It will be the first meeting of the society in New York. The nominees for office are: President, John Foley; vice-president, M. K. Trumbull and J. B. Card; secretary-treasurer, F. J. Angier; executive committee, V. K. Hendricks and C. M. Taylor. The results of the ballot will be announced at the convention.

Will Meet to Push Completion of Highway Across Washington

The Pasco (Wash.) Chamber of Commerce will invite the commercial bodies, county commissioners, good-roads and taxpayers' associations, and automobile clubs in the counties of Asotin, Columbia, Garfield, Adams, Whitman, Walla Walla, Franklin, Benton, Yakima, Klickitat, Skamania, Clarke, Cowlitz, and Lewis to send representatives to a meeting to be held in Pasco late in January or early in February to effect the organization of a highway association, the object of which will be to encourage and hasten the completion of one highway across the state of Washington that can be traveled every day of the year. After the route is logged, marked and mapped efforts will be made to popularize it by a campaign of publicity. The organization will cooperate with similar associations in Idaho, Montana and Oregon, so as to concentrate a greater amount of tourist travel throughout the southern counties of Washington.

Road School of Wisconsin Highway Commission January 29 to February 3

The sixth annual road school of the Wisconsin State Highway Commission will be held in the State Capitol at Madison, beginning Jan. 29. At that meeting all recent developments in road and bridge construction, maintenance and administration will be discussed. All who are interested are invited to attend. Last year the registration at the road school was about 700. It is expected that this will be exceeded this year. The usual exhibit of road machinery, motor trucks, and road materials will be held in connection with the school. Those who will attend are advised to make their hotel reservations immediately.

NEXT WEEK

Articles by

CHARLES A. STONE
GANO DUNN
NELSON P. LEWIS
T. CHALKLEY HATTON
A. B. FLETCHER
B. F. CRESSON, JR.
H. E. BREED
W. S. KELLER
ARTHUR J. SLADE

Reviews of Labor and Material Markets

War Department Approves Vehicle Tube Under Hudson River at New York

A permit for a tube to be used for vehicle traffic between Canal Street, Manhattan, and Thirteenth Street, Jersey City, has been issued by the War Department to the New Jersey Interstate Bridge and Tunnel Commission. Plans showing the size of the tunnel have not been filed by the applicants. The permit requires that the tunnel be located at least 50 ft. below mean water level.

The project has already been approved by the Boards of Freeholders of Hudson and Bergen Counties, New Jersey. In Essex County the board stood 4 to 4 on the vote taken last summer, but will vote again soon. Favorable action by all three counties is necessary before the governor of New Jersey can appoint a commission to undertake actual work of construction.

The tunnel's cost is estimated at about $11,000,000, of which half will be paid by each state. It is expected that twin tubes of the type used in the Hudson and Manhattan tunnels will be constructed.

Short Course in Highway Engineering at University of Michigan

The College of Engineering of the University of Michigan announces its third annual short course in highway engineering to be given during the week of Feb. 19 to 23, 1917. In the conduct of this course, the same plan will be followed as in former years. The instruction will be given from the viewpoint of road conditions in Michigan and expressly for the benefit of highway commissioners, engineers, contractors and others interested in the construction and maintenance of roads.

The course is a continuation of the work done in the past two years, but arrangements will be made for those coming the first time. The instruction will be under the supervision of the engineering faculty of the University of Michigan and engineers of the Michigan State Highway Department. This will be supplemented by several lectures by prominent highway engineers and State highway commissioners of various states throughout the country. No charge will be made for the course.

Agree Tentatively on Plan for New Buffalo Station

Subject to ratification by the commission after a public hearing in January, the Buffalo Terminal Commission has agreed to the proposal of the New York Central Railroad for the construction of a new terminal in that city. The site of the present station, and not the Terrace site, is the one chosen, but the new station will be moved west to Washington. The estimated cost of the project is between $6,000,000 and $7,000,000.

Call for $60,000,000 Road Bond Issue in Illinois

A bond issue of $60,000,000 to complete a 4000-mile system of state highways in Illinois is the legislation asked for by the Illinois Highway Improvement Association, which met in Danville Dec. 19 to dedicate the state's share of the Dixie Highway. This organization is largely responsible for past good-roads legislation, so that its deliberations have more than ordinary significance. The resolution proposes that the Legislature submit the question to the voters in November, 1918. Counties which have built or are building hard roads in the system are to receive a refund, but this refund must be spent on other roads in the county. Selection of the system is to be made by the state highway department. The Legislature was urged to appropriate funds to meet the federal aid and also to increase the license fees on large automobiles and trucks.

Interlocking Managements Prohibited by Commission

Massachusetts Commission Disapproves Overlapping Control in Construction and Managing Contracts and Will Have No More of It

In an order recently made public, the Massachusetts Gas & Electric Light Commission sets forth its disapproval of certain classes of public utility construction and management contracts in which overlapping control is a feature of the administration. The order, which is addressed to all companies under the commission's direction, states that the board has for some time viewed with concern the control of the directorates of certain of the companies under its supervision by officials and employees of engineering construction and management organizations and corporations with which the companies involved have from time to time contracted for extensions and improvements of and managerial services for their respective properties. In the opinion of the commission such practices are wrong.

Should Be in Hands of Company's Officers

The order states that whatever justification may exist for these practices in public service companies whose credit is feeble or future hazardous and uncertain, "that justification ceases when their financial position is firmly established. The management of such companies should be in the hands of directors and officers responsible solely to their stockholders and the public whom they have undertaken to serve. For reasons that are obvious companies should not have any dealings in supplies or materials or make any contracts for construction or management with another corporation, partnership or association when that company has upon its board of directors or as its president, manager, purchasing or selling officers, or as its agent in the particular transaction, a person who is at the same time a director, purchasing or selling officer, or agent of, or who has any substantial interest in, such other corporation, partnership or association, unless and except such purchases shall be made from, or such dealing shall be with, the bidder whose bid is the most favorable to such company, to be ascertained by honestly conducted competitive bidding.

"Notice is hereby given of the conclusions reached by the board to the end that no company under its supervision shall hereafter enter into contracts and relationships of the character above described save under exceptional circumstances and with the approval of the board, and that upon the expiration of existing contracts they shall not be renewed."

$8,000,000 Street Improvements Planned for Baltimore

Baltimore has for the improvement of its streets and alleys during the next few years approximately $8,000,000, available at the rate of about $2,000,000 per year. The character of the paving will be mostly sheet asphalt for the streets, and Portland cement concrete and vitrified block for the alleys. A small amount of recut granite work will also be done. The job will be advertised for bids about Jan. 15, and the contracts will range from $5,000 for alley work to $200,000 each for street work. Contractors who are equipped to do this work are invited to investigate conditions. The paving commission, the highways engineer and the commissioners for opening streets will handle the work for the city.

Oregon Commission Reports

Recommendations for the survey of approximately 3,000,000 acres of land susceptible to drainage in the state of Oregon, the enactment of a business-like road code, the eventual guarantee by the state or federal government of bonds of irrigation districts, and the conservation of the water resources of the state are contained in the annual report of the Oregon State Conservation Commission, recently made public.

Engineering Society Activities

Providence Engineering Society will meet Jan. 24 to hear W. S. Franklin, professor of electrical engineering at Lehigh University, lecture on "Some Mechanical Analogies in Electricity and Magnetism."

Municipal Engineers of the City of New York met Dec. 27 in the Engineering Societies Building. Jay Downer, engineer and secretary of the Bronx Parkway Commission, presented an illustrated paper on the Bronx River Parkway.

Albany Society of Civil Engineers held a meeting last Wednesday at which Prof. E. E. Haskell, dean of the College of Engineering, Cornell University, was the speaker. His subject was the "United States Lake Survey," with which work Professor Haskell has long been associated.

Florida State Engineering Society held an organization meeting Dec. 22 and 23 at Jacksonville.

Engineers' Club of Seattle has closed a contract for 1200 ft. of floor space in the new Arctic Club Building for the new home of the organization. The club will move from its present quarters about Jan. 15. Among the new features planned are a daily noon luncheon and a Thursday banquet. Ernest B. Hussey is president and J. Thomas Dovey, secretary.

What Engineers and Contractors Are Doing

W. J. PARKES was recently appointed highway engineer of Jefferson County, Arkansas. He succeeds H. H. Humphreys.

ROBERT E. BARRETT, formerly acting chief engineer of the Directors of the Port of Boston, is now with Fay, Spofford & Thorndike, consulting engineers, of that city. Mr. Barrett's first engineering work was with the Metropolitan Water Board of Massachusetts in 1900. Later he studied at Harvard University.

W. D. SALTER has been appointed city engineer of Boulder, Col., to succeed George R. Joslin, resigned. For the last 10 years Mr. Salter was assistant engineer in the engineering department of Denver.

JOHN SWAN, JR., brother of the late Robert Swan, succeeds Edward M. Bigelow as director of the Department of Public Works of Pittsburgh.

GORDON SUMNER, of Wauchula, Fla., was recently appointed highway engineer of Bay County, Fla. He will direct surveys and construction of a $375,000 road system.

CAPT. JOHN W. N. SCHULZ, Corps of Engineers, U. S. A., has been granted a two-months' leave of absence as assistant to the officer in charge of road construction and maintenance in Yellowstone National Park.

L. WILLIAMS is now in the valuation department of the Missouri, Kansas & Texas Railway, with office at Parsons, Kan.

R. J. AYDLOTTE, formerly with Remington & Vosbury, consulting engineers, of Camden, N. J., is now in the employ of the John M. Kelley Contracting Company, of that city. He has charge of the construction of bulkheads and shipways for the Pennsylvania Ship Building Company, of Gloucester, N. J.

A. W. DOANE has taken a position with the American Waterworks & Electric Company at Butler, Pa.

J. K. CHOATE, vice-president of the J. G. White Management Corporation, has just returned from a six weeks' trip to Nicaragua, where he inspected the property of the Ferrocarril del Pacifico de Nicaragua, which is being operated by the J. G. White Management Corporation.

T. B. SHERTZER has been elected city manager of Portsmouth, Va.

JULIUS ZIMNY, who is employed by the Robert Grace Contracting Company, is now at Hurlburt, Ind., working on overhead bridges between that city and Palmer.

D. E. HOOKER, assistant superintendent of buildings, Seattle, on Dec. 16 addressed the Pacific Northwest Society of Engineers in the assembly room of the Arctic Club. He described the second test of the Bell Street warehouse.

C. O. MANNES, of Tenino, has been appointed deputy county engineer of Thurston County, Washington, by Frank Weir, county engineer-elect. Mr. Mannes is now in the service of the Washington State Highway Department.

BARTLETT & RANNEY, consulting engineers, of San Antonio, Tex., have been retained to design and construct the 30,000-acre Eagle's Nest irrigation project in Colfax County, New Mexico. Construction has been started. The storage dam will be an arched masonry structure 140 ft. high. Neal Hanson is resident engineer on the work.

LORD COWDRAY, president of S. Pearson & Son, Ltd., of London, builders of the Pennsylvania Railroad tunnels under the East River at New York City, has been made a viscount. Lord Cowdray, whose family name is Sir Weetman D. Pearson, was made a peer June 23, 1910. He was born in 1856 at High Joyland, Yorkshire, and was privately educated at Harrogate. Aside from having been associated with the tunnel work in New York, Lord Cowdray's firm has engaged in extensive engineering enterprises in England and Mexico.

S. A. GREELEY and LANGDON PEARSE, the consulting engineers who made the original sewage-disposal experiments at Decatur, Ill., have been re-employed to assist P. T. Hicks, city engineer, in the design of an intercepting sewer. They will also help in solving such other general problems as may develop.

LUTHER B. YOUNGS, superintendent of water, Seattle, was recently reappointed for a period of three years. Mr. Youngs has held his position since 1895.

CALEB BERRY, former city engineer of Centralia, Wash., has been retained by residents of Grand Mound, to investigate the feasibility of draining land on Wanche's and Ford's Prairies.

C. H. SNYDER, consulting engineer, of San Francisco, has been appointed lecturer in civil engineering at the University of California for the coming half year.

R. M. LEE, of South Vancouver, Canada, who has been in charge of sewer work, has been appointed assistant to Municipal Engineer Bennet.

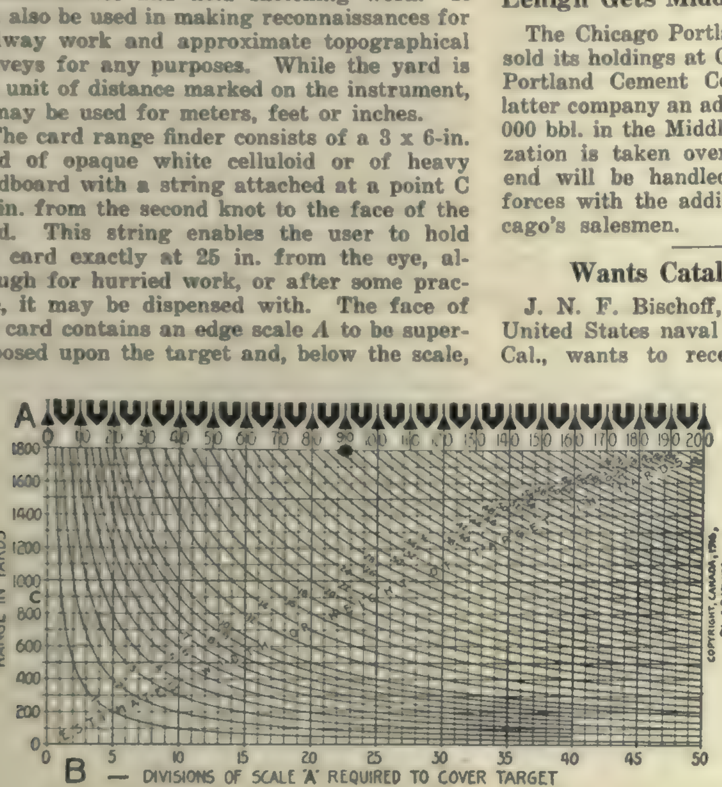
Obituary Notes

WLLIAM E. LEARD, manufacturer, of New Brighton, Pa., died recently at Southern Pines, N. C. He was born at Livermore, Pa., 74 years ago and was in Company M, 102d Pennsylvania Volunteers, during the Civil War. Shortly after the war Mr. Leard engaged in the manufacture of drill presses in Cincinnati. In 1882 he organized a plant in New Brighton, Pa., for the manufacture of connecting rods, strap joints, crankshafts and machine keys. He had not been in active charge of the work for the last eight years.

Range Finder and Slope Card Designed for Field Sketching

An inexpensive range finder and slope card which is said to have found favor among military engineers is that designed by Major C. R. Young, 98 Hilton Avenue, Toronto, Canada It is based on the principle that it is much easier to judge the size of familiar objects than it is to estimate their distance from the eye. The instrument has been used successfully on reconnaissance and field sketching work. It can also be used in making reconnaissances for railway work and approximate topographical surveys for any purposes. While the yard is the unit of distance marked on the instrument, it may be used for meters, feet or inches.

The card range finder consists of a 3 x 6-in. card of opaque white celluloid or of heavy cardboard with a string attached at a point C 25 in. from the second knot to the face of the card. This string enables the user to hold the card exactly at 25 in. from the eye, although for hurried work, or after some practice, it may be dispensed with. The face of the card contains an edge scale *A* to be superimposed upon the target and, below the scale, a diagram for the determination of the range without calculation.



RANGE FINDER IS USEFUL ON RAILROAD AND MILITARY RECONNAISSANCE — HORIZONTAL DISTANCE DETERMINED BY ESTIMATING SIZE OF FAMILIAR OBJECTS

To use the instrument, select some known dimension of the target or object at right angles to the line of sight. If no dimension is known accurately, choose the one that may be estimated with least error. Place the second knot of the string close to the eye, hold the card out at right angles to the string in the direction of the target so that the string is taut. Place the zero mark of the edge scale *A* at one extremity of the known or estimated dimension of the target and note the scale reading for the other extremity. Find on the bottom horizontal scale *B* a point having a reading equal to that obtained on scale *A*. Locate on the diagram the curve giving the estimated width, height or other selected dimension of the target. Find the point where a vertical line through the reading on scale *B* will intersect this curve. Directly opposite this point on the vertical scale at the left-hand side the desired range will be found.

White Company Holds "Factory Warming"

A motor car factory running full blast and 6000 persons present at a reception and luncheon was the unusual feature of the recent house-warming in a new manufacturing building of the White Motor Company, Cleveland. About 8000 persons attended the dance in the evening. Between dances the guests were shown motion pictures of the factory's product in unusual forms of service, as well as current feature films. The new building is 240 x 304 ft. Decorations completely obscured its industrial character.

Filter Department Changes Hands

The Blackburn-Smith Corporation of New York, through purchase of the filter department of James Beggs & Company, has acquired all patents, records, patterns and rights for the manufacture and sale of the Blackburn-Smith feed-water filter and grease extractor and the Blackburn-Smith sewage-ejector system. The engineers and agents previously identified with these products have been taken over in a body by the new corporation and will work under the direction of Irwin H. Kaufman, vice-president, who has supervised the manufacture, sale and installation of the Blackburn-Smith filter for the last ten years.

Lehigh Gets Middle West Cement Plant

The Chicago Portland Cement Company has sold its holdings at Oglesby, Ill., to the Lehigh Portland Cement Company. This gives the latter company an additional capacity of 1,500,000 bbl. in the Middle West. The mill organization is taken over as a whole; the selling end will be handled by the present Lehigh forces with the addition of a few of the Chicago's salesmen.

Wants Catalogs of All Kinds

J. N. F. Bischoff, civilian assistant at the United States naval coal depot at San Diego, Cal., wants to receive catalogs of "equipment, machinery, tools, fireproof building material, railroad track material, coal handling and conveying machinery." Considerable improvements, he says, are contemplated at the station.

Infringement Suit on Turbine Sewer Cleaner Started

Suit in a federal court has been started by the Turbine Sewer Machine Company against William J. Stevenson, alleging that the latter is manufacturing an infringing turbine sewer-cleaning machine. The case will come up for trial Jan. 1, 1917.

Trade Publications

The following companies have recently issued trade literature:

American Ingot Iron Manufacturers. Folder describing and illustrating "Armco" culverts.

Hudson & Thurber Company, Minneapolis and Omaha. Folders describing sprayers and giving price lists on brass goods and engine supplies. Catalog D, 7 x 11 in., 460 pages, illustrated. Shows and lists every conceivable hardware implement, as well as pumps, fittings and other contractors' materials.

Diamond Power Specialty Company, Detroit. Illustrated folder describing mechanical soot blower.

Newton Machine Tool Works, Philadelphia. Catalog 51, 6 x 9 in., 52 pages, illustrated. Cold saw-cutting machines.

Watson-Stillman Company, New York City. Catalog 94, 6 x 9 in., 96 pages, illustrated. Hydraulic valves and fittings.

Ingersoll-Rand Company, New York City. Forms 3130 and 8311, describing air compressors and "Little David" pneumatic riveting hammers.

Quaker City Rubber Company, Philadelphia. Catalog, 6 x 9 in., 180 pages, illustrated. Mechanical rubber goods.

Van Dorn & Dutton Company, Cleveland. "Facts About Gears."

Wyoming Shovel Works, Wyoming, Pa. Catalogs, 4 x 9 in., 68 pages, illustrated.

Philadelphia Steel & Forge Company, New York City. Tables and notes on high-grade steels.

Verona Tool Works, Verona, Pa. Catalog 11, 7 x 9 in., 64 pages, illustrated. Describes full line of Verona tools.

Good Roads Machinery Company, Fort Wayne, Ind. Complete list of road machinery, well compiled and illustrated. Bound in loose-leaf form.

Glasgow Iron Company, Pottstown, Pa. New catalog, 5 x 7 in., 112 pages, illustrated and indexed. Tables and specifications to assist in selecting steel products. Note pages in back.

American Oxygen Company, Cincinnati. Folder on oxyacetylene welding. Costs of cutting given.

Tippett & Wood, Inc., Phillipsburg, Pa. Catalog of water towers, standpipes and general plate construction.

A. B. Farquhar Company, Ltd., York, Pa. Catalog, 9 x 12 in., 78 pages, illustrated. Engines, boilers, tractors and saw-mill machinery.

Lowe Brothers Company, Dayton, Ohio. Catalog 26, on paints.

Link-Belt Company, Chicago. Bulletin 282, entitled "Link-Belt Silent Chain Transmitting Power in Dye Making Industry." Folder on coal handling.

Baldwin Locomotive Works and **Westinghouse Electric & Manufacturing Company.** Circular 1516 A; 64 pages and cover. Electric locomotives.

Chicago Pneumatic Tool Company, Chicago. Bulletins 34-X and K describing Giant gas engines and fuel-oil-driven compressors.

Portland Cement Association, Chicago. Bulletins "How to Maintain Concrete Roads and Streets" and "Fundamentals of Reinforced Concrete Design."

National Lime Manufacturers' Association, Pittsburgh Bulletin A-2, entitled "Hydrated Lime and Its Effect on Workability, Segregation, Uniformity, Strength and Permeability."

Pittsburgh Valve & Fittings Company, Barberton, Ohio. Catalog D, 5 x 8 in., 356 pages, illustrated. Bound in leather. Lists all kinds of valves, castings and fittings. Tables of properties of saturated steam, weights of pipe, and formulas for design. Complete index. Handy reference book.

Cochran Pipe Wrench Company, Chicago. Folder describing spring oiler for trucks.

Samuel L. Moore & Sons Corporation, Elizabeth, N. J. Bulletin 103, devoted to industrial electric trucks.

Shepard Electric Crane & Hoist Company, Montour Falls, N. Y. Bulletin M-1, describing ¼, ½ and 1-ton hoists.

American Manganese Steel Company, Chicago. Bulletin 72, listing sand and gravel pumps and wearing parts for pump dredges.

Goulds Manufacturing Company, Seneca Falls, N. Y. Bulletin 113, devoted to rotary pumps.

Chicago Pneumatic Tool Company, Chicago. Bulletin E-44 on Duntley portable electric tools.

B. F. Sturtevant Company, Boston, Mass. Bulletin 228, 8 x 11 in., 100 pages, illustrated. Devoted to multivane fans. Dimensions, capacities, horsepower, etc.

Thwing Instrument Company, Philadelphia. Catalog 8, 8 x 11 in., 46 pages. Electrical pyrometers.

C. H. & E. Manufacturing Company, Milwaukee. Catalog of contractors' equipment listing mixers, saws, hoists, pumps, etc.

John F. Byers Machine Company, Ravenna, Ohio. Bulletin 1004. Describes Byers auto-crane.

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